



DOKUMEN KURIKULUM 2023-2028
CURRICULUM DOCUMENT 2023-2028

PRODI/*DEGREE*: SARJANA/*UNDERGRADUATE*
DEPARTEMEN : TEKNIK MESIN / *MECHANICAL*
ENGINEERING

FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
2023



DOKUMEN

Penyusunan Kurikulum Pendidikan Tinggi

Program Studi Sarjana Teknik Mesin

Surabaya, 21 Februari 2023

Nama Ketua Tim : Prof. Suwarno, Ph.D
NIP/NIDN : 198005202005011003
Program Studi : Sarjana Teknik Mesin
Fakultas : Fakultas Teknologi Industri dan Rekayasa Sistem

INSTITUT TEKNOLOGI SEPULUH NOPEMBER, Tahun 2023



DOCUMENT

Curriculum Design for Higher Education

Mechanical Engineering Undergraduate Degree Program

Surabaya, 21 Februari 2023

Team Leader	: Prof. Suwarno, Ph.D
NIP/NIDN	: 198005202005011003
Degree	: Undergraduate Program in Mechanical Engineering
Fakultas	: Industrial Technology and Systems Engineering

INSTITUT TEKNOLOGI SEPULUH NOPEMBER, year 2023



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER Kampus ITS, Jl. Raya ITS, Keputih Sikolilo, Surabaya, 60111 Telpon (031) 5994251 URL www.its.ac.id	Nomor / Number: 2.3.1.2
	DOKUMEN KURIKULUM CURRICULUM DOCUMENT	Rev: - Halaman/Page : ...

Proses <i>Process</i>	Penanggung Jawab <i>Person in Charge</i>			Tanggal <i>Date</i>
	Nama <i>Name</i>	Jabatan <i>Position</i>	Tanda tangan <i>sign</i>	
Perumus <i>Formulator</i>	Suwarno, Ph.D	Ketua kurikulum DTM <i>Head of Curriculum</i>		
Pemeriksa <i>Reviewer</i>	Suwarno, Ph.D	Sekretaris Departemen <i>Department Secretary</i>		
Persetujuan <i>Approval</i>	Dr. Atok Setiawan	Kepala Departemen <i>Head of Department</i>		
Penetapan <i>Establishment</i>	Dr. Wawan Aries Widodo	Dekan FTIRS <i>Dean of FTIRS</i>		
Pengendalian <i>Supervision</i>	Prof. Aulia Siti Aisyah	Kepala Kantor PJM ITS <i>Office Head of PJM ITS</i>		



DAFTAR ISI / TABLE OF CONTENT

DAFTAR ISI / TABLE OF CONTENT	IV
KATA PENGANTAR.....	V
PREFACE	VI
1. LANDASAN PENGEMBANGAN KURIKULUM	9
1.1 UNIVERSITAS <i>VALUE</i>	9
1.2 LANDASAN FILOSOFI	13
1.3 LANDASAN HISTORIS	14
1.4 LANDASAN HUKUM	21
2 VISI, MISI, DAN TUJUAN PENDIDIKAN	24
2.1 VISI, MISI DAN TUJUAN FAKULTAS	25
2.2 VISI, MISI DAN TUJUAN DEPARTEMEN	26
2.3 VISI, MISI DAN TUJUAN PENDIDIKAN PROGRAM STUDI	27
3 EVALUASI KURIKULUM DAN <i>TRACER STUDY</i>	31
3.1 EVALUASI KURIKULUM	32
3.2 <i>TRACER STUDY</i>	37
4 PROFIL LULUSAN, TUJUAN PENDIDIKAN PRODI DAN RUMUSAN CAPAIAN PEMBELAJARAN LULUSAN (CPL).....	42
4.1 PROFIL LULUSAN DAN TUJUAN PENDIDIKAN PRODI.....	43
4.2 PERUMUSAN CPL	44
4.3 Matrik Hubungan CPL dengan Profil Lulusan.....	47
4.4 Matrik Hubungan CPL Prodi dengan Tujuan Pendidikan Program Studi <i>MATRIX OF THE RELATIONSHIP BETWEEN PROGRAM LEARNING OUTCOMES (CPL) AND PROGRAM EDUCATIONAL OBJECTIVES (PEO)</i>	51
5 PENENTUAN BAHAN KAJIAN	55
5.1 <i>BODY OF KNOWLEDGE (BOK)</i>	56
5.2 BAHAN KAJIAN (BK).....	61
6 PEMBENTUKAN MATA KULIAH DAN PENENTUAN BOBOT SKS	110
7 ORGANISASI MATA KULIAH PROGRAM STUDI	128
8 SEBARAN MATA KULIAH TIAP SEMESTER DAN PENJADWALAN PENGUKURAN CPL - KHUSUS BAGI PRODI YANG BERORIENTASI PADA AKREDITASI IABEE	139
9 PEMBELAJARAN MELALUI MB - KM.....	145
9.1. KEGIATAN MB – KM	147
9.2. STRUKTUR KURIKULUM MB – KM	149
10 RENCANA PEMBELAJARAN SEMESTER (RPS).....	152
11 PENGELOLAAN PEMBELAJARAN.....	1051



KATA PENGANTAR

Puji Syukur kita panjatkan kepada Allah SWT yang dengan ridho-Nya, akhirnya tim Kurikulum Departemen Teknik Mesin dengan dukungan seluruh Dosen, Tendik dan pemangku kepentingan (stake holder) dari berbagai kalangan, yaitu: Advisory Board, pengguna lulusan dan alumni telah bisa menyelesaikan tugas Penyusunan Kurikulum Tahun 2023 dengan baik.

Peninjauan ulang dan Penyusunan Kurikulum baru selalu dilakukan secara periodik untuk setiap lima tahunan. Hal ini dilakukan untuk menyelaraskan kurikulum baru dengan berkembangnya ilmu pengetahuan dan kebutuhan kompetensi di bidang Teknik Mesin yang dibutuhkan oleh industri dan pengguna lulusan yang lainnya serta kuliah lanjut Pasca Sarjana dan pertukaran mahasiswa dengan Universitas Luar Negeri.

Berbeda dengan penyusunan kurikulum sebelumnya, kali ini tinjauan ulang dan penyusunan Kurikulum tahun 2023, harus memenuhi banyak kriteria yang diamanatkan oleh ITS dan KEMENDIKBUD RISTEK DIKTI, seperti: program MBKM, akreditasi Nasional maupun Internasional (LAM TEKNIK & IABEE), perubahan RPS yang disesuaikan dengan CPL maupun berbasis pada Project Based Learning (PjBL).

Departemen Teknik Mesin sudah membekali mahasiswa dengan kurikulum Internasional, sejak tahun 2000, ketika Teknik Mesin mendapatkan hibah QUE (Quality for Under Graduate Education) dari Worl Bank. Namun dengan dibukanya program IUP (International Under Graduate Program) pada tahun 2019, maka sinkronisasi dengan kurikulum Internasional menjadi lebih penting, karena ada kewajiban mahasiswa IUP melakukan International Exposure yang salah satunya pertukaran mahasiswa. Dengan demikian, perlu kesepadanan antara kurikulum 2023 dengan kurikulum inti Universitas di Luar Negeri, baik judul mata Kuliah maupun isi dari mata kuliahnya sehingga bisa dialih kreditkan.

Akhirnya, dengan penyelesaian kurikulum 2023 ini, patut kiranya diucapkan banyak terima kasih kepada Tim Kurikulum Departemen Teknik Mesin yang telah bekerja keras, juga semua pihak yang memberikan bantuan dan dukungannya. Semoga Kurikulum 2023 ini bisa diimplementasikan dengan baik dan akan memberikan peningkatan mutu lulusan Teknik Mesin dengan kompetensi ilmu yang dibutuhkan oleh pengguna di industri pada khususnya dan institusi lainnya.



PREFACE

All praise and gratitude be to Allah SWT, by whose grace and will the Curriculum Team of the Department of Mechanical Engineering, with the support of all lecturers, educational staff, and various stakeholders—namely the Advisory Board, graduate users, and alumni—has successfully completed the preparation of the 2023 Curriculum.

The review and formulation of a new curriculum are regularly carried out every five years. This process is undertaken to align the curriculum with the advancement of knowledge and the evolving competency needs in the field of Mechanical Engineering, as required by industry, graduate users, postgraduate study programs, and international student exchange initiatives.

Unlike previous curriculum development efforts, the 2023 Curriculum Review and Development had to fulfill multiple criteria mandated by ITS and the Ministry of Education, Culture, Research, and Technology (KEMENDIKBUD RISTEK DIKTI), including the implementation of the *Merdeka Belajar–Kampus Merdeka* (MBKM) program, national and international accreditation standards (such as LAM TEKNIK and IABEE), and adjustments to course outlines (RPS) in alignment with Learning Outcomes (CPL) and the integration of Project-Based Learning (PjBL) approaches.

The Department of Mechanical Engineering has incorporated international curriculum standards since 2000, when it received the QUE (Quality for Undergraduate Education) grant from the World Bank. However, with the launch of the International Undergraduate Program (IUP) in 2019, synchronizing with international curricula has become even more crucial. This is due to the requirement for IUP students to participate in international exposure activities, including student exchanges. Therefore, the 2023 curriculum needs to be aligned with the core curricula of foreign universities, both in course titles and content, to enable credit transfer.

Finally, with the completion of the 2023 curriculum, we express our deepest gratitude to the Curriculum Team of the Department of Mechanical Engineering for their hard work, as well as to all parties who have offered their support and contributions. May this 2023 Curriculum be well implemented and contribute to the enhanced quality of Mechanical Engineering graduates, equipping them with the competencies required by industries and other institutions.



IDENTITAS PROGRAM STUDI

PROGRAM IDENTITY

No	Nama Perguruan Tinggi (PT) <i>University Name</i>	INSTITUT TEKNOLOGI SEPULUH NOPEMBER
1	Fakultas <i>Faculty</i>	Teknologi Industri dan Rekayasa Sistem <i>Industrial Technology and Systems Engineering</i>
2	Departemen <i>Department</i>	Teknik Mesin <i>Mechanical Engineering</i>
3	Program Studi <i>Program</i>	S1 – Sarjana <i>Undergraduate</i>
4	Status Akreditasi <i>Accreditation Status</i>	A (unggul) <i>A (excellent)</i>
5	Jumlah Mahasiswa <i>Number of Students</i>	919
6	Jumlah Dosen <i>Number of Lecturers</i>	47
7	Alamat Prodi <i>Program Address</i>	Gedung D - Kampus ITS Sukolilo, Surabaya 60111
8	Telepon <i>Telephone</i>	(031) 5946230
9	Website Prodi/ Departemen <i>Department Website</i>	https://www.its.ac.id/tmesin/

Landasan Pengembangan Kurikulum — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 1





1. Landasan Pengembangan Kurikulum

Foundation of Curriculum Development

1.1 Universitas Value

University Value

Berdasarkan Peraturan Pemerintah Republik Indonesia Nomor 54 Tahun 2015 Tentang Statuta Institut Teknologi Sepuluh Nopember, ITS memiliki tata nilai:

Based on Government Regulation of the Republic of Indonesia Number 54 of 2015 concerning the Statute of Institut Teknologi Sepuluh Nopember (ITS), ITS upholds the following core values:

- a. etika dan integritas / *ethics and integrity*;
- b. kreativitas dan inovasi / *creativity and innovation*;
- c. ekselensi / *excellence*;
- d. kepemimpinan yang kuat / *strong leadership*
- e. sinergi / *synergy*;
- f. kebersamaan sosial dan tanggung jawab sosial / *social harmony and social responsibility*.

Nilai-nilai (values) dari ITS yang menjadi dasar di dalam pelaksanaan proses pendidikan di ITS adalah:

These values serve as the foundation for all educational processes at ITS, which are further elaborated as follows:

1. Untuk berkontribusi dalam sains dan teknologi untuk kesejahteraan masyarakat melalui pendidikan, penelitian, pengabdian masyarakat dan manajemen berdasarkan teknologi informasi dan komunikasi.

To contribute to science and technology for the welfare of society through education, research, community engagement, and management based on information and communication technology.

2. Untuk melakukan pendidikan tinggi dengan kualitas kurikulum internasional, dosen dan metode pembelajaran berdasarkan teknologi informasi dan komunikasi.

To provide higher education with internationally standardized curricula, lecturers, and learning methods, supported by information and communication technology.



3. Untuk melakukan pendidikan, penelitian, dan keterlibatan masyarakat, ITS harus memuliakan umat manusia dengan bermartabat sebagai ciptaan Tuhan Yang Maha Esa.

In carrying out education, research, and community involvement, ITS must uphold human dignity as creations of the Almighty God.

4. Untuk melakukan pendidikan, penelitian, dan pelibatan masyarakat, ITS harus memprioritaskan pelestarian dan peningkatan kualitas alam dan lingkungannya

In carrying out education, research, and community involvement, ITS must prioritize the preservation and enhancement of environmental quality and natural resources.

5. Untuk melakukan pendidikan, penelitian, dan keterlibatan masyarakat, ITS harus memprioritaskan negara, tanah air, dan kepentingan nasional Indonesia.

In carrying out education, research, and community involvement, ITS must prioritize the nation, homeland, and the national interest of Indonesia.

Nilai-nilai tersebut sesuai dengan visi ITS, yaitu “menjadi perguruan tinggi dengan reputasi internasional dalam ilmu pengetahuan dan teknologi terutama yang menunjang industri dan kelautan yang berwawasan lingkungan.”

These values are aligned with ITS's vision: "To become a university with an international reputation in science and technology, particularly those supporting industry and marine development with environmental insight."

Adapun misi ITS untuk mewujudkan visi di atas diwujudkan melalui misi bidang Pendidikan, Penelitian, Pengabdian kepada Masyarakat, dan didukung oleh misi bidang Manajemen dengan rincian berikut:

To realize this vision, ITS has formulated missions in the fields of education, research, community service, and is supported by management missions, as follows:

1. Misi ITS di bidang pendidikan / *ITS Mission in the Field of Education:*
 - Menyelenggarakan pendidikan tinggi berbasis teknologi informasi dan komunikasi dengan kurikulum, Dosen, dan metode pembelajaran berkualitas internasional;



To provide higher education based on information and communication technology with internationally standardized curricula, lecturers, and learning methods;

- Menyelenggarakan pendidikan tinggi berbasis teknologi informasi dan komunikasi dengan kurikulum, Dosen, dan metode pembelajaran berkualitas internasional;

To provide higher education based on information and communication technology with internationally standardized curricula, lecturers, and learning methods;

- Membekali lulusan dengan pengetahuan kewirausahaan berbasis teknologi.
To equip graduates with entrepreneurship knowledge based on technology.

2. Misi ITS di bidang penelitian / *ITS Mission in the Field of Research:*

- Berperan secara aktif dalam pengembangan ilmu pengetahuan dan teknologi terutama di bidang kelautan, lingkungan dan permukiman, energi, serta teknologi informasi dan komunikasi yang berwawasan lingkungan melalui kegiatan penelitian yang berkualitas internasional.

To actively contribute to the development of science and technology, especially in the fields of marine, environment and settlement, energy, and information and communication technology with environmental insight through high-quality research.

3. Misi ITS di bidang pengabdian kepada masyarakat

- Memanfaatkan segala sumber daya yang dimiliki untuk ikut serta dalam menyelesaikan problem yang dihadapi oleh masyarakat, industri, pemerintah pusat, dan pemerintah daerah dengan mengedepankan fasilitas teknologi informasi dan komunikasi.

To utilize all available resources to contribute to solving problems faced by the community, industry, central government, and local governments by prioritizing the use of information and communication technology.

4. Misi ITS di bidang manajemen

- Pengelolaan ITS dilakukan dengan memperhatikan prinsip tata pamong yang baik yang didukung dengan teknologi informasi dan komunikasi;

ITS management is carried out by adhering to the principles of good governance supported by information and communication technology.



- Pengelolaan ITS dilakukan dengan memperhatikan prinsip tata pamong yang baik yang didukung dengan teknologi informasi dan komunikasi;
ITS management is carried out by adhering to the principles of good governance supported by information and communication technology.
- Mengembangkan jejaring untuk dapat bersinergi dengan perguruan tinggi lain, industri, masyarakat, pemerintah pusat, dan pemerintah daerah dalam menyelenggarakan kegiatan pendidikan, penelitian, dan pengabdian kepada masyarakat
To develop networks and partnerships in synergy with other universities, industries, communities, central and local governments in conducting education, research, and community service activities.

Untuk mendukung visi, misi dan nilai-nilai institusi, Departemen juga memiliki nilai-nilai yang menjadi dasar di dalam pelaksanaan proses pembelajaran antara lain

To support the institution's vision, mission, and core values, the Department also upholds its own set of values that guide the implementation of the learning process, including:

1. Etika dan integritas: dalam kehidupan bermasyarakat, bernegara, maupun menjalankan profesinya, selalu berpegang teguh pada norma-norma dan peraturan-peraturan yang berlaku di masyarakat, negara, dan agama
Ethics and Integrity: Upholding societal, national, and religious norms and regulations in both community life and professional practice.
2. Kreativitas dan inovasi: selalu mencari ide-ide baru untuk menghasilkan inovasi dalam menjalankan tugas/perannya dengan lebih baik
Creativity and Innovation: Continuously seeking new ideas to generate innovation for better performance in carrying out duties or roles.
3. Ekselensi: berusaha secara maksimal untuk mencapai hasil yang sempurna
Excellence: Striving for the highest possible quality in every endeavor.
4. Kepemimpinan yang kuat: menunjukkan perilaku yang visioner, kreatif, inovatif, pekerja keras, berani melakukan perubahan-perubahan ke arah yang lebih baik, dan bertanggung jawab



Strong Leadership: Demonstrating visionary, creative, and innovative behavior; being hardworking, courageous in initiating positive change, and responsible.

5. Sinergi: bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki

Synergy: Collaborating effectively to fully utilize available potential.

6. Kebersamaan sosial & tanggung jawab sosial: menjaga kerukunan dan peduli terhadap masyarakat sekitar.

Social Harmony and Social Responsibility: Maintaining harmony and showing care for the surrounding community.

1.2 Landasan Filosofi

Philosophical Foundation

Kurikulum pendidikan tinggi adalah seperangkat rencana dan pengaturan mengenai isi, bahan kajian, maupun bahan pelajaran serta cara penyampaian, dan penilaian yang digunakan sebagai pedoman penyelenggaraan kegiatan pembelajaran di perguruan tinggi.

Kurikulum memuat standar kompetensi lulusan yang terstruktur dalam kompetensi utama, pendukung dan lainnya yang mendukung tercapainya tujuan, terlaksananya misi, dan terwujudnya visi program studi. Kurikulum memuat mata kuliah/modul/blok yang mendukung pencapaian kompetensi lulusan dan memberikan keleluasaan pada mahasiswa untuk memperluas wawasan dan memperdalam keahlian sesuai dengan minatnya, serta dilengkapi dengan deskripsi mata kuliah/modul/blok, silabus, rencana pembelajaran dan evaluasi.

Kurikulum Teknik Mesin disusun sesuai dengan Kerangka Kualifikasi Nasional Indonesia (KKNI) tahun 2013 dan mengacu pada Standar Nasional Pendidikan Tinggi (SNPT) serta kajian dari Badan Kerjasama Teknik Mesin (BKSTM).

A higher education curriculum is a set of plans and arrangements regarding content, subject matter, as well as methods of delivery and assessment, which serve as guidelines for the implementation of learning activities in higher education institutions.

The curriculum includes graduate competency standards that are structured into core competencies, supporting competencies, and other complementary



competencies aimed at achieving the goals, implementing the mission, and realizing the vision of the study program. It encompasses courses/modules/blocks that support the attainment of graduate competencies while providing students the flexibility to broaden their knowledge and deepen their expertise according to their interests. Each course/module/block is equipped with a course description, syllabus, learning plan, and evaluation scheme.

The Mechanical Engineering curriculum is designed in accordance with the Indonesian National Qualifications Framework (KKNI) of 2013 and refers to the National Standards for Higher Education (SNPT), as well as academic studies and recommendations from the Indonesian Mechanical Engineering Cooperation Board (BKSTM).

1.3 Landasan Historis

Historical Foundation

Kurikulum Teknik Mesin mengalami perubahan dan / atau perkembangan mengikuti kebijakan Nasional, kebijakan ITS serta mengakomodasi perkembangan IPTEK di dalam bidang Teknik Mesin. Penetapan kurikulum yang saat ini digunakan oleh Prodi sarjana Teknik Mesin, diawali dengan ITS membentuk tim kurikulum pada tingkat Institut, yang bekerja sama dengan tim kurikulum Program Studi dalam penyusunan kurikulum yang diterapkan pada masing-masing Program Studi. Kurikulum Program Studi Sarjana Teknik Mesin disusun mengacu pada KKNI dimana diharapkan lulusan Teknik Mesin mencapai level 6. Selain itu, Kurikulum dirancang sesuai dengan panduan Kurikulum Inti untuk sarjana Teknik Mesin yang dibuat oleh Badan Kerjasama Teknik Mesin (BKSTM) Indonesia. Kurikulum Teknik Mesin mempunyai beban studi 144 SKS untuk ditempuh dalam waktu delapan semester, dibagi dalam tahap persiapan dengan beban studi 36 SKS (ditempuh dalam dua semester) dan tahap sarjana dengan beban studi 108 SKS (ditempuh dalam enam semester). Sistem penyelenggaraan pendidikan menggunakan Sistem Kredit Semester (SKS) yang diartikan sebagai suatu sistem penyelenggaraan pendidikan dengan menggunakan satuan kredit semester (sks) untuk menyatakan beban mahasiswa, beban kerja dosen, dan beban penyelenggaraan program. Semester adalah satuan



waktu kegiatan yang terdiri dari 16 (enam belas) minggu perkuliahan atau kegiatan terjadwal lainnya, termasuk kegiatan evaluasi.

Berdasarkan Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 3 Tahun 2020 (dh Permenristekdikti No 44 Tahun 2015), 1 sks untuk penyelenggaraan kuliah, responsi, atau tutorial diartikan sebagai beban studi mahasiswa untuk mengikuti keseluruhan tiga kegiatan per minggu, yaitu 50 menit kegiatan tatap muka terjadwal dengan tenaga pengajar, 60 menit kegiatan akademik terstruktur, dan 60 menit kegiatan akademik mandiri dalam satu semester. Satu sks untuk proses pembelajaran berupa seminar atau bentuk lain yang sejenis, diartikan sebagai kegiatan proses belajar 100 (seratus) menit per minggu per semester; dan kegiatan mandiri 70 (tujuh puluh) menit per minggu per semester. Sedangkan satu sks untuk proses pembelajaran berupa praktikum, praktik studio, praktik bengkel, praktik lapangan, praktik kerja, penelitian, perancangan, atau pengembangan, pelatihan militer, pertukaran pelajar, magang, wirausaha, dan/atau Pengabdian kepada Masyarakat, sebanyak 170 (seratus tujuh puluh) menit per minggu per semester.

Kurikulum Teknik Mesin terdiri dari 4 aspek, yaitu Sikap, Keterampilan Umum, Keterampilan Khusus, dan Pengetahuan. Dalam penyusunannya aspek Sikap dan Keterampilan Umum mengacu pada SN Dikti yang berlaku saat itu, yaitu Permenristek-dikti nomer 44 tahun 2015 dan Peraturan Rektor ITS nomor 17 tahun 2017 tentang Pedoman Evaluasi Kurikulum di Lingkungan Institut Teknologi Sepuluh Nopember sebagai tambahan dan penciri dengan Perguruan Tinggi lainnya.

Aspek Keterampilan Khusus dan Pengetahuan ditetapkan oleh Kemenristek DIKTI dan dikembangkan oleh Program Studi berdasarkan pada analisa kebutuhan *stakeholder*, Visi Misi Departemen dan pengembangan keilmuan Program Studi. Dalam kurikulum 2018 – 2023, terdapat 45 mata kuliah wajib (134 SKS) dan 4 mata kuliah pilihan (10 SKS) yang harus diambil oleh mahasiswa. Mata kuliah wajib yang diambil termasuk mata kuliah pengayaan, dimana mahasiswa wajib mengambil mata kuliah di luar prodi di ITS, sebagai wujud dari program Merdeka Belajar Kampus Merdeka (MBKM) yang bertujuan mendorong mahasiswa untuk menguasai berbagai keilmuan yang berguna untuk memasuki dunia kerja dengan memberikan kesempatan bagi mahasiswa untuk memilih mata kuliah yang akan



mereka ambil. Dimana mata kuliah yang diambil dapat disesuaikan dengan minat mahasiswa atau mata kuliah yang dapat menunjang kemampuan dalam manajemen atau kewirausahaan. Sejak berlakunya MBKM (yang dituangkan di dalam Permendikbud No 3/2020), di ITS Program MBKM ini diatur melalui Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 30 Tahun 2020 tentang Penyelenggaraan Kegiatan Merdeka Belajar-Kampus Merdeka di Institut Teknologi Sepuluh Nopember. Dalam kurikulum tersebut, terdapat 28 mata kuliah pilihan yang disediakan dengan bahan kajian disesuaikan dengan isu-isu terkini yang diperlukan dalam pengembangan karier kerja terutama di bidang geomatika.

CPL disusun dengan mengacu pada Kerangka Kualifikasi Nasional Indonesia (KKNI) yang tertuang dalam Peraturan Presiden Nomor 8 Tahun 2012. Selain itu sesuai dengan peraturan yang telah ditetapkan dalam SN DIKTI, CPL mencakup 4 (empat) unsur yaitu: sikap, keterampilan umum, keterampilan khusus dan penguasaan pengetahuan. Dalam penyusunan CPL, Prodi Sarjana DTM memperhatikan kebutuhan industri sektor surveying dan geospasial dengan melibatkan *stakeholder* yang terdiri dari seluruh dosen, alumni, industri, asosiasi dan instansi pemerintahan yang berkaitan dengan sektor tersebut untuk memberikan saran atau usulan terkait kesesuaian CPL dengan kebutuhan industri. Evaluasi kurikulum yang dilakukan di Teknik Mesin merupakan evaluasi *summative* dan evaluasi *formative*. Dimana evaluasi *summative* adalah evaluasi yang menyebabkan diubahnya/dikembangkannya kurikulum, dan berdampak pada implementasi kurikulum baru. Pada evaluasi *summative*, dilakukan evaluasi terhadap CPL dan CPMK serta pembentukan struktur kurikulum beserta mata kuliah di dalamnya. Evaluasi *summative* ini dilakukan secara berkala (5 tahunan) dengan memperhatikan PPM, hasil evaluasi kurikulum periode sebelumnya, serta usulan/masukan pemangku kepentingan. Saat ini, Teknik Mesin menggunakan CPL kurikulum 2018-2023. Sedangkan evaluasi *formative* tidak selalu berdampak pada perubahan kurikulum, tetapi bisa merubah strategi di dalam operasional kurikulum, sebagai contoh: dalam metode pembelajaran, penambahan atau perubahan pada sub bab atau sub topik atau topik ataupun materi di dalam suatu mata kuliah, dimana perubahan tersebut dapat disebabkan karena mengikuti perkembangan ilmu pengetahuan dan teknologi saat ini. Di samping itu, evaluasi



dari pihak eksternal seperti industri atau hasil evaluasi akreditasi dapat digunakan sebagai masukan untuk evaluasi *formative*.

Desain didalam pelaksanaan pembelajaran dilakukan dengan penyusunan Rancangan Pembelajaran Semester (RPS) untuk setiap mata kuliah. RPS memuat tujuan pembelajaran, kompetensi, topik/materi kuliah, indikator pencapaian, metoda pembelajaran, dan daftar pustaka. RPS disusun untuk 16 kali pertemuan dalam satu semester, termasuk di dalamnya evaluasi tengah semester (ETS) dan evaluasi akhir semester (EAS). RPS yang telah tersusun digunakan sebagai acuan oleh mahasiswa dan dosen dalam perkuliahan selama satu semester. Setiap mata kuliah mempunyai strategi dan metoda yang berbeda, sesuai dengan tujuan dan kedalaman materi. Pada saat mahasiswa mengambil mata kuliah tugas akhir, mahasiswa akan bergabung di laboratorium yang sesuai dengan topik penelitian dan *road map* laboratorium.

Hubungan antara *civitas* akademika sangat kondusif, terbuka, bebas dan tertib. Mahasiswa bebas berdiskusi sesama mereka dengan adanya prasarana “ruang diskusi” yang berada di setiap laboratorium, dan gazebo. Ruang baca dapat dimanfaatkan oleh mahasiswa untuk belajar secara mandiri, dan dapat meminjam buku referensi yang dilayani oleh pustakawan. Mahasiswa juga bebas bertanya dan berdiskusi dengan dosen, baik yang bersifat akademis ataupun kegiatan-kegiatan mahasiswa yang bersifat non akademis, terutama mendiskusikan topik Tugas Akhir. Tenaga pendidikan akan mendukung seluruh keperluan dan kegiatan mahasiswa. Suasana akademik yang kondusif ini cukup menunjang proses pembelajaran, penelitian, dan pengabdian kepada masyarakat antara dosen dan mahasiswa.

Teknik Mesin secara berkala mengadakan kuliah tamu dengan mengundang alumni, orang-orang yang berkompeten di bidangnya, ataupun dosen dari perguruan tinggi luar negeri untuk meningkatkan wawasan mahasiswa. Pembekalan alumni juga dilakukan secara berkala, sebagai wujud dari *lifelong learning* dengan mengundang alumni untuk berdiskusi di kampus. Teknik Mesin juga mengadakan kegiatan ilmiah bertaraf nasional atau internasional, seperti seminar nasional dan internasional.

Pengelolaan jurusan yang baik memungkinkan penjaminan mutu dapat dilaksanakan dengan baik. Dasar penjaminan mutu pada Teknik Mesin adalah



peraturan Akademik ITS tahun 2019 yang dijabarkan melalui sistem penjaminan mutu internal (SPMI). Penjaminan mutu pada tingkat program studi dilakukan melalui pembentukan Rumpun Mata Kuliah (RMK), yaitu (1) Rekayasa Produksi, (2) Metalurgi, (3) Rekayasa Sistem Termal dan Energi, (4) Rekayasa Sistem Vibrasi dan Otomasi, (5) Mekanika dan Fluida, (6) Mekanika Benda Padat, dan (7) Rekayasa Sistem dan Kontrol. Pembentukan RMK dimaksudkan sebagai wadah bagi dosen-dosen dengan bidang keahlian sejenis untuk saling memberikan masukan dalam perencanaan, pelaksanaan, dan evaluasi pembelajaran. Penjaminan mutu ini selanjutnya dibawa ke tingkat rapat dosen yang melibatkan seluruh dosen Teknik Mesin.

Secara internal, penjaminan mutu Teknik Mesin dilakukan melalui evaluasi PPM, CPL, dan kurikulum, serta evaluasi pelaksanaan dan mutu penyelenggaraan perkuliahan, meliputi monitoring soal-soal evaluasi, tugas akhir, dan pelaksanaan tugas akhir setiap semester. Penjaminan mutu dilakukan terintegrasi di lingkup ITS di bawah Kantor Penjaminan Mutu (KPM). Hasil evaluasi akan menunjukkan nilai Indeks Pengajaran Dosen (IPD), yang merupakan penilaian mahasiswa terhadap dosen pengampu mata kuliah dan memperlihatkan kendala yang dialami mahasiswa selama mengikuti perkuliahan. Evaluasi dilakukan berjenjang menggunakan perangkat *Self Assesment Report (SAR)* yang terintegrasi dalam SI Akademik ITS. Dimulai dari tingkat institut (SAR 1), fakultas (SAR 2), departemen (SAR 3), RMK (SAR 4) dan mata kuliah (SAR 5). Selanjutnya secara eksternal, penjaminan mutu dilakukan melalui penilaian oleh BAN-PT, dan mendapatkan nilai akreditasi A sejak tahun 2016. Dan hingga sampai saat ini Teknik Mesin memiliki akreditasi Unggul dari BAN PT .

Penjaminan mutu yang dilakukan secara berkala dan bertingkat akan menjadi kontrol bagi penyelenggaraan pembelajaran. Melalui evaluasi tersebut dapat diketahui kendala yang dihadapi oleh dosen dan mahasiswa, selanjutnya digunakan untuk penyusunan program yang akan datang, misal meningkatkan kualitas dosen dan tenaga kependidikan, meningkatkan layanan akademik dan administrasi, serta perbaikan proses pembelajaran.

The Mechanical Engineering curriculum undergoes changes and/or developments in response to national policies, ITS policies, and the advancement of science and



technology in the field of mechanical engineering. The current undergraduate curriculum was initiated by the formation of a university-level curriculum team at ITS, working collaboratively with the curriculum team of each study program to develop and implement the curriculum accordingly. The undergraduate program follows the Indonesian National Qualifications Framework (KKNI), aiming for graduates to attain level 6. Furthermore, it is designed in accordance with the Core Curriculum Guidelines for Mechanical Engineering developed by the Indonesian Mechanical Engineering Cooperation Board (BKSTM).

The Mechanical Engineering curriculum requires a total of 144 credits (SKS) to be completed in eight semesters. These are divided into a preparatory stage of 36 SKS (over two semesters) and a bachelor stage of 108 SKS (over six semesters). The education system adopts the Semester Credit System (SKS), which defines student workload, faculty workload, and program delivery using semester credit units. A semester consists of 16 weeks of scheduled academic activities, including evaluation. According to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 3 of 2020 (formerly Permenristekdikti No. 44 of 2015), 1 SKS for lectures, responses, or tutorials includes three weekly activities: 50 minutes of scheduled face-to-face instruction, 60 minutes of structured academic activities, and 60 minutes of independent academic activities. For seminars or equivalent forms, 1 SKS is equal to 100 minutes of learning activities and 70 minutes of independent study per week per semester. For practical courses such as labs, workshops, fieldwork, internships, or community service, 1 SKS equals 170 minutes per week per semester.

The Mechanical Engineering curriculum comprises four aspects: Attitude, General Skills, Specific Skills, and Knowledge. The Attitude and General Skills components refer to the applicable Higher Education National Standards (SN Dikti), specifically Permenristekdikti No. 44 of 2015 and ITS Rector Regulation No. 17 of 2017 on Curriculum Evaluation Guidelines. Specific Skills and Knowledge components are determined by the Ministry of Research, Technology and Higher Education and are developed by the study program based on stakeholder needs, departmental vision and mission, and field-specific academic growth.

In the 2018–2023 curriculum, students are required to complete 45 compulsory courses (134 SKS) and 4 elective courses (10 SKS). Compulsory courses include



enrichment courses, where students must take courses outside their study program at ITS as part of the Merdeka Belajar Kampus Merdeka (MBKM) initiative. This program aims to help students acquire multidisciplinary knowledge and skills to prepare them for the workforce, with the flexibility to choose courses aligned with their interests or to enhance managerial and entrepreneurial abilities. Since the enactment of MBKM (Ministerial Regulation No. 3/2020), ITS has implemented it through Rector Regulation No. 30 of 2020. The curriculum includes 28 elective courses addressing current issues relevant to career development, especially in geomatics.

The Learning Outcomes (CPL) are based on KKN I as outlined in Presidential Regulation No. 8 of 2012 and include four elements: attitude, general skills, specific skills, and knowledge mastery. The CPL formulation involves input from stakeholders—lecturers, alumni, industry representatives, associations, and government institutions—particularly those in the surveying and geospatial sectors. Curriculum evaluation in Mechanical Engineering includes both summative and formative approaches. Summative evaluations lead to curriculum revisions and implementation of new curricula, involving assessments of CPL and CPMK, as well as curriculum structure and courses. These evaluations occur every five years and consider academic guidelines, previous evaluation results, and stakeholder feedback. Currently, the 2018–2023 CPL is in use. Formative evaluations influence operational strategies—such as teaching methods, topic updates, or material enhancements—to keep up with scientific and technological advances. External evaluations from industries and accreditation results also inform formative evaluations.

Learning design is implemented through the development of Semester Learning Plans (RPS) for each course. An RPS outlines learning objectives, competencies, topics, indicators, methods, and references. It spans 16 sessions per semester, including midterm and final evaluations. Each course employs different strategies and methods depending on its objectives and content depth. For final project courses, students are assigned to relevant laboratories aligned with their research topics and lab roadmaps.

The academic atmosphere fosters open, free, and orderly interaction among the academic community. Students are encouraged to engage in peer discussions using designated spaces such as discussion rooms and gazebos in each lab. Reading rooms



offer independent study opportunities with librarian-supported reference access. Students are also welcome to consult lecturers for both academic and non-academic matters, especially regarding final project discussions. Educational staff supports all student needs and activities. This conducive academic environment enhances learning, research, and community service processes.

Mechanical Engineering regularly invites guest lecturers—alumni, professionals, and international faculty—to broaden students' insights. Alumni briefings are also held as part of lifelong learning efforts. National and international academic events, such as seminars, are organized to foster scholarly engagement.

Effective department management ensures quality assurance through ITS's 2019 Academic Regulations and its internal quality assurance system (SPMI). At the program level, quality is ensured through the establishment of Subject Matter Groups (RMK), which include: (1) Production Engineering, (2) Metallurgy, (3) Thermal Systems and Energy, (4) Vibration and Automation Systems, (5) Mechanics and Fluid, (6) Solid Mechanics, and (7) Systems and Control Engineering. RMKs provide a platform for faculty within similar expertise to collaborate on planning, implementation, and evaluation.

Internal quality assurance includes evaluation of academic guidelines, CPL, curriculum, and course implementation quality, such as assessment tools and final project processes. ITS's Quality Assurance Office (KPM) oversees integrated evaluations. Student evaluations of instructors (IPD) help identify teaching challenges. Evaluations use a tiered Self-Assessment Report (SAR) system through ITS Academic Information System (SI Akademik), starting from the institute (SAR 1) to the course level (SAR 5). Externally, quality assurance is validated by BAN-PT, which has awarded the program with an "Excellent" accreditation since 2016.

Regular, multilevel quality assurance serves as a control mechanism to improve learning implementation. Evaluation results inform future programs, such as faculty development, improved academic services, and teaching process enhancements.

1.4 Landasan Hukum

Legal Foundation

Landasan hukum di dalam penyusunan kurikulum Departemen Teknik Mesin adalah *The legal foundation for curriculum development of Mechanical Engineering Department is as follows:*



1. Undang-Undang Republik Indonesia Nomor 14 Tahun 2005 tentang Guru dan Dosen (Lembaran Negara Republik Indonesia Tahun 2005 Nomor 157, Tambahan Lembaran Negara Republik Indonesia Nomor 4586).
2. Undang-Undang Republik Indonesia Nomor 12 Tahun 2012 tentang Pendidikan Tinggi (Lembaran Negara Republik Indonesia Tahun 2012 Nomor 158, Tambahan Lembaran Negara Republik Indonesia Nomor 5336).
3. Peraturan Presiden Republik Indonesia Nomor 8 Tahun 2012 tentang Kerangka Kualifikasi Nasional Indonesia (KKNI).
4. Peraturan Pemerintah Nomor 4 Tahun 2014 tentang Penyelenggaraan Pendidikan Tinggi dan Pengelolaan Perguruan Tinggi.
5. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 73 Tahun 2013 tentang Penerapan KKNI Bidang Perguruan Tinggi.
6. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Republik Indonesia Nomor 62 Tahun 2016 tentang Sistem Penjaminan Mutu Pendidikan Tinggi.
7. Peraturan Menteri Pendayagunaan Aparatur Negara dan Reformasi Birokrasi Nomor 17 Tahun 2012 tentang Jabatan Fungsional Dosen dan Angka Kreditnya.
8. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Nomor 59 tahun 2018 tentang Ijazah, Sertifikat Kompetensi, Sertifikat Profesi, Gelar dan Tata Cara Penulisan Gelar di Perguruan Tinggi.
9. Keputusan Menteri Riset, Teknologi, dan Pendidikan Tinggi Nomor 123 Tahun 2019 tentang Magang dan Pengakuan Satuan Kredit Semester Magang Industri untuk Program Sarjana dan Sarjana Terapan.
10. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi.
11. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 7 Tahun 2020 tentang Pendirian, Perubahan, Pembubaran PTN, dan Pendirian, Perubahan, Pencabutan Izin PTS
12. Peraturan Menteri Pendidikan dan Kebudayaan Nomor 22 Tahun 2020 tentang Rencana Strategis Kementerian Pendidikan dan Kebudayaan.



13. Peraturan Badan Akreditasi Nasional Perguruan Tinggi Nomor 12 Tahun 2021 tentang Instrumen Akreditasi Program Studi pada Pendidikan Akademik dan Vokasi Lingkup Teknik (IAPS-PAV Teknik)
14. Keputusan Majelis Wali Amanat Institut Teknologi Sepuluh Nopember Nomor 02 Tahun 2017 tentang Pengesahan Rencana Induk Pengembangan Institut Teknologi Sepuluh Nopember Tahun 2015 – 2040.
15. Keputusan Majelis Wali Amanat Institut Teknologi Sepuluh Nopember Nomor 04 Tahun 2021 tentang Pengesahan Rencana Strategis Institut Teknologi Sepuluh Nopember Tahun 2021 – 2025.
16. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 32 Tahun 2019 tentang Peraturan Akademik Institut Teknologi Sepuluh Nopember.
17. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 26 Tahun 2020 tentang Peraturan Akademik Program Vokasi Institut Teknologi Sepuluh Nopember.
18. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 25 Tahun 2020 tentang Pedoman Evaluasi Kurikulum Untuk Program Pendidikan Vokasi di Lingkungan Institut Teknologi Sepuluh Nopember.
19. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 27 Tahun 2020 tentang Pedoman Evaluasi Kurikulum Untuk Program Pendidikan Akademik Dan Profesi di Lingkungan Institut Teknologi Sepuluh Nopember.
20. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 22 Tahun 2021 tentang Penyelenggaraan Kegiatan Merdeka Belajar - Kampus Merdeka Institut Teknologi Sepuluh Nopember.

Visi, Misi, dan Tujuan Pendidikan — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 2



INSTITUT TEKNOLOGI SEPULUH NOPEMBER
SURABAYA



2. Visi, Misi, dan Tujuan Pendidikan

Vision, Mission, and Objectives

2.1 Visi, Misi dan Tujuan Fakultas

Vision, Mission, and Objectives of the Faculty

Visi, Misi, Tujuan dari Fakultas dan bedakan antara Visi Misi Fakultas Teknologi Industri dan Rekayasa Sistem adalah sebagai berikut

Vision, Mission, and Objectives of the Faculty, and a Distinction of the Vision and Mission of the Faculty of Industrial Technology and Systems Engineering (FTIRS)

Visi / *Vision*:

Fakultas Teknologi Industri dan Rekayasa Sistem ITS sebagai fakultas dengan reputasi internasional dalam pengembangan ilmu pengetahuan dan teknologi industri

The Faculty of Industrial Technology and Systems Engineering (FTIRS) at ITS aspires to be a faculty with an international reputation in the development of industrial science and technology.

Misi / *Mission*:

Mengkoordinasi, membina dan mendorong elemen-elemen fakultas dalam penyelenggaraan pendidikan, penelitian dan pemberdayaan masyarakat dengan kualitas internasional yang berkesinambungan, untuk meningkatkan daya saing bangsa dengan menjunjung tinggi etika dan moral akademik.

To coordinate, guide, and encourage all faculty elements in conducting education, research, and community empowerment with sustainable international quality, in order to enhance the nation's competitiveness while upholding academic ethics and moral values.

Tujuan / *Objectives*:

1. Menjadikan sistem pendidikan dan pengajaran pada semua elemen fakultas agar setara dengan standard internasional.

To align the education and teaching systems within all elements of the faculty with international standards.

2. Menyediakan lulusan yang memiliki skill, knowledge, kemampuan praktis sehingga mempunyai kompetensi dan kepercayaan diri untuk bersaing dalam pasar global serta memiliki moral dan etika yang baik.



To produce graduates with skills, knowledge, and practical abilities so they are competent and confident to compete in the global market, while upholding strong morals and ethics.

3. Memiliki hasil riset, melalui elemen fakultas, yang bisa dipatenkan dan diaplikasikan secara riil dalam dunia industri.

To generate research outcomes, through faculty elements, that can be patented and applied directly in the industrial sector.

4. Menghasilkan publikasi nasional dan internasional.

To produce both national and international publications.

5. Memberikan konsultasi dan pelatihan teknik di industri dan masyarakat, agar mampu memecahkan persoalan teknik.

To provide technical consultation and training in industry and society to help solve engineering problems.

6. Memiliki jaringan kerjasama ditingkat nasional dan internasional.

To establish collaborative networks at both national and international levels.

2.2 Visi, Misi dan Tujuan Departemen

Vision, Mission, and Objectives of the Department

Visi, Misi, Tujuan dari Departemen Teknik Mesin adalah sebagai berikut

The vision, mission, and objectives of the Department of Mechanical Engineering are as follows:

Visi / *Vision:*

Menjadi Institusi Pendidikan tinggi dengan reputasi internasional dalam ilmu pengetahuan dan teknologi di bidang Teknik mesin terutama yang menunjang industri yang berwawasan lingkungan

To become a higher education institution with an international reputation in science and technology in the field of Mechanical Engineering, particularly in support of environmentally conscious industries.

Misi / *Mission:*

Memberikan kontribusi dalam pengembangan ilmu pengetahuan dan teknologi bidang Teknik Mesin untuk membantu memecahkan masalah industri dan untuk kesejahteraan masyarakat melalui kegiatan pendidikan, penelitian dan pengabdian kepada masyarakat



To contribute to the development of science and technology in the field of Mechanical Engineering in order to help solve industrial problems and improve societal well-being through education, research, and community service activities.

Misi bidang pendidikan: Menyelenggarakan program Pendidikan Teknik Mesin berbasis teknologi informasi dan komunikasi dengan Kurikulum, dosen, dan metode pembelajaran berkualitas internasional, serta menumbuhkan kreatifitas dan inovasi untuk menunjang proses industrialisasi

Mission in Education: to conduct Mechanical Engineering education programs based on information and communication technology with internationally qualified curricula, faculty, and teaching methods, while fostering creativity and innovation to support the process of industrialization.

Misi bidang penelitian: Berperan secara aktif dalam pengembangan ilmu pengetahuan dan teknologi terutama di Teknik Mesin melalui kegiatan penelitian yang berkualitas internasional

Mission in Research: to actively contribute to the development of science and technology, particularly in Mechanical Engineering, through high-quality international research activities.

Pengabdian Memanfaatkan segala sumber daya yang ikut serta dalam menyelesaikan yang dihadapi oleh masyarakat, industri dan pemerintah pusat dan pemerintah daerah, khususnya bidang Teknik Mesin dengan mengedepankan teknologi informasi dan komunikasi

Mission in Community Service: to utilize all available resources to contribute to solving problems faced by society, industry, and both central and regional governments—especially in the field of Mechanical Engineering—by prioritizing information and communication technology.

Visi dan misi Departemen Teknik Mesin juga bisa ditemukan di link / *The vision and mission of the Department of Mechanical Engineering can also be found at the following link:* [Visi dan Misi - Departemen Teknik Mesin \(its.ac.id\)](http://its.ac.id)

2.3 Visi, Misi dan Tujuan Pendidikan Program Studi

Vision, Mission, and Educational Objectives of the Study Program

Visi pengembangan keilmuan prodi dan juga Tujuan Pendidikan Prodi adalah sebagai berikut



The scientific development vision and educational objectives of the study program are as follows:

Visi Prodi / Program Vision:

Menjadi Institusi Pendidikan Sarjana Teknik Mesin dengan reputasi internasional dan berperan sebagai institusi rujukan program studi sarjana Teknik Mesin di Indonesia
To become an undergraduate Mechanical Engineering education institution with an international reputation and serve as a reference institution for Mechanical Engineering undergraduate programs in Indonesia.

Misi Prodi / Program Mission:

Menyelenggarakan program Pendidikan Sarjana Teknik Mesin untuk menghasilkan lulusan yang mampu bersaing di pasar global, melaksanakan penelitian dan mempublikasikan hasil penelitian bidang keilmuan Teknik Mesin yang berkualitas dalam forum nasional, regional maupun internasional, serta menerapkan hasil penelitian untuk membantu memecahkan masalah industri dan masyarakat.

To conduct the Mechanical Engineering Undergraduate Program to produce graduates who are competitive in the global market, to carry out research and publish high-quality research findings in national, regional, and international forums, and to apply research results to help solve industrial and societal problems.

Tujuan Prodi (Programme Educational Objective - PEO):

1. Menyelenggarakan program pendidikan teknik mesin berbasis teknologi informasi dan komunikasi dengan kurikulum, dan dosen berkualitas internasional, serta menumbuhkan kreatifitas dan inovasi untuk menunjang proses industrialisasi

To conduct a mechanical engineering education program based on information and communication technology with an internationally qualified curriculum and faculty, while fostering creativity and innovation to support industrialization processes.

2. Berperan secara aktif dalam pengembangan ilmu pengetahuan dan teknologi terutama bidang teknik mesin melalui kegiatan penelitian yang berkualitas internasional



To actively contribute to the development of science and technology, especially in the field of mechanical engineering, through internationally recognized research activities.

3. Memanfaatkan segala sumber daya yang ikut serta dalam menyelesaikan yang dihadapi oleh masyarakat, industri dan pemerintah pusat dan pemerintah daerah, khususnya bidang teknik mesin dengan mengedepan teknologi informasi dan komunikasi

To utilize all available resources to help solve problems faced by society, industry, and both central and regional governments, particularly in the field of mechanical engineering, by prioritizing information and communication technology.

Berikut ini adalah tabel tujuan pendidikan prodi

The following is the table of Programme Educational Objectives (PEO):

**Tabel 2.1. Tujuan Pendidikan Prodi (TPP) /
Programme Educational Objectives (PEO)**

No	Kode Tujuan Pendidikan Prodi PEO Code	Deskripsi Tujuan Pendidikan Prodi Description of Programme Educational Objectives
1	TPP-1 PEO-1	Menyelenggarakan program pendidikan teknik mesin berbasis teknologi informasi dan komunikasi dengan kurikulum, dan dosen berkualitas internasional, serta menumbuhkan kreatifitas dan inovasi untuk menunjang proses industrialisasi <i>To conduct a Mechanical Engineering education program based on information and communication technology, supported by an internationally qualified curriculum and faculty, while fostering creativity and innovation to support the process of industrialization.</i>
2	TPP-2 PEO-2	Berperan secara aktif dalam pengembangan ilmu pengetahuan dan teknologi terutama bidang teknik mesin melalui kegiatan penelitian yang berkualitas internasional



3

TPP-3
PEO-3

To actively contribute to the development of science and technology, particularly in the field of Mechanical Engineering, through internationally recognized research activities.

Memanfaatkan segala sumber daya yang ikut serta dalam menyelesaikan yang dihadapi oleh masyarakat, industri dan pemerintah pusat dan pemerintah daerah, khususnya bidang teknik mesin dengan mengedepan teknologi informasi dan komunikasi

To utilize all available resources to address challenges faced by society, industry, and both central and regional governments, particularly in the field of Mechanical Engineering, by prioritizing information and communication technology.

Evaluasi Kurikulum & Tracer Study — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 3

PERPUSTAKAAN



3. Evaluasi Kurikulum dan *Tracer Study* *Curriculum Evaluation and Tracer Study*

3.1 Evaluasi Kurikulum

Curriculum Evaluation

Kurikulum yang digunakan di Teknik Mesin saat ini didasarkan pada kurikulum 2018-2023, dimana Capaian Pembelajaran yang diharapkan dari program ini ditentukan secara nasional oleh Kementerian Pendidikan dan Kebudayaan, dengan mempertimbangkan tuntutan kompetensi.

The curriculum currently implemented in the Mechanical Engineering Department is based on the 2018–2023 curriculum. The Learning Outcomes expected from this program are determined nationally by the Ministry of Education and Culture, taking into account competency demands.

Bentuk proses pendidikan dan pembelajaran berupa: kuliah, seminar, atau yang setara dengan praktikum, penelitian/riset, KKN tematik, pertukaran mahasiswa, magang/kerja praktik, asisten mengajar, proyek kemanusiaan, kegiatan kewirausahaan, dan studi independen. Sedangkan metode pembelajaran berupa: diskusi kelompok, simulasi, studi kasus, pembelajaran kolaboratif, pembelajaran kooperatif, pembelajaran berbasis proyek, pembelajaran berbasis proyek dan pembelajaran berbasis masalah.

The forms of education and learning activities include lectures, seminars, and their equivalents such as practical sessions, research, thematic community service programs, student exchanges, internships/industrial training, teaching assistantships, humanitarian projects, entrepreneurship activities, and independent studies. The learning methods employed include group discussions, simulations, case studies, collaborative learning, cooperative learning, project-based learning, and problem-based learning.

Silabus dan rencana pembelajaran untuk setiap mata kuliah telah dirancang dengan cermat agar selaras dengan Capaian Pembelajaran yang diharapkan. Kurikulum mendefinisikan Capaian Pembelajaran yang diharapkan pada setiap silabus yang digunakan untuk meningkatkan kualitas pengajaran dan pembelajaran, serta berisi metode penilaian evaluasi mahasiswa. Berbagai penilaian mahasiswa diterapkan untuk mendapatkan peningkatan dalam menilai prestasi mahasiswa dan ketercapaian capaian pembelajaran oleh mahasiswa. Penilaian tersebut meliputi presentasi



kelompok, pre-test/posttest dan laporan individu, selain dari evaluasi tertulis yang terjadwal.

Syllabi and lesson plans for each course have been carefully designed to align with the expected Learning Outcomes. The curriculum defines the Learning Outcomes in each syllabus to improve the quality of teaching and learning and includes student assessment methods. Various student assessments are applied to enhance the evaluation of student performance and the achievement of learning outcomes. These assessments include group presentations, pre-tests/post-tests, individual reports, in addition to scheduled written evaluations.

Sejak diberlakukannya kurikulum 2018 dan sejalan dengan upaya untuk mencapai status akreditasi umum dari IABEE, maka Capaian Pembelajaran dari setiap mata kuliah disatukan dan diintegrasikan dalam silabus. Mahasiswa harus melaksanakan kerja praktik di industri selama durasi satu bulan yang setara dengan 2 SKS. Melalui kerja praktik di industri, mahasiswa memperoleh kesempatan untuk mempelajari pelaksanaan beberapa mata kuliah. Capaian Pembelajaran lainnya adalah memiliki kemampuan berkomunikasi dan memanfaatkan software-software mekanik.

Since the implementation of the 2018 curriculum and in alignment with efforts to achieve general accreditation status from IABEE, the Learning Outcomes of each course have been consolidated and integrated into the syllabus. Students are required to undertake industrial internships for one month, equivalent to 2 credits (SKS). Through these industrial internships, students gain the opportunity to observe and experience the real-world application of several courses. Other Learning Outcomes include the ability to communicate effectively and utilize mechanical engineering software.

Kurikulum disusun berdasarkan evaluasi kurikulum sebelumnya dan analisis SWOT dengan mempertimbangkan masukan dari pemerintah, stakeholder, industri dan alumni serta pemangku kepentingan lain. Kemudian semua kompetensi dan Capaian Pembelajaran ditetapkan berdasarkan visi misi dan profil lulusan yang diinginkan. Mata kuliah terkait kemudian disusun sesuai dengan Capaian Pembelajaran yang diusulkan.

The curriculum is developed based on evaluations of previous curricula and SWOT analysis, considering input from the government, stakeholders, industry, alumni, and other relevant parties. All competencies and Learning Outcomes are then defined based on the department's vision, mission, and desired graduate profiles. Related



courses are subsequently designed in accordance with the proposed Learning Outcomes.



Gambar 3.1 Prosedur penyusunan kurikulum Departemen Teknik Mesin /
Curriculum Development Procedure of the Department of Mechanical Engineering

Kegiatan perkuliahan dapat dilakukan baik di kelas maupun di laboratorium. Perkuliahan di kelas dilakukan untuk mempersiapkan mahasiswa dengan pemahaman yang kuat tentang konsep pengetahuan/teknologi. Sementara itu, kegiatan praktikum di laboratorium memperkaya mahasiswa dengan keterampilan praktis dan pemahaman yang lebih mendalam tentang fenomena fisis dari suatu masalah keteknikan tertentu. Tidak kurang dari 15 mata kuliah dilaksanakan baik di kelas maupun di laboratorium

Lectures can be conducted either in the classroom or in the laboratory. Classroom lectures are designed to equip students with a solid understanding of concepts and knowledge/technology, while laboratory practicals enrich students with hands-on skills and a deeper comprehension of the physical phenomena related to specific engineering problems. No fewer than 15 courses are conducted both in the classroom and in the laboratory.

Program Studi Sarjana Teknik Mesin selalu menjaga agar mata kuliah selalu up dated dengan mengelola beberapa pertemuan rutin setiap RMK. Pada setiap akhir semester, semua laboratorium mengelola pertemuan untuk mengevaluasi output dari proses belajar-mengajar. Pada sesi ini, kepala laboratorium memimpin rapat. Para anggota laboratorium mendiskusikan hambatan dan cara untuk mengatasi masalah belajar-mengajar yang sesuai. Alih-alih diskusi manajerial, ini adalah diskusi kelompok sejawat di mana setiap anggota laboratorium berbagi ide dan memperkaya hasil diskusi.



The Undergraduate Program in Mechanical Engineering consistently ensures that its courses remain up to date by holding regular meetings for each Research Group (RMK). At the end of each semester, all laboratories conduct meetings to evaluate the outcomes of the teaching and learning process. These sessions are led by the head of each laboratory. Laboratory members discuss obstacles encountered and propose solutions to teaching and learning challenges. Rather than being managerial in nature, these meetings are peer group discussions in which each laboratory member contributes ideas and insights to enhance the outcome of the discussions.

Pertemuan penting lainnya adalah rapat umum departemen, yang diadakan setiap semester. Rapat ini dipimpin oleh manajemen Departemen Teknik Mesi, yaitu Ketua dan Sekretaris Departemen. Semua anggota fakultas didorong untuk menghadiri rapat dan berbagi ide mereka untuk kepentingan DoME. Pada akhir pertemuan, departemen akan menyimpulkan pencapaian departemen dan mengusulkan perbaikan, revisi atau pembaruan program untuk tahun akademik yang akan datang. Revisi yang disebutkan di atas hanya berlaku untuk mata kuliah tertentu, sebagian besar mata kuliah tahun atas.

Another important meeting is the general department meeting, held each semester. This meeting is chaired by the department management (Head and Secretary of the Department). All faculty members are encouraged to attend and share their ideas for the benefit of the Department of Mechanical Engineering (DoME). At the end of the meeting, the department summarizes its achievements and proposes improvements, revisions, or program updates for the upcoming academic year. These revisions typically apply to specific courses, particularly upper-level courses.

Evaluasi Kurikulum terdapat 2 jenis yaitu evaluasi formatif dan evaluasi summatif: *Curriculum evaluation is carried out in two forms: formative and summative evaluation.*

1. *Evaluasi Formative / Formative Evaluation*

Evaluasi formative dari diskusi Advisory Board, kemudian mengadakan FGD dengan stakeholders, maka ada penyesuaian pada metode pembelajaran, misalnya: project based learning, perencanaan elemen mesin menjadi *capstone design*, project management, green energi dan ilmu ekonomi teknik. Selaras dengan perencanaan ITS dalam memperkaya Massive Online Open Course (MOOC) sehingga metode pembelajaran dilengkapi dengan e-learning MOOC. *Breakdown* bahan kajian ilmu sains dasar yang sama/terdapat dalam tiap mata



kuliah mesin dasar seperti termodinamika dan mekanika fluida yang memiliki bahan kajian terkait satuan unit.

Formative evaluation stems from discussions with the Advisory Board, followed by focus group discussions (FGDs) with stakeholders. This leads to adjustments in learning methods, such as the adoption of project-based learning, the transformation of the Machine Element Design course into a capstone design project, as well as the integration of project management, green energy, and engineering economics. This is aligned with ITS's plan to enhance its Massive Open Online Course (MOOC) platform, thereby integrating e-learning through MOOCs. Additionally, there is a breakdown of fundamental science topics that are shared across core mechanical engineering courses, such as thermodynamics and fluid mechanics, both of which cover topics related to unit systems.

2. Evaluasi Summative / Summative Evaluation

Evaluasi summative adalah evaluasi yang menyebabkan dirubahnya/dikembangkannya kurikulum, dan berdampak pada implementasi kurikulum baru dengan memperhatikan landasan pengembangan kurikulum yang telah dituliskan di Bab 1. Perubahan kurikulum karena adanya penambahan mata kuliah *basic science* yang merupakan tuntutan dari akreditasi internasional yaitu minimum 20% dari seluruh matakuliah. Mata kuliah tersebut adalah Matematika 1 (3 sks), Fisika Mekanika (4 sks), Kimia (3 sks), Matematika 2 (3 sks), Fisika Listrik dan Magnet (4 sks), Fisika Klasik (2 sks), Matematika Rekayasa (2 sks), Algoritma Dasar (2 sks), Analisa Numerik (3 sks), Statistika dan Perencanaan Eksperimen (4sks) sehingga dapat memenuhi tuntutan akreditasi internasional dengan mempertimbangkan bahan kajian dasar dan basic science yang dipelajari. Selain itu, siklus perubahan kurikulum setiap 5 tahunan oleh ITS dalam rangka merespon perubahan dan pengembangan dunia industri dan teknologi. Kebijakan BKSTM juga terkait matakuliah **capstone design yang harus ada dalam kurikulum ilmu Teknik Mesin**. Sebelumnya di Prodi Sarjana Teknik Mesin ada MK Perencanaan Elemen Mesin yang mempelajari terkait dengan analisis perencanaan alat yang didalamnya terdapat analisis elemen-elemen mesin dan kekuatan material. Selain itu juga menganalisis gambar dalam bentuk 2D dan 3 dimensi hingga menjadi gambar assembly. MK ini dikembangkan



menjadi capstone design 1 dan capstone design 2 yang mana capstone desain harus menjadi luaran produk.

Summative evaluation refers to the assessment that leads to changes or developments in the curriculum and impacts the implementation of a new curriculum, as discussed in Chapter 1. Curriculum changes include the addition of basic science courses, as required by international accreditation standards—which stipulate that at least 20% of all courses must cover basic sciences. These courses include Mathematics 1 (3 credits), Mechanics Physics (4 credits), Chemistry (3 credits), Mathematics 2 (3 credits), Electricity and Magnetism Physics (4 credits), Classical Physics (2 credits), Engineering Mathematics (2 credits), Basic Algorithms (2 credits), Numerical Analysis (3 credits), and Statistics and Experimental Design (4 credits), thus meeting international accreditation requirements. In addition, ITS mandates a five-year curriculum review cycle to address changes and developments in industry and technology. The BKSTM (Mechanical Engineering Cooperation Agency) also mandates the inclusion of a capstone design course in mechanical engineering curricula. Previously, the Mechanical Engineering undergraduate program included a Machine Element Design course, covering tool design analysis, component strength analysis, and engineering drawings in both 2D and 3D formats, culminating in assembly drawings. This course has since been developed into Capstone Design 1 and Capstone Design 2, both of which are required to produce tangible product outcomes.

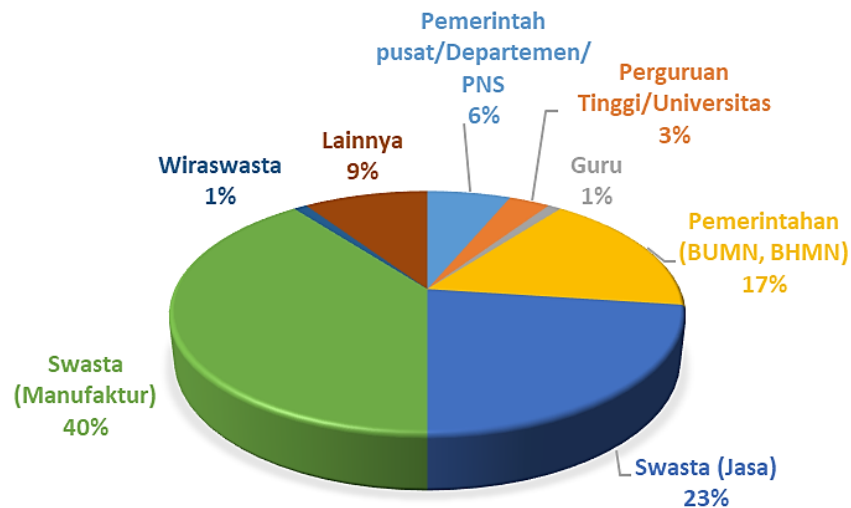
3.2 Tracer Study

Tracer studi merupakan salah satu proses pendataan alumni teknik mesin secara berkala terkait dengan data base mereka setelah lulus dari DTM dengan rincian profil, pekerjaan yang dilakukan, kisaran gaji dan kebermanfaatan penerapan kurikulum terhadap pekerjaan yang dilakukan. Berikut ini beberapa hasil tracer yang dilakukan antara lain distribusi pekerjaan alumni teknik mesin yang dapat dilihat pada gambar 3.2.

Tracer study is one of the processes conducted periodically to collect data on Mechanical Engineering alumni, specifically regarding their database after graduating from the Department of Mechanical Engineering (DTM). It includes detailed information such as alumni profiles, types of jobs held, salary ranges, and the relevance of the curriculum to their professional work. Some of the tracer study



results include the distribution of Mechanical Engineering alumni occupations, as shown in Figure 3.2.



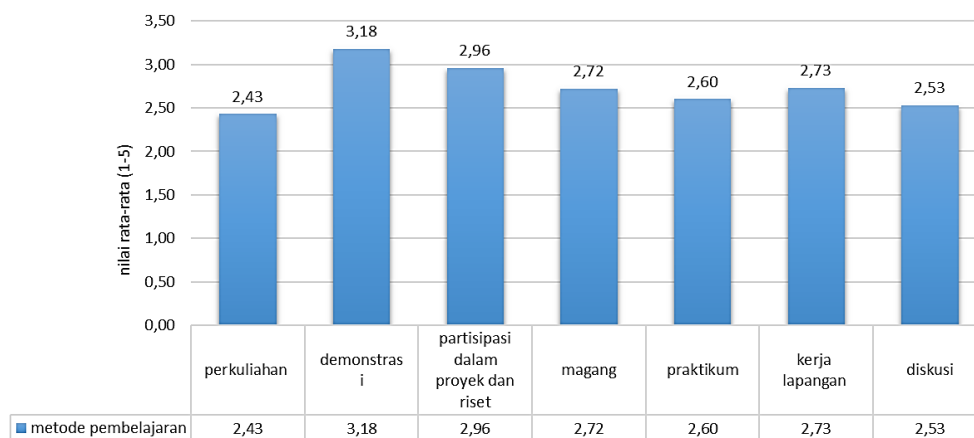
Gambar 3.2 sebaran instansi/bidang usaha/industri tempat bekerja alumni
distribution of institutions/business sectors/industries where alumni are employed

Proses pembelajaran memiliki banyak metode dan cara yang baik serta relevan sehingga value yang diberikan bisa tersampaikan dengan tepat. Pembelajaran yang dilakukan oleh Departemen melalui beberapa macam metode diantaranya Perkuliahan, Diskusi, Praktikum, Kerja praktik, Partisipasi dalam Proyek Riset, Magang dan Demonstrasi/ Peragaan. Dalam penerapannya, teknik demonstrasi memiliki nilai penekanan pembelajaran lebih tinggi dari pada Praktikum, Perkuliahan, partisipasi dalam proyek riset, Kerja Lapangan, Magang dan Diskusi. Hal ini diperoleh dari hasil tracer studi yang dilakukan. Nilai paling tinggi dimiliki pada pembelajaran melalui demonstrasi dengan skor 3,18 dan paling rendah pada pembelajaran dengan metode Perkuliahan dengan skor 2,48. Hal ini dapat disimpulkan bahwa Departemen Teknik Mesin lebih menekankan lulusan pada metode pembelajaran melalui demonstrasi. Dan untuk metode kerja lapangandan partisipasi dalam proyek riset dinilai oleh lulusan sudah baik, atau penekanannya sebagai pendukung dalam pembelajaran pengaruhnya cukup besar.

The learning process involves various effective and relevant methods to ensure that the intended value is delivered accurately. The Department implements multiple learning methods, including Lectures, Discussions, Practicums, Internships,



Participation in Research Projects, Industrial Training, and Demonstrations. Among these, the demonstration method is found to have a greater learning impact compared to Practicums, Lectures, participation in research projects, fieldwork, internships, and discussions. This conclusion is based on the results of a tracer study. Demonstration-based learning received the highest score of 3.18, while lectures received the lowest score of 2.48. It can be concluded that the Department of Mechanical Engineering places greater emphasis on demonstration-based learning. Meanwhile, fieldwork and participation in research projects are also considered effective by alumni, indicating a significant supportive role in the overall learning process.

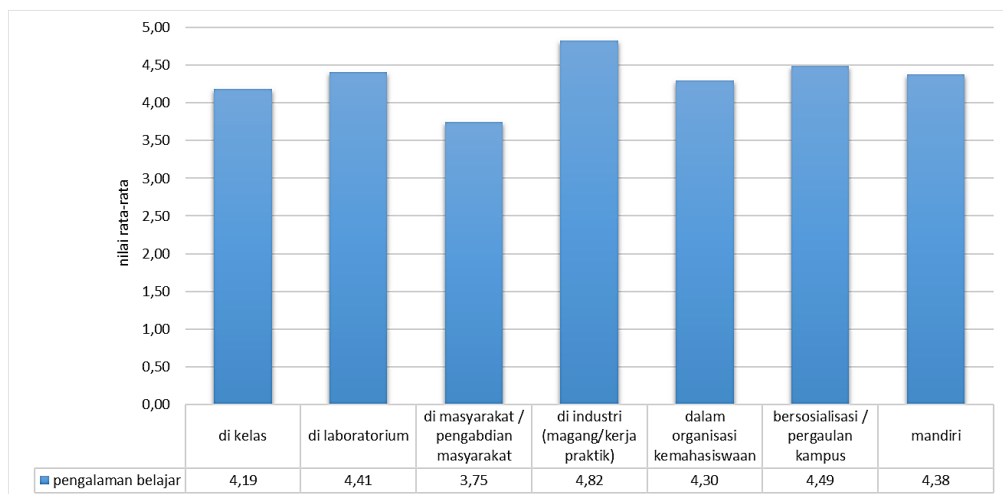


Gambar 3.3 metode pembelajaran / *Learning Method*

Selain itu metode pembelajaran diatas, ada juga pengalaman belajar yang didapat mahasiswa yang dapat memberikan kontribusi untuk kelancaran dalam bekerja antara lain belajar di kelas, di laboratorium, di masyarakat, di industri, belajar mandiri dan belajar dalam berorganisasi. Dalam penerapannya, belajar di industri memiliki nilai yang lebih tinggi dalam memberikan pengaruh/kontribusi terhadap pekerjaan yang dilakukan saat ini yaitu 4.82 dibanding belajar di kelas dan dilaboratorium, 4.19 dan 4.41. Hal ini menunjukkan bahwa proses pembelajaran diluar kelas sangat memberikan dampak positif terhadap pengembangan kompetensi mahasiswa di dalam industri seperti dapat memberikan pengalaman praktis seperti manajemen waktu, mengembangkan keterampilan interpersonal dan keterampilan kerja tim, serta membangun jaringan profesional untuk menjalin hubungan profesional yang berharga.



In addition to the learning methods mentioned above, students also gain learning experiences that contribute to their effectiveness in the workplace. These include learning in the classroom, in laboratories, within the community, in industry, through self-directed learning, and through organizational involvement. In practice, industrial-based learning holds a higher value in terms of its influence/contribution to current job performance, scoring 4.82, compared to classroom learning and laboratory learning, which scored 4.19 and 4.41 respectively. This indicates that out-of-class learning processes have a significant positive impact on the development of students' competencies in industry, as they provide practical experience such as time management, the development of interpersonal and teamwork skills, and the opportunity to build professional networks and valuable relationships.



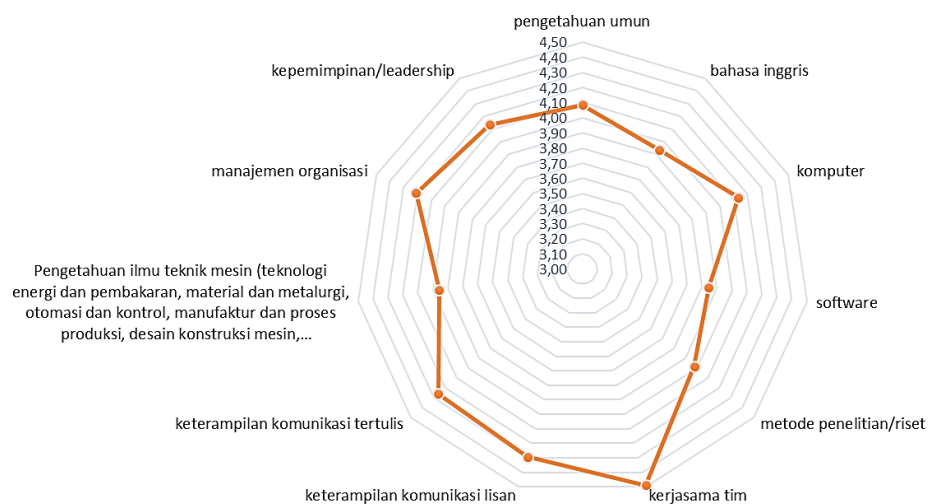
Gambar 3.4 pengalaman belajar mahasiswa / *student learning experience*

Dalam penerapan kurikulum yang tepat dan efektif dapat membantu mahasiswa mengembangkan berbagai keterampilan dan pengetahuan yang penting untuk kesuksesan di masa depan, termasuk keterampilan umum, pengetahuan teknik/engineering yang akan membantu mahasiswa dalam mempersiapkan diri untuk menjadi profesional yang terampil dan terlatih dalam bidang keteknikmesinan, kemampuan kerjasama tim, keterampilan komunikasi, dan keterampilan kepemimpinan yang dibutuhkan dalam dunia kerja. dengan nilai rerata paling tinggi adalah perihal kerjasama tim. Persebaran kebermanfaatan penerapan kurikulum dalam pengembangan kompetensi mahasiswa dapat dilihat pada gambar 3.5 Kompetensi yang paling tinggi didapatkan adalah terkait



kerjasama tim. Kurikulum yang mempromosikan kerjasama tim dalam pengajaran dapat membantu mahasiswa mengembangkan kemampuan untuk bekerja sama dalam kelompok dan meningkatkan keterampilan sosial mereka. Hal ini dapat membantu mahasiswa dalam mempersiapkan diri untuk bekerja di lingkungan kerja yang menuntut kolaborasi dan tim.

The implementation of an appropriate and effective curriculum can help students develop a wide range of skills and knowledge essential for future success. This includes general skills and technical/engineering knowledge that prepare students to become skilled and well-trained professionals in the field of mechanical engineering, as well as teamwork abilities, communication skills, and leadership skills required in the workplace. Among these, teamwork received the highest average score. The distribution of the curriculum's effectiveness in developing student competencies is shown in Figure 3.5, where teamwork emerged as the most significant competency gained. A curriculum that promotes teamwork in teaching can help students develop the ability to collaborate in groups and enhance their social skills. This, in turn, better prepares them to work in professional environments that demand collaboration and teamwork.



Gambar 3.5 persebaran nilai kompetensi / *distribution of competency scores*

Profil Lulusan & Rumusan Capaian Pembelajaran Lulusan (CPL) — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 4





4. Profil Lulusan, Tujuan Pendidikan Prodi dan Rumusan Capaian Pembelajaran Lulusan (CPL)

Graduate Profile, Program Educational Objectives, and Formulation of Learning Outcomes (CPL)

4.1 Profil Lulusan dan Tujuan Pendidikan Prodi

Graduate Profile and Program Educational Objectives

Profil lulusan Prodi Sarjana Teknik Mesin adalah sebagai berikut

The graduate profiles of the Bachelor of Mechanical Engineering Program are as follows:

Tabel 4.1. Profil Lulusan dan deskripsinya
Graduate Profiles and Their Descriptions

No	Profil Lulusan (PL) <i>Graduate Profile (PL)</i>	Deskripsi Profil Lulusan <i>Description of Graduate Profile</i>
1	PL-1	Mampu menganalisis dan merancang sistem dasar mekanikal (desain, energi, material dan manufaktur), serta berkontribusi secara aktif dalam memecahkan permasalahan teknik yang kompleks di bidang sistem energi (energi konvensional dan terbarukan) dan industri otomotif <i>Able to analyze and design fundamental mechanical systems (design, energy, materials, and manufacturing), and actively contribute to solving complex engineering problems in the fields of energy systems (both conventional and renewable) and the automotive industry</i>
2	PL-2	Mampu berkomunikasi secara efektif dengan berbagai macam latar belakang pendengar <i>Able to communicate effectively with a diverse range of audiences.</i>
3	PL-3	Mampu bertanggungjawab dan bekerja secara profesional, serta memenuhi etika keinsinyuran dalam memecahkan masalah keteknikan dengan mempertimbangkan dampak sosial, ekonomi dan lingkungan secara global



		<i>Able to take responsibility and work professionally, while upholding engineering ethics in solving engineering problems by considering global social, economic, and environmental impacts.</i>
4	PL-4	Mampu bekerja bersama tim secara efektif dan menciptakan lingkungan kepemimpinan yang kolaboratif dan inklusif, dalam merencanakan tugas dan memenuhi tujuan bersama <i>Able to work effectively in teams and create a collaborative and inclusive leadership environment in planning tasks and achieving common goals.</i>

Korelasi antara Profil Lulusan dengan Tujuan Pendidikan Prodi dapat dinyatakan dalam bentuk Tabel 4.2 di bawah ini

The correlation between the Graduate Profiles and the Program Educational Objectives can be presented in Table 4.2 below:

Tabel 4.2 Tabel korelasi profil lulusan dan tujuan pendidikan Prodi
Correlation Table between Graduate Profiles and Program Educational Objectives

No	Profil Lulusan (PL) <i>Graduate Profile</i>	Tujuan Pendidikan Prodi (TPP) <i>Program Educational Objectives (PEO)</i>		
		TPP-1	TPP-2	TPP-3
1	PL-1	√	√	√
2	PL-2	√		√
3	PL-3	√	√	√
4	PL-4	√		√

4.2 Perumusan CPL

Formulation of Learning Outcomes (CPL)

CPL yang akan dioperasikan dalam masa akademik 2023 - 2028 mengimplementasikan kurikulum baru. CPL Prodi Sarjana Teknik Mesin yang sesuai dengan kaidah badan standar akreditasi internasional dalpada tabel 4.3 di bawah ini:

The Learning Outcomes (CPL) to be implemented during the 2023–2028 academic period are aligned with the newly adopted curriculum. The CPL of the Undergraduate Program in Mechanical Engineering has been formulated in accordance with the standards set by international accreditation bodies, as presented in Table 4.3 below:



Tabel 4.3. Capaian Pembelajaran Lulusan Program Studi
Learning Outcomes of the Study Program

Kode <i>Code</i>	Deskripsi Capaian Pembelajaran Lulusan (CPL) <i>Description of Graduate Learning Outcomes (CPL)</i>
CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, noble morals, sensitivity and concern for social and environmental issues, respect for cultural differences and diversity, upholding the law, prioritizing the interests of the nation and the wider community, through creativity and innovation, excellence, strong leadership, synergy, and other personal potential to achieve optimal results.</i>
CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>Able to study and utilize science and technology in the field of mechanical engineering, and make appropriate decisions based on individual or group work outcomes, in the form of a final project report or other equivalent learning activities through logical, critical, systematic, and innovative thinking.</i>
CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi.



Kode Code	Deskripsi Capaian Pembelajaran Lulusan (CPL) Description of Graduate Learning Outcomes (CPL)
	<i>Able to manage their own learning and develop themselves as lifelong learners to compete nationally and internationally, contributing to problem-solving by implementing information and communication technology, considering sustainability principles, and understanding technology-based entrepreneurship.</i>
CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.</i>
CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan <i>Ability to design mechanical components, systems, and/or processes to meet expected needs using an analytical engineering approach based on up-to-date science & technology, while considering technical standards, performance, reliability, and maintainability.</i>
CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>Ability to conduct laboratory and/or field experiments and analyze and interpret data to support technical assessments.</i>
CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply modern methods, skills, and engineering tools required in the practice of mechanical systems.</i>
CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve engineering problems.</i>
CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi <i>Ability to communicate effectively, both orally and in writing, and to apply technology-based entrepreneurship.</i>



Kode <i>Code</i>	Deskripsi Capaian Pembelajaran Lulusan (CPL) <i>Description of Graduate Learning Outcomes (CPL)</i>
CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, complete, and evaluate tasks based on the analysis of information and data.</i>
CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika <i>Ability to be responsible to society and adhere to professional ethics in solving mechanical system problems.</i>

4.3 Matrik hubungan CPL dengan Profil Lulusan

Matrix of the Relationship Between Learning Outcomes (CPL) and Graduate Profiles

Tabel 4.3. Matrik hubungan Profil & CPL Prodi
Matrix of the Relationship Between Program Learning Outcomes and Graduate Profiles

Kode <i>Code</i>	Deskripsi CPL Prodi <i>Description of Program Learning Outcomes (CPL)</i>	PL1	PL2	PL3	PL4
CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal	√	√	√	√



Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, noble character, sensitivity and concern for social and environmental issues, respect for cultural diversity and pluralism, uphold the rule of law, prioritize the interests of the nation and society at large, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve optimal results.

CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif.	√	√	√
	<i>Able to study and utilize science and technology for application in the field of mechanical engineering, and able to make accurate decisions based on individual or group work results in the form of a final project report or other learning activities equivalent to the final project through logical, critical, systematic, and innovative thinking.</i>			
CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang	√	√	



hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi

Able to manage self-learning and develop oneself as a lifelong learner to compete at national and international levels, and to contribute concretely in solving problems by implementing information and communication technology, considering sustainability principles, and understanding technology-based entrepreneurship.

CPL-4 Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika

√

Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.

CPL-5 Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan

√



Ability to design components, systems, and/or mechanical processes to meet expected needs using an engineering analytical approach based on cutting-edge science and technology, considering technical standards, performance aspects, reliability, and usability.

- CPL-6 Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. ✓

Ability to conduct laboratory and/or field experiments and analyze and interpret data to strengthen technical assessments.

- CPL-7 Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika ✓

Ability to apply modern engineering methods, skills, and tools necessary for the practice of mechanical systems.

- CPL-8 Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik ✓

Ability to identify, formulate, analyze, and solve engineering problems.

- CPL-9 Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi ✓ ✓ ✓

Ability to communicate effectively both orally and in writing, and to apply technology-based entrepreneurship.



CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, complete, and evaluate tasks based on the analysis of information and data.</i>	√	√
CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika <i>Ability to take responsibility to society and adhere to professional ethics in solving mechanical system problems.</i>	√	√

Catatan: Kode CPL dapat dituliskan dengan CPL-1, CPL-2, dst

PL: Profil lulusan ke ...

Note: CPL codes can be written as CPL-1, CPL-2, etc.

PL: Graduate Profile number ...

4.4 Matrik hubungan CPL Prodi dengan Tujuan Pendidikan Program Studi *Matrix of the Relationship Between Program Learning Outcomes (CPL) and Program Educational Objectives (PEO)*

Tabel 4.4. Matrik hubungan CPL Prodi & Tujuan Pendidikan Program Studi
Matrix of the Relationship Between CPL and Program Educational Objectives

Kode	Deskripsi CPL Prodi	TPP-1	TPP-2	TPP-3
Description of Program Learning Outcomes (CPL)				
CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi,	√		√



kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal

Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, noble character, sensitivity and concern for social and environmental issues, appreciation of cultural diversity and pluralism, upholding the rule of law, prioritizing national and societal interests, through creativity and innovation, excellence, strong leadership, synergy, and other potentials to achieve optimal results

CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>Able to study and utilize science and technology for application in the field of mechanical engineering, and able to make accurate decisions based on individual or group work results in the form of a final project report or other learning activities equivalent to a final project through logical, critical, systematic, and innovative thinking</i>	√	√	√
CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi	√		√



nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi

Able to manage self-learning and develop oneself as a lifelong learner to compete at national and international levels, and to contribute concretely to solving problems by implementing information and communication technology, considering the principles of sustainability, and understanding technology-based entrepreneurship

CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>	√	√
CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan <i>Ability to design components, systems, and/or mechanical processes to meet expected needs using an engineering analytical approach based on cutting-edge science and technology, considering technical standards, performance aspects, reliability, and usability</i>	√	√
CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta	√	√

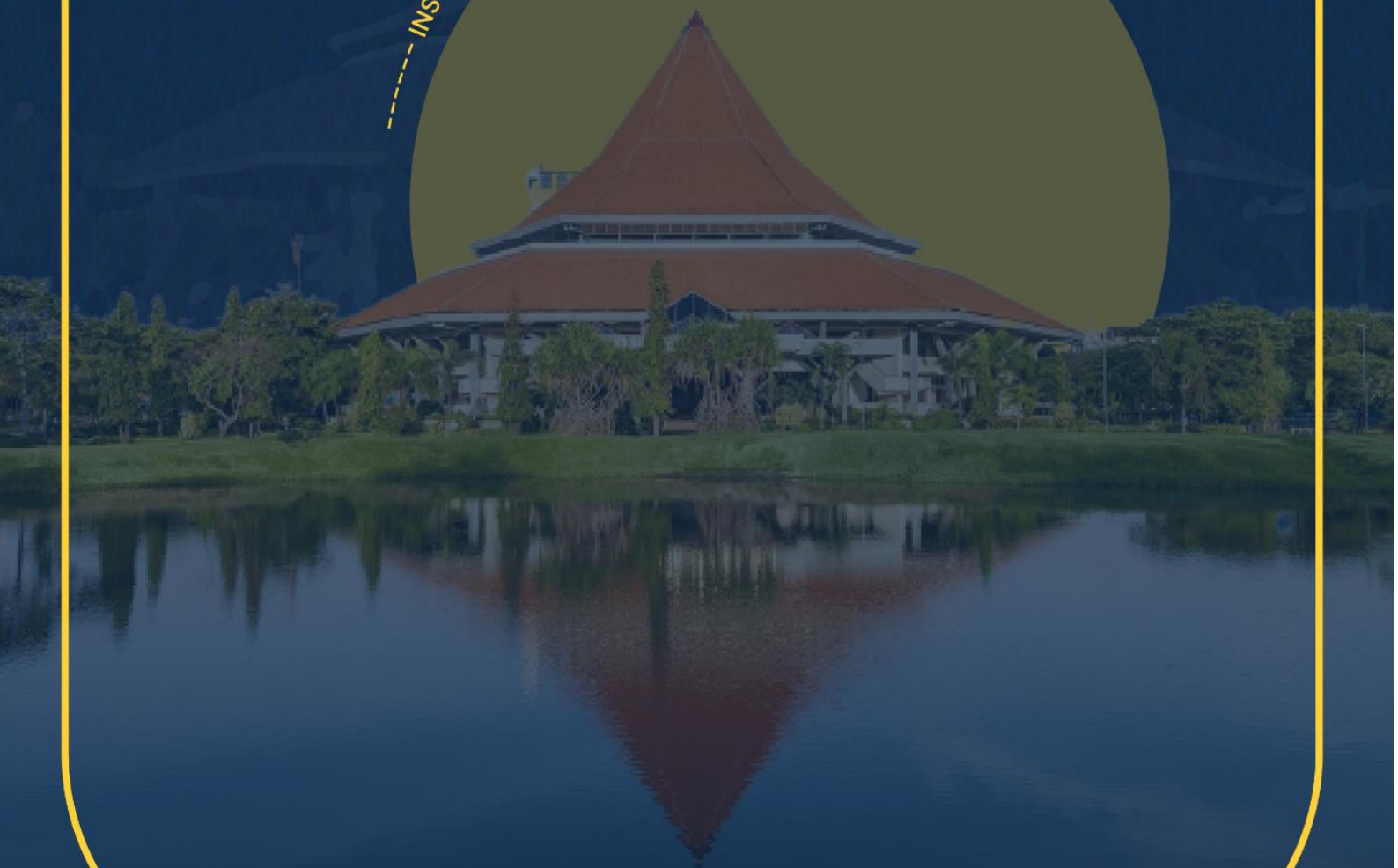


	menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>Ability to conduct laboratory and/or field experiments and to analyze and interpret data to reinforce technical assessments</i>			
CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika <i>Ability to apply modern engineering methods, skills, and tools necessary for practicing mechanical system</i>	√		
CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve engineering problems</i>	√	√	√
CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi <i>Ability to communicate effectively both orally and in writing, and to apply technology-based entrepreneurship</i>	√		√
CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, complete, and evaluate tasks based on the analysis of information and data</i>	√	√	√
CPL-11	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika <i>Ability to take responsibility to society and adhere to professional ethics in solving mechanical system problems</i>	√		√

Penentuan — . Bahan Kajian

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 5





5. Penentuan Bahan Kajian

5.1 *Body of Knowledge (BoK)*

Kajian Program Sarjana Teknik Mesin dibangun di atas kerangka keilmuan yang mencakup dasar-dasar ilmu keteknikan dan pengembangannya melalui pendekatan sistem teknik mesin. Pengetahuan ini diperkuat dengan struktur bahan kajian yang dikembangkan dari enam bidang utama keilmuan berdasarkan laboratorium riset, yaitu: Mekanika Benda Padat, Mekanika Fluida dan Mesin Fluida, Metalurgi, Rekayasa Produksi, Rekayasa Sistem dan Kontrol, Rekayasa Termal dan Energi, serta Rekayasa Vibrasi dan Sistem Otomotif. Setiap bidang ilmu memiliki subtema dan turunan bahan kajian yang menjadi landasan penguasaan kompetensi dan keahlian lulusan teknik mesin. Berikut adalah bidang ilmu utama dan lingkup bahan kajiannya:

The study framework of the Mechanical Engineering Undergraduate Program is built upon a scientific foundation that encompasses the fundamentals of engineering and its development through the mechanical engineering systems approach. This knowledge is reinforced by a structured body of study materials developed from six core scientific fields based on research laboratories, namely: Solid Mechanics, Fluid Mechanics and Fluid Machinery, Metallurgy, Manufacturing Engineering, Systems and Control Engineering, Thermal and Energy Engineering, and Vibration and Automotive Systems Engineering. Each field has its own subthemes and derived study topics, which form the foundation for graduates' competency and expertise in mechanical engineering. The following are the main scientific fields and the scope of their study areas:

5.1.1 Mekanika Benda Padat / *Solid Mechanics*

Bidang mekanika benda padat menjadi fondasi penting dalam analisis perilaku dan kekuatan struktur teknik, mulai dari benda kaku hingga struktur kompleks yang melibatkan deformasi elastis maupun plastis. Keilmuan ini mencakup kajian tentang daya tahan struktur, desain berbasis beban dan lingkungan kerja, serta pendekatan numerik melalui mekanika komputasi. Selain itu, terdapat integrasi dengan pendekatan multidisiplin seperti biomekanika dan struktur pintar (smart



structure), yang merepresentasikan tren teknologi terkini dalam pengembangan sistem mekanik beradaptasi tinggi dan ringan.

The field of solid mechanics serves as a fundamental basis for analyzing the behavior and strength of engineering structures, from rigid bodies to complex structures involving elastic and plastic deformation. This discipline includes studies on structural durability, load- and environment-based design, and numerical approaches through computational mechanics. Additionally, it integrates multidisciplinary approaches such as biomechanics and smart structures, reflecting current technological trends in the development of highly adaptive and lightweight mechanical systems.

5.1.2 Mekanika Fluida & Mesin-Mesin Fluida / *Fluid Mechanics & Fluid Machinery*

Dalam bidang mekanika fluida dan mesin-mesin fluida, kajian difokuskan pada pemahaman aliran fluida dalam berbagai konfigurasi teknik serta penggunaannya dalam mesin-mesin konversi energi fluida seperti pompa, turbin, dan kompresor. Pengetahuan tentang aerodinamika, aliran turbulen, dan aliran multifase menjadi sangat relevan dalam mengkaji kinerja sistem fluida teknik, termasuk dalam aplikasi otomotif dan sistem energi. Pendekatan komputasional (*Computational Fluid Dynamics/CFD*) memainkan peran penting dalam menganalisis perilaku fluida yang kompleks secara efisien dan presisi.

In the field of fluid mechanics and fluid machinery, the focus lies on understanding fluid flow in various engineering configurations and its application in energy conversion machines such as pumps, turbines, and compressors. Knowledge of aerodynamics, turbulent flow, and multiphase flow is highly relevant for evaluating the performance of fluid systems, including automotive and energy applications. Computational Fluid Dynamics (CFD) plays a critical role in efficiently and accurately analyzing complex fluid behavior.

5.1.3 Metalurgi / *Metallurgy*

Bidang metalurgi berfokus pada karakteristik material teknik, baik logam maupun non-logam, dalam hubungannya dengan kekuatan, ketahanan, dan aplikasinya dalam komponen mesin. Keilmuan ini mencakup mekanika patahan, teknik perlakuan panas, serta pengembangan material fungsional seperti penyimpan energi



(material baterai, hidrogen), biomaterial, dan komposit. Pemahaman mikrostruktur dan pemodelan perilaku material menjadi krusial dalam perancangan struktur dan sistem yang tangguh namun efisien.

The metallurgy field focuses on the characteristics of engineering materials, both metals and non-metals, in relation to strength, durability, and application in machine components. This includes fracture mechanics, heat treatment technologies, and the development of functional materials such as energy storage materials (batteries, hydrogen), biomaterials, and composites. Understanding microstructures and modeling material behavior is crucial in designing robust yet efficient structures and systems.

5.1.4 Rekayasa Produksi / Manufacturing Engineering

Pada bidang rekayasa produksi, kajian diarahkan pada proses manufaktur dari tahap perencanaan, pemrosesan, hingga optimasi kinerja produksi. Cakupan keilmuannya meliputi pengendalian getaran pada mesin perkakas, pengembangan strategi optimasi proses pemesinan, dan pendekatan sistemik terhadap perencanaan manufaktur. Topik manufaktur cerdas (smart manufacturing) dan integrasi sistem digital juga mulai menjadi bagian integral dalam pengembangan laboratorium ini untuk menghadapi era Industri 4.0.

In the area of manufacturing engineering, studies are directed toward the manufacturing process from planning, processing, to performance optimization. The scientific scope includes vibration control in machine tools, development of machining process optimization strategies, and systemic approaches to manufacturing planning. Topics such as smart manufacturing and digital system integration are also becoming integral parts of this field in response to the Industry 4.0 era.

5.1.5 Rekayasa Sistem dan Kontrol / Systems and Control Engineering

Bidang rekayasa sistem dan kontrol merupakan jembatan antara model matematika dari sistem teknik dengan implementasi nyata dalam pengendalian dan otomasi. Keilmuan ini mencakup pemodelan sistem dinamik, analisis vibrasi, kontrol sistem mekanik, hingga implementasi sistem kendali berbasis aktuator dan sensor dalam konteks industri. Pengembangan sistem kontrol pada energi terbarukan, kendaraan



listrik, hingga robotika menjadikan bidang ini sangat strategis dalam mendukung transformasi digital dan otomatisasi.

Systems and control engineering bridges the gap between mathematical models of engineering systems and their real-world implementation in control and automation. This discipline encompasses dynamic system modeling, vibration analysis, mechanical system control, and the implementation of actuator- and sensor-based control systems in industrial contexts. Control system development in renewable energy, electric vehicles, and robotics makes this field highly strategic in supporting digital transformation and automation.

5.1.6 Rekayasa Termal dan Sistem Energi / *Thermal Engineering and Energy Systems*

Bidang rekayasa termal dan sistem energi berperan penting dalam pemahaman dan rekayasa sistem konversi energi. Fokus utamanya meliputi perpindahan panas, sistem pembakaran, energi surya, penukar kalor, dan energi terbarukan. Kajian teoritik dipadukan dengan pendekatan numerik dan eksperimental dalam mengevaluasi efisiensi serta kestabilan sistem termal. Kebutuhan terhadap sistem energi yang ramah lingkungan dan berkelanjutan menjadi latar belakang utama dari pengembangan keilmuan ini.

Thermal engineering and energy systems play a crucial role in the understanding and engineering of energy conversion systems. The primary focus includes heat transfer, combustion systems, solar energy, heat exchangers, and renewable energy. Theoretical studies are combined with numerical and experimental approaches to evaluate the efficiency and stability of thermal systems. The need for environmentally friendly and sustainable energy systems is the main driver of the development in this discipline.

5.1.7 Rekayasa Vibrasi dan Sistem Otomotif / *Vibration Engineering and Automotive Systems*

Bidang rekayasa vibrasi dan sistem otomotif memberikan penekanan pada aspek dinamis dari sistem teknik, khususnya yang terkait dengan getaran, keausan, dan kestabilan gerak. Keilmuan ini mencakup teknik peredaman getaran, diagnostik kerusakan berbasis getaran, serta pengembangan sistem kendaraan cerdas dan kendaraan listrik. Kajian terhadap sistem suspensi, stabilitas kendaraan, dan



teknologi otomotif inovatif menjadikan laboratorium ini sebagai penggerak utama dalam pengembangan sistem mobilitas masa depan.

The vibration engineering and automotive systems field emphasizes the dynamic aspects of engineering systems, particularly those related to vibration, wear, and motion stability. This includes vibration damping techniques, vibration-based fault diagnostics, and the development of intelligent and electric vehicle systems. Studies on suspension systems, vehicle stability, and innovative automotive technologies position this lab as a key driver in the advancement of future mobility systems.



5.2 Bahan Kajian (BK)

Study Materials

	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
Matematika	0. Pendahuluan	0.1. Sistem bilangan riil 0.2. Ketidaksamaan dan nilai mutlak 0.3. Sistem koordinat cartesius 0.4. Grafik persamaan 0.5. Fungsi dan grafiknya 0.6. Operasi pada fungsi 0.7. Fungsi trigonometri	Kalkulus 1 Kalkulus 2
	1. Limit	1.1. Pendahuluan limit 1.2. Teorema limit 1.3. Limit fungsi trigonometri 1.4. Limit di tak hingga , limit tak hingga 1.5. Kekontinuan fungsi	
	2. Turunan Derivatif	2.1 Pengertian turunan 2.2. Arti geometris 2.3. Rumus rumus dasar turunan 2.4. Turunan fungsi trigonometri 2.5. Aturan rantai 2.6. Turunan fungsi tingkat tinggi	
		2.7. Turunan fungsi implisit 2.8. Laju yang berkaitan	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	3. Aplikasi Turunan (Aplikasi Derivatif)	3.1. Maksimum dan minimum 3.2. Kemonotonan dan kecekungan 3.3. Ekstrim lokal dan ekstrim di interval terbuka 3.4. Permasalahan praktis (optimasi) 3.5. Penggambaran grafik lanjutan 3.6. Teorema nilai rata rata untuk turunan 3.7. Anti turunan (anti derivatif).	
	4. Integral Tentu	4.1 Pendahuluan luas 4.2. Integral tentu 4.3. Teorema dasar kalkulus pertama 4.4. Teorema dasar kalkulus kedua dan metode substitusi 4.5. Teorema rata rata untuk integral.	
	5. Aplikasi Integral	5.1 Luas daerah 5.2. Volume benda putar 5.3. Panjang kurva dan luas permukaan benda putar 5.4. Usaha dan gaya fluida 5.5. Momen dan pusat massa	
	6. Fungsi Transenden	6.1 Fungsi logaritma natural 6.2. Fungsi inverse dan turunannya	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		6.3. Fungsi eksponensial natural 6.4. Fungsi eksponensial dan logaritma umum 6.5. Fungsi trigonometri inverse dan turunannya 6.6. Fungsi hiperbolik dan inversenya	
	7. Teknik integrasi	7.1 Integral parsial 7.2. Integral fungsi trigonometri 7.3. Substitusi yang merasionalkan 7.4. Integral fungsi rasional	
	8. Bentuk Tak Tentu dan Integral Tak Wajar	8.1. Bentuk tak tentu (Kaidah l'Hôpital) 8.2. Integral tak wajar	
	1. Barisan dan Deret Tak Hingga	1.1. Barisan tak hingga 1.2. Deret tak hingga 1.3. Deret suku positif dan uji kekonvergenannya 1.4. Deret ganti tanda dan uji kekonvergenannya. 1.5. Deret pangkat dan operasinya 1.6. Deret Taylor dan Mc Laurin 1.7. Aproksimasi Taylor untuk fungsi	
	2. Irisan kerucut dan koordinat polar	2.1. Parabola 2.2. Elips dan Hiperbola	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		2.3. Translasi dan Rotasi sumbu koordinat 2.4. Representasi parametrik dari kurva di bidang 2.5. Sistem koordinat polar 2.6. Grafik dari persamaan polar 2.7. Kalkulus dalam koordinat polar	
	3. Turunan dalam Fungsi dua peubah atau lebih	3.1. Definisi fungsi peubah banyak 3.2. Turunan Parsial 3.3. Limit dan kekontinuan 3.4. Keterdiferensialan 3.5. Turunan berarah dan gradien 3.6. Aturan rantai 3.7. Bidang singgung dan aproksimasi permukaan 3.8. Maksimum dan minimum 3.9. Metode pengali Lagrange	
	4. Integral dalam Fungsi dua peubah atau lebih	4.1. Integral lipat dua atas daerah persegi panjang 4.2. Integral lipat dua atas daerah bukan persegi panjang	
		4.3. Integral lipat dua dalam koordinat polar 4.4. Aplikasi integral lipat dua	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		4.5. Luas permukaan 4.6. Integral lipat tiga pada koordinat Kartesian 4.7. Integral lipat tiga pada koordinat silinder dan koordinat bola 4.8. Perubahan variabel peubah) dalam integral lipat	
	Sistim Persamaan Linier	1. Pengenalan konsep aljabar linier dalam bidang keteknikan 2. Pendahuluan Sistim Pers Linier 3. Eliminasi Gauss Jordan 4. Matriks dan operasi Matriks 5. Aljabar Matriks , Matriks balikan 6. Matriks Elementer , cara mencari matriks balikan 7. Jenis jenis matriks	
	Determinan	1. Fungsi Determinan , Definisi 2. Menghitung determinan menggunakan operasi baris. 3. Sifat sifat determinan 4. Ekspansi Kofaktor	
		5. Aturan Cramer	
	Vektor di R^2 dan R^3	1. Definisi vektor di R^2 dan R^3 .	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		2. Aritmetika vektor 3. Hasil kali titik , proyeksi 4. Hasil kali Silang 5. Garis dan bidang di R^2 dan R^3	
	Ruang Vektor Euclid	1. Ruang-n Euclid 2. Transformasi linier dari R^n dan R^m 3. Sifat sifat Transformasi Linier	
	Ruang vektor Umum	1. Ruang vektor umum 2. Subruang 3. Kebebasan Linier	
	Ruang vektor Umum	4. Basis dan Dimensi 5. Ruang Baris, Ruang Kolom dan Ruang Nul 6. Rank dan Nulitas	
	Ruang hasil kali dalam	1. Hasil kali dalam 2. Sudut dan keorthogonalan pada ruang hasil kali dalam 3. Basis Orthogonal, proses Gram Schmidt; Dekomposisi QR (optional) 4. Matriks orthogonal; Perubahan basis	
	Nilai Eigen dan Vektor Eigen	1. Nilai eigen dan vektor eigen	
		2. Diagonalisasi 3. Diagonalisasi secara orthogonal	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Transformasi Linier	1. Transformasi Linier secara umum 2. Kernel dan Range 3. Transformasi Linier Invers 4. Matriks Transformasi 5. Similaritas	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
FISIKA	Fisika Mekanika	1. Satuan, Besaran dan Vektor 2. Gerak Sepanjang Garis Lurus 3. Gerak dalam Dua dan Tiga Dimensi 4. Hukum Gerak Newton 5. Aplikasi Hukum Newton 6. Kerja dan Energi Kinetik 7. Energi Potensial dan Kekekalan Energi 8. Momentum, Impuls dan Tumbukan 9. Rotasi Benda Tegar 10. Dinamika Gerak Rotasi 11. Gerak Periodik 12. Gelombang Mekanik 13. Bunyi	Fisika Mekanika Fisika Listrik dan Magnet
		14. Gravitasi 15. Keseimbangan dan Elastisitas	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Fisika Panas	1. Mekanika Fluida 2. Temperatur, Kalor, Hukum I Termodinamika 3. Gas Ideal dan Teori Kinetik Gas 4. Mesin Kalor, Entropi dan Hukum II Termodinamika	
	Fisika Listrik	1. Muatan Listrik 2. Medan Listrik 3. Hukum Gauss dan Potensial Listrik 4. Kapasitansi dan Dielektrikum 5. Arus Listrik, Resistansi, dan Arus Searah 6. Induksi dan induktansi 7. Arus Bolak-Balik	
	Fisika Magnet	1. Medan Magnet 2. Sumber Medan Magnet 3. Gelombang Elektromagnetik, Sifat Dasar dan Perambatan Cahaya 4. Interferensi dan Difraksi Gelombang Cahaya 5. Optik Geometri	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
KIMIA	Materi dan Pengukuran	1. Studi Ilmu Kimia 2. Klasifikasi Materi 3. Sifat materi 4. Unit Pengukuran 5. Ketidak pastian dalam pengukuran 6. Analisis Dimensional	Kimia
	Atom, Molekul dan Ion	1. Teori atom klasik 2. Penemuan struktur atom 3. Teori atom modern 4. Tabel periodik 5. Molekul dan senyawa molekuler 6. Iono dan senyawa ionik 7. Penamaan senyawa anorganik	
	Stoikiometri	1. Persamaan kimia 2. Reaktivitas reaksi kimia 3. Massa atom dan molekul 4. Konsep mol 5. Senyawa empirik 6. Informasi kuantitatif dari persamaan kimia 7. Reaktan pembatas	
	Reaksi Fasa Air dan Stoikiometri Larutan	1. Sifat umum larutan dengan pelarut air 2. Reaksi pengendapan	
		3. Reaksi asam basa	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		4. Reaksi oksidasi reduksi 5. Konsentrasi larutan 6. Stoikiometri larutan dan analisis kimia	
	Termokimia	1. Energi kinetik dan panas 2. Hukum I Termodinamika 3. Entalpi dan entalpi reaksi 4. Kalorimeter 5. Hukum Hess 6. Entalpi pembentukan 7. Makanan dan bahan bakar 8. Entropi dan Energi Gibbs	
	Kesetimbangan Kimia	1. Konsep kesetimbangan dan tetapan kesetimbangan 2. Kesetimbangan heterogen 3. Penggunaan tetapan kesetimbangan 4. Faktor-faktor yang mempengaruhi kesetimbangan	
	Kesetimbangan Asam Basa	1. Teori asam basa Bronsted-Lowry 2. Kekuatan larutan asam atau larutan basa 3. Disosiasi asam basa 4. Pasangan asam basa konjugasi 5. pH asam basa	
		6. Teori asam basa Lewis	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Elektrokimia	1. Sel Galvanik 2. Potensial sel standar Persamaan Nearst 3. Potensial reduksi standar 4. Hubungan potensial sel standar dan tetapan kesetimbangan, perubahan energi bebas Gibbs dan pH 5. Aplikasi Sel Galvanik 6. Sel elektrolisa dan aplikasinya	
	Kinetika Kimia	1. Kecepatan Reaksi 2. Tetapan dan order reaksi 3. Penentuan order reaksi secara eksperimen 4. Penyelesaian analitik persamaan reaksi order 1 dan order 2 5. Waktu paruh reaksi order 1 dan order 2	
	Aplikasi kimia	1. Aplikasi kimia	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Statistik / Statistika & Probabilitas	Pengantar Statistik untuk Kajian Teknik	1. Peranan statistik dan penerapannya di bidang teknik 2. Metode pemecahan masalah secara statistic	Statistik & Perencanaan Eksperimen
	Statistik Deskriptif	1. Pengumpulan data, pengorganisasian data, distribusifrekuensi, presentasi grafik	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		2. Ukuran pemusatan (central tendency), ukuran penyebaran (dispersion), moments, skewness, kurtosis, data kualitatif	
	Teori Probabilitas	1. Konsep dasar dan definisi, probabilitas 2. Kombinasi peristiwa, variabel acak	
	Distribusi Probabilitas	1. Model matematik distribusi 2. Probabilitas kontinyu dan diskrit 3. Fungsi kepadatan probabilitas (PDF) 4. Distribusi binomial, distribusi Poisson, distribusi normal (gaussian), distribusi chi square	
	Sampling	1. Kegunaan dan keuntungan sampling, 2. Distribusi sampling dari nilai rata-rata, 3. Distribusi sampling prosentase	
	Estimasi	1. Definisi dan konsep dasar, 2. Estimasi interval, 3. Mengestimasi nilai rata-rata populasi, 4. Mengestimasi prosentasi populasi, 5. Mengestimasi varians populasi, 6. Menentukan ukuran sampel untuk mengestimasi	
	Uji hipotesis	1. Prosedur umum uji hipotesis, 2. Uji hipotesis 1 sampel pada nilai rata-rata,	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		3. Uji hipotesis 1 sampel pada varians 4. Uji hipotesis 2 sampel pada varians, 5. Uji hipotesis 2 sampel pada nilai rata-rata, 6. Uji hipotesis 2 sampel pada prosentase 7. Tujuan dan prosedur ANOVA, contoh ANOVA, tabel ANOVA	
	Regresi	1. Konsep-konsep dasar analisis regresi linear sederhana, 2. Uji relasi dan interval prediksi pada analisis regresi linear	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Bahan/Material Teknik	Pendahuluan	1. Klasifikasi material 2. Klasifikasi sifat material (Sifat mekanik, Sifat fisis, Sifat kimia, Sifat termal, sifat optik, sifat magnetik) 3. Keterkaitan sifat material dengan desain/perancangan dan produksi 4. Perkembangan material terkini dan aplikasinya (nano material, material sensor, material magnet dll)	Metalurgi 1 Metalurgi 2 Mata Kuliah Pilihan Prodi
	Struktur Kristal	1. Struktur Atom 2. Struktur Kristal: SC, BCC, FCC, HCP	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		3. Hitungan-hitungan yang berkaitan dengan struktur kristal 4. Cacat Kristal	
	Karakterisasi Material	1. Uji tarik 2. Uji kekerasan 3. Uji bending 4. Uji impact 5. Uji puntir 6. Metalografi	
	Diagram Fasa	1. Diagram fasa isomorphus 2. Diagram fasa eutektik 3. Hitungan-hitungan yang berkaitan dengan diagram fasa	
	Material Logam Ferro	1. Klasifikasi material logam ferro 2. Iron making 3. Steel making 4. Baja Karbon dan Baja Paduan 5. Besi Cor 6. Struktur kristal logam fero 7. Diagram Fasa Fe-C 8. Heat treatment pada baja	
		9. Sifat mekanik logam fero 10. Standarisasi material baja	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Mekanisme penguatan logam	1. Penguatan batas butir 2. Larutan padat 3. Pengerasan regangan 4. Penguatan presipitasi	
	Material Non Logam Ferro	1. Aluminium dan paduannya 2. Tembaga dan paduannya 3. Magnesium dan paduannya 4. Nikel dan paduannya 5. Titanium dan paduannya	
	Keramik	Keramik	
	Polimer	Polimer	
	Komposit	Komposit	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Mekanika dan kekuatan Material/Statika Struktur	1. Konsep partikel dan benda tegar 2. Keseimbangan statik untuk partikel dan benda tegar	Konsep partikel dan benda tegar Keseimbangan statik untuk partikel (Hukum Newton 1 untuk partikel)	Mekanika Kekuatan Material Fisika Klasik
		Keseimbangan statik pada benda tegar (Hukum Newton 1 untuk benda tegar) Reaksi2 tumpuan Resultan sistem gaya	
	3. Klasifikasi struktur mekanika	Analisis struktur: klasifikasi dan bedanya Analisis rangka (truss)	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	4. Analisis struktur: truss, beam, frame dan mechanism (machine)	Analisis frame dan mechanism (machine)	
		Analisis balok (beam) Diagram gaya internal: diagram normal, geser, dan momen Analisis gaya eksternal (gaya gesek, gaya normal)	
	5. Konsep beban - tegangan, perpindahan - regangan 6. Analisis tegangan akibat beban tunggal	Sifat mekanik material Hubungan beban-tegangan, perpindahan-regangan Hukum Hooke	
		Klasifikasi tegangan: tunggal-kombinasi, statik-fluktuasi Analisis tegangan akibat beban aksial dan termal	
		Analisis tegangan akibat beban torsi Analisis tegangan akibat beban bending murni	
		Analisis tegangan (normal dan geser) akibat beban lintang Teori kegagalan statik (akibat beban tunggal) Angka keamanan	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	7. Analisis tegangan akibat beban kombinasi 8. Transformasi tegangan 9. Tegangan-tegangan ekstrem	Analisis tegangan akibat beban kombinasi Transformasi tegangan 2D: analitis dan grafis (Mohr) Plane stress-plane strain	
		Transformasi tegangan 3D: analitis dan grafis State of stress	
		Tegangan2 ekstrem (prinsipal, max shear dan von Mises) Angka keamanan - Implementasi desain	
	10. Defleksi pada balok	Defleksi balok tertentu: Integrasi ganda, diskontinyu, moment area Defleksi pada poros akibat putaran kritis	
		Defleksi balok tak tentu: Integrasi ganda, diskontinyu, moment area	
	11. Buckling pada kolom (balok vertikal)	Buckling kolom panjang - konsentrik, eksentrik Buckling kolom pendek	
	12. Metode energi regangan untuk analisis defleksi struktur	Metode energi regangan utk defleksi struktur Metode Castigliano utk defleksi struktur	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Kinematika - Dinamika	1. Kinematika partikel dan benda tegar 2. Kinetika partikel dan benda tegar	Kinematika partikel dan benda tegar: perpindahan, kecepatan dan percepatan - Gerak partikel: lurus dan lengkung - Gerak benda tegar: translasi, rotasi, gerak umum.	Kinematika dan Dinamika Teknik Dinamika Pemesinan
	3. Konsep kerja dan energi pada gerak partikel dan benda tegar 4. Konsep kekekalan energi pada gerak benda tegar	Kinetika partikel dan benda tegar (Prinsip Newton untuk partikel dan benda tegar) - Gerak rectilinear, curvilinear dan dependen - Gerak translasi, rotasi dan umum	
		Prinsip kerja dan energi untuk partikel: - Kerja oleh gaya luar, gaya berat, gaya pegas dan gaya gesek - Energi kinetik dan potensial - Konsep gaya konservatif dan non konservatif Prinsip kerja dan energi pada benda tegar: - Kerja oleh momen kopel	
		- Energi kinetik pada gerak translasi, gerak rotasi dan gerak general Hukum Konservasi Energi:	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		- Konsep kekekalan energi pada gerak benda tegar	
	5. Konsep impuls dan momentum pada partikel dan benda tegar	Impuls momentum partikel: - Prinsip impuls dan momentum untuk gerak translasi dan rotasi - Tumbukan partikel segaris (central impact) - Tumbukan partikel membentuk sudut (oblique impact) Impuls momentum pada benda tegar: - Linear dan angular momentum - Prinsip impuls dan momentum untuk gerak translasi, rotasi, dan umum - Konservasi momentum	
	6. Balancing (implementasi kinetika partikel)	Balancing: Menyeimbangkan massa yang berputar, kasus satu bidang dan multi bidang	
	7. Kinematika mekanisme sederhana:	Mobilitas dan diagram kinematik	
	slider-crank dan four-bar linkage		
		Analisis posisi dan perpindahan: metode grafis - analitis	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		- Mekanisme slider-crank - Mekanisme four-bar linkage	
		Analisis kecepatan: kecepatan relatif - sesaat, metode grafis - analitis - Mekanisme slider-crank - Mekanisme four-bar linkage	
		Analisis percepatan: percepatan relatif - sesaat, metode grafis - analitis - Mekanisme slider-crank - Mekanisme four-bar linkage Analisis percepatan Coriolis	
	8. Kinetika mekanisme sederhana: slider-crank dan four-bar linkage	Kinetika mekanisme slider crank	
		Kinetika mekanisme fourbar linkage	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Getaran Mekanik	1. Fundamental getaran 2. Getaran bebas 1 dof	1. Pentingnya kajian getaran 2. Konsep dasar getaran 3. Klasifikasi Getaran 4. Prosedur analisis Getaran	Mekanika Getaran
		5. Elemen pegas, inersia dan redaman 6. Gerak Harmonik	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		7. Getaran bebas tak teredam translasi dan torsional 8. Metode Rayleigh Energi dan Lagrange 9. Getaran bebas teredam viskos 10. Getaran bebas teredam Coulomb	
	3. Respon getaran bebas 4. Respon getaran paksa (akibat gaya harmonik dan tidak harmonik)	1. Respon getaran bebas tanpa redaman 2. Respon getaran bebas dengan redaman kurang, redaman kritis, dan redaman lebih 3. Respon getaran paksa akibat gaya harmonik 4. Respon getaran paksa akibat gaya tidak harmonik	
	5. Pengukuran Getaran 6. Whirling Shaft	1. Metode pengukuran getaran 2. Accelerometer (prinsip kerja, karakteristik) 3. Pengenalan pengolahan sinyal getaran 4. Alat eksitasi getaran 5. Critical speed 6. Poros melendut	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Termodinamika		1.1. Review: Property (massa, temperature, tekanan dsb)	Termodinamika I



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Bab 1. Pendahuluan	<u>1.2. Definisi sistem (sistem tertutup dan sistem terbuka)</u> <u>1.3. Macam-macam energi</u> <u>1.4. Keadaan dan kesetimbangan</u> 1.5. Proses dan siklus dengan contoh aplikasi 1.6. Termodinamika, energi dan lingkungan 1.7. Hukum ke 0 Termodinamika 1.8. Metodologi penyelesaian problem termodinamika	Termodinamika II
	Bab 2. Sifat-sifat zat murni	2.1. Zat murni 2.2. Proses perubahan fasa zat murni <u>2.3. Diagram properti untuk proses perubahan fasa</u> 2.4. Tabel uap 2.5. Persamaan gas ideal dan persamaan keadaan lainnya 2.6. Faktor kompresibilitas	
	Bab 3. Energi dan hukum pertama termodinamika	3.1. Konversi energi (fokus pada energi mekanis dan termal) dan contoh-contoh <u>3.2. Transfer energi termal (heat)</u>	
		<u>3.3. Transfer energi mekanik (work)</u> 3.4. Hukum pertama termodinamika	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		3.5. Efisiensi konversi energi	
		4.1. Prinsip kesetimbangan energi untuk sistem tertutup	
	Bab 4. Hukum pertama Termodinamika untuk sistem tertutup	<u>4.2. Kalor spesifik gas ideal untuk liquid dan solid</u> <u>4.3. Internal energy</u> 4.4. Interaksi kerja dan kalor (konduksi, konveksi dan radiasi) 4.5. Proses-proses termodinamika	
	Bab 5. Hukum pertama Termodinamika untuk sistem terbuka	5.1. Kekekalan massa, pengertian batas sistem dan volume atur <u>5.2. Kerja aliran dan entalpi</u> <u>5.3. Hukum kekekalan energi</u> 5.4. Peralatan dan penerapan hukum pertama termodinamika pada kondisi steady <u>5.4.1. Nozzle dan diffuser</u> <u>5.4.2. Turbin dan kompresor/pompa</u> 5.4.3. Throttling valve 5.4.4. Mixing chamber	
		5.4.5. Heat exchanger 5.5. Aliran kondisi transient	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Bab 6 Hukum kedua termodinamika	6.1. Reservoir energi termal 6.2. Heat engine 6.3. Refrigerator dan pompa kalor <u>6.4. Proses reversible dan irreversible</u> 6.5. Siklus Carnot 6.5.1 Heat engine 6.5.2 Refrigerator dan pompa kalor 6.6. Skala temperature termodinamika	
	Bab 7 Entropi	7.1. Pengertian entropi 7.2. Prinsip peningkatan entropi 7.3. Pengertian perubahan entropi 7.4. Proses-proses isentropic <u>7.5. Diagram-diagram hubungan entropi</u> 7.6. Persamaan T-ds 7.7. Efisiensi isentropic 7.8. Kestimbangan entropi 7.9. Entropi generation	
	Bab 8 Exergy	8.1. Definisi exergy 8.2. Kerja reversible dan irreversible <u>8.3. Efisiensi hukum kedua termodinamika</u>	
		8.4. Perubahan exergy sebagai akibat perpindahan kerja, kalor dan massa	
		<u>9.1. Pertimbangan dasar</u>	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Bab 9. Siklus Daya Gas	<u>9.2. Siklus Otto dan Motor Bensin</u> <u>9.3. Siklus Diesel dan Motor Diesel</u> 9.4. Siklus Dual 9.5. Siklus Stirling dan Ericsson 9.6. Siklus Brayton dan PLTG	
	Bab 10 Siklus daya uap dan gabungan	10.1. Pengenalan siklus daya uap, siklus uap Carnot <u>10.2. Siklus Rankine Ideal</u> 10.3. Penyimpangan /deviasi kondisi actual dari kondisi ideal 10.4. Upaya meningkatkan efisiensi termal <u>10.4.1. Reheating</u> <u>10.4.2. Regeneratif</u> 10.4.3. Pengendalian temperatur kondensor 10.5. Kogenerasi 10.6. Siklus gabungan gas dan uap	
		11.1. Pengenalan siklus refrijerasi dan pompa kalor	
	Bab 11. Siklus Refrijerasi dan Pompa Kalor	11.2. Siklus Carnot terbalik (reversed Carnot cycle) <u>11.3. Siklus refrijerasi kompresi uap</u>	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		<u>11.3.1 Siklus ideal</u> 11.3.2. Siklus aktual 11.4. Sistem pompa kalor 11.5. Sistem refrigerasi absorpsi	
	Bab 12. Campuran tak bereaksi	12.1. Komposisi campuran udara (udara kering dan udara lembab) 12.2. Kelembaban spesifik dan kelembaban relative udara 12.3. Temperatur pengembunan 12.4. Temperatur bola basah dan temperature adiabatik jenuh <u>12.5. Kurva psikrometrik</u> 12.6. Tingkat kenyamanan dan pengkondisian udara 12.7. Proses pengkondisian udara	
		<u>13.1. Bahan bakar dan pembakaran</u> 13.2. Proses pembakaran teoritis dan aktual 13.3. Entalpi pembentukan dan entalpi pembakaran	
	Bab 13. Campuran bereaksi/reaksi kimia	13.4. Analisis hukum pertama termodinamika pada sistem bereaksi <u>13.5. Temperatur nyala adiabatika</u> 13.6. Perubahan entropi pada sistem bereaksi	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		13.7. Analisis hukum kedua termodinamika pada sistem bereaksi	
	Bab 14. Aliran kompresibel kecepatan tinggi	14.1. Sifat-sifat fluida pada kondisi stagnan 14.2. Kecepatan suara dan bilangan Mach <u>14.3. Aliran isentropic satu dimensi</u> <u>14.3.1. Nozzle</u> 14.3.2. Diffuser 14.4. Gelombang kejut 14.5. Implementasi pada pesawat jet	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Mekanika Fluida	Konsep Dasar Mekanika Fluida dan Karakteristik Fluida	1. Konsep Kontinum dan Konsep Dasar Mekanika Fluida 2. Karakteristik/Sifat-sifat Fluida 3. Fluida Newtonian dan Non-Newtonian 4. Tegangan Geser dan Kekuatan Geser, Gradien kecepatan, Lapisan Geser, Karakteristik Deformasi	Mekanika Fluida Dasar I Mekanika Fluida Dasar II
		5. Sistem Dimensi dan Satuan 6. Kerapatan (Densitas), Volume Jenis, Berat Jenis dan Viskositas Fluida	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Statika Fluida	7. Tekanan Penguapan dan Tegangan Permukaan Fluida	
		1. Konsep Dasar Statika Fluida 2. Persamaan Dasar Statika Fluida 3. Skala dan Satuan 4. Pengukuran Tekanan 5. Gaya – gaya pada bidang lengkung, Stabilitas benda terapung dan terendam 6. Gaya-gaya Keseimbangan Relatif pada bidang datar 7. Gaya Apung	
		1. Konsep Dasar Dinamika Fluida 2. Persamaan Dasar Dinamika Fluida 3. Kinematika Fluida tentang garis arus dan pipa arus, percepatan dan debit aliran, aliran steady dan unsteady, kordinat streamline 4. Persamaan Kontinuitas 5. Tekanan Stagnasi 6. Tekanan Dinamis	
	Dinamika Fluida	7. Analisis Diferensial Aliran Fluida 8. Konservasi Massa dan Konservasi Momentum Linier	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		9. Sistem dan Volume Atur, Hukum Dasar Sistem 10. Penurunan dan Penerapan Persamaan Volume Atur	
	Konsep dan Hukum-hukum Dasar Aliran Fluida	1. Klasifikasi dan Jenis Aliran Fluida 3. Persamaan Bernoulli 4. Persamaan Cauchy 5. Persamaan Navier Stokes 6. Teorema Reynolds 7. Persamaan Energi	
	Analisis Dimensional dan Kekerupaan	1. Teorema pi-Buckingham 2. Parameter Tuna Dimensi 3. Kekerupaan Geometris (Geometric Similarity) 4. Kekerupaan Kinematis (Kinematic Similarity) 5. Kekerupaan Dinamis (Dynamic Similarity) 6. Studi model: terowongan angin, aliran dalam pipa, dan mesin hidrolik	
	Aliran fluida viskos dalam saluran (Aliran Internal)	1. Aliran Laminar, Transisi, dan Turbulent 2. Distribusi kecepatan 3. Fenomena transport	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		4. Aliran Laminar Berkembang Penuh 5. Aliran Fluida dalam Pipa 6. Diagram Moody 7. Kerugian Minor 8. Kerugian Mayor	
	Aliran Eksternal	1. Karakteristik Aliran Fluida 2. Aliran Laminar Berkembang Penuh 3. Ketebalan Lapisan Batas (Boundary Layer)	
	Aliran Kompresibel	1. Aliran Kompresibel dalam Pipa 2. Hukum Gas Ideal 3. Kecepatan suara dan bilangan Mach 4. Aliran Subsonic, Sonic dan Supersonic 5. Aliran Transonic dan Hypersonic 6. Alat Ukur Aliran Fluida pada fluida yang mengalir 7. Pengukuran Tekanan Fluida 8. Pengukuran Kecepatan Fluida 9. Orifice	
		10. Venturi meter 11. Pengukuran Kekentalan Fluida 12. Aliran Isentropik dan Non-isentropik	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Perpindahan Kalor dan Massa	I. Konsep perpindahan kalor	I.1 Mode perpindahan panas I.2 Keterkaitannya dgn Hukum Termodinamika I.3 Satuan dan besaran I.4 Metode analisis problem perpindahan panas I.5 Relevansi perpindahan panas	Perpindahan Panas
	II. Dasar-dasar konduksi	II.1 Persamaan laju konduksi II.2 Sifat-sifat termal material II.3 Persamaan difusi panas II.4 Kondisi batas dan mula	
	III. Konduksi 1-D tunak	III.1 Konduksi tanpa pembangkit panas pada dinding datar, silinder, dan bola III.2 Konduksi dengan pembangkit panas pada dinding datar III.3 Perpindahan panas pada fin/sirip	
	IV. Konduksi 2-D tunak	IV.1 Metode pemisahan variabel IV.2 Faktor bentuk konduksi dan laju konduksi non dimensional IV.3 Metode beda hingga (FDM)	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		IV.4 Metode grafis	
	V. Konduksi transien	V.1 Lumped capacitance method V.2 Konduksi transien pada dinding datar V.3 Konduksi transien pada sistem radial V.4 Konduksi transien pada solidus semi-infinite V.5 Permukaan temperatur konstan V.6 Permukaan fluks panas konstan V.7 Pemanasan periodik V.8 Metode beda hingga pada konduksi transien	
	VI. Radiasi termal: Proses dan sifat-sifat	VI.1 Konsep dasar radiasi termal VI.2 Fluks panas radiasi VI.3 Intensitas radiasi VI.4 Radiasi black body VI.5 Emisi permukaan riil VI.6 Absorpsi-refleksi-transmisi VI.7 Hukum Kirchhoff	
		VI.8 Permukaan abu-abu VI.9 Radiasi lingkungan	
	VII. Pertukaran radiasi antar permukaan	VII.1 Faktor bentuk VII.2 Pertukaran radiasi antar black body	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		VII.3 Pertukaraan radiasi antar permukaan opaque, diffuse, abu-abu dalam suatu permukaan tertutup VII.4 Multimode heat transfer VII.5 Pertukaran radiasi dengan keterlibatan media	
	VIII. Perpindahan massa secara difusi	VIII.1 Mekanisme fisik dan persamaan laju difusi VIII.2 Perpindahan massa dalam media tidak stasioner VIII.3 Pendekatan media stasioner VIII.4 Konservasi species untuk media stasioner VIII.5 Kondisi batas dan Konsentrasi diskontinu pada interface VIII.6 Difusi massa dengan reaksi kimia yang homogen VIII.7 Difusi transien	
	I. Dasar-dasar konveksi	I.1 Mekanisme konveksi I.2 Lapis batas kecepatan dan termal I.3 Koefisien konveksi I.4 Aliran laminar dan turbulen	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		I.5 Persamaan lapis batas dan Similaritas I.6 Parameter tak berdimensi I.7 Analogi lapis batas	
	II. Konveksi paksa aliran eksternal	II.1 Rumus koefisien konveksi secara empiris II.2 Konveksi pada plat datar II.3 Konveksi pada silinder aliran melintang II.4 Konveksi pada permukaan bola II.5 Konveksi pada bundled tube aliran melintang II.6 Impinging Jets II.7 Package beds	
	III. Konveksi paksa aliran internal	III.1 Pertimbangan hidrodinamik III.2 Pertimbangan termal III.3 Keseimbangan energi III.4 Konveksi paksa pada circular tubes III.5 Konveksi paksa pada non-circular tubes and annulus III.6 Konveksi paksa pada small channel	
		III.7 Peningkatan perpindahan panas III.8 Pertukaran massa konveksi	
	IV. Konveksi bebas	IV.1 Konveksi bebas pada plat vertikal, horizontal, dan miring	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		IV.2 Konveksi bebas pada plat paralel vertikal dan horizontal IV.3 Konveksi bebas pada permukaan tertutup IV.4 Kombinasi konveksi bebas dan paksa IV.5 Perpindahan massa konveksi	
	V. Pendidihan dan Pengembunan	V.1 Parameter tak berdimensi V.2 Pendidihan kolam V.3 Korelasi pendidihan kolam V.4 Pendidihan konveksi paksa V.5 Mekanisme kondensasi V.6 Kondensasi film pada plat vertikal dan sistem radial V.7 Kondensasi pada pipa horizontal V.8 Dropwise condensation	
	VI. Penukar Kalor	VI.1 Tipe-tipe penukar kalor VI.2 Metode Logaritmic Mean Temperature Difference (LMTD) VI.3 Metode Effectiveness-NTU	
		VI.4 Perhitungan desain dan performa Penukar kalor	
Praktikum	I. Praktikum Konduksi	I.1 Pengukuran konduktivitas termal material padat dengan Thermal	Perpindahan Panas



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
Perpindahan Kalor dan Massa		Conductivity Measuring Apparatus.	
	II. Praktikum Konveksi	II.1 Percobaan tentang proses atau sifat perpindahan kalor secara konveksi antara air panas dengan udara. II.2 Percobaan untuk menentukan bilangan Reynolds, bilangan Nusselt, dan koefisien perpindahan kalor konveksi lokal. II.3 Percobaan untuk mengetahui penyimpangan persamaan-persamaan perpindahan kalor konveksi secara empiris terhadap hasil percobaan (eksperimental)	
	III. Praktikum Radiasi	III.1 Percobaan untuk mempelajari hukum Stefan Boltzmann, hukum Kirchoff dan hukum Planck. III.2 Percobaan untuk mempelajari perpindahan kalor radiasi antara permukaan yang dipisahkan oleh medium semi transparan.	
		III.3 Percobaan menentukan faktor bentuk antara dua permukaan dan menentukan emisivitas permukaan.	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	IV. Praktikum Perpindahan Kalor pada Recirculating AC	IV.1 Mengamati dan mempelajari secara langsung salah satu contoh proses perpindahan kalor pada Peralatan recirculating AC.	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Pengukuran Teknik/ Metrologi	Pendahuluan Karakteristik pengukuran Jenis-jenis pengukuran Pengolahan data pengukuran	1. Konsep sistem pengukuran, satuan besaran, standard, kalibrasi. 2. Karakteristik statik & dinamik instrument pengukuran (akurasi, presisi, sensitivitas, linearitas, error dan respons frekuensi) 3. Sistem sensor dan transduser. 4. Pengukuran dimensi. 5. Pengukuran perpindahan, regangan, gaya, torsi, kecepatan dan percepatan. 6. Pengukuran temperatur, aliran fluida dan tekanan. 7. Pengolahan dan penyajian data pengukuran.	INSTRUMENTASI, PENGUKURAN & METROLOGI
	Metrologi Industri	8. Klasifikasi alat dan cara pengukuran geometrik 9. Pengukuran linier, sudut, kerataan 10. Metrologi ulir, metrologi roda gigi	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		11. Pengukuran kebulatan dan kesalahan bentuk 12. Diagram kontrol kualitatif 13. Diagram kontrol kuantitatif 14. Teknik sampling	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Teknik Tenaga Listrik	1. Konsep-konsep dasar mengenai Teknik tenaga listrik	1.1 Konsep-Konsep Dasar dari Arus dan Tegangan "1.2 Sejarah Perkembangan Pembangkitan Tenaga Listrik dan Dasar- ""Dasar Fisika dari Pembangkitan Tenaga Listrik "" 1.3 Elemen-Element dan Model Ideal Sirkuit 1.4 Sirkuit DC termasuk Hukum Ohm, Kirchoff, Single Loop Circuits 1.5 Analisis Nodal, Loop and Mesh 1.6 Teori-Teori Thevenin dan Norton	Mekatronika
	2. Komponen sistem daya untuk analisis sistem tenaga listrik	<u>2.1. Analisis Transien, Kapasitor dan Induktor</u>	
		2.2 Analisis AC Steady State termasuk Fungsi Sinusoidal 2.3 Dioda-Dioda Semikonduktor dan Dioda Zener	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		2.4 Pendekatan Linier dan Analisis Signal	
	3. Konsep kontrol frekuensi dan daya, daya reaktif dan voltase, metode power flow, dan metode stabilitas di dalam sistem tenaga	3.1 Pembangkitan Tenaga Listrik 3.2 Konversi Energi Elektris-Mekanis 3.3 Transformator Fasa Tunggal dan Tiga Fasa 3.4 Pembangkitan untuk Tiga Fasa.	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Gambar Mesin	Pengantar Proyeksi, sketsa, gambar potongan Pengertian dimensi dan toleransi	• Pengantar Gambar • Alat gambar • Sintesa geometri • Macam-macam garis • Proyeksi (isometri, Amerika, Eropa) • Gambar sketsa • Pandangan bantu dan gambar potongan • Pemberian ukuran dan toleransi	Menggambar Mesin
	Simbol pengerjaan	• Simbol pengerjaan dan kekasaran permukaan • Simbol pengelasan: simbol dasar, jenis las, simbol pelengkap, ukuran lasan	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Penyederhanaan gambar Gambar susunan dan bentuk rincian	• Penyederhanaan gambar elemen mesin: ulir, pegas, roda gigi, dan bantalan • Lambang (untuk P&ID) • Gambar susunan, bentuk rincian • Pengantar Computer Aided Drafting • Tugas gambar	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Proses Manufaktur	Pendahuluan Proses Manufaktur dan Pemilihan Material	Proses Manufaktur & Sistem Produksi;	Proses Manufaktur I
	Teori dan Metode Proses Casting (Pengecoran Logam)	1. Pengecoran pasir 2. Pengecoran investment 3. Pengecoran dengan permanen mold 4. Material coran dan parameternya	Proses Manufaktur II
	Teori dan Metode Proses Pembentukan Bulk	1. Rolling 2. Forging	
		3. Drawing 4. Extrusion 5. Material dan parameternya	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Teori dan Metode Proses Pembentukan Material Lembaran (Metal Forming);	1. Blanking 2. Punching 3. Stamping 4. Deep drawing 5. Stretching 6. Material dan parameternya	
	Teori dan Metode Proses Metalurgi Serbuk (Powder Metalurgy);	1. Powder metalurgy 2. Powder injection molding 3. Powder material 4. Processing Parameter	
	Teori dan Metode Proses Pemesinan/Pemotongan Material	1. Miling 2. Turning 3. Drilling 4. Boring	
	Teori dan Metode Proses Peningkatan Kualitas Permukaan Produk	1. Grinding 2. Polishing	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Teori dan Metode Proses Penyambungan	1. Fusion Welding 2. Solid state Welding 3. Material dan Parameter	
	Teori dan Metode Proses Pengembangan Prototipe (Prototyping);	1. Teknik rapid prototyping 2. FDM 3. STL 4. SLS 5. LOM 6. Material dalam rapid prototyping	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Elemen Mesin	Konsep Dasar Perancangan	1. Pengenalan Design Thinking 2. Diagram Alir Proses Desain 3. Kriteria Desain 4. Desain berbasis Constraint	Elemen Mesin I Elemen Mesin II
		5. Design for X (DFM, DFA, DFD, DFE, DFC, dsb) 6. Pengenalan Komponen Standar 7. Prototyping	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Perhitungan Kekuatan dan Beban	1. Konsep dan Prinsip Dasar Perancangan Elemen 2. Analisis Beban 3. Analisis Tegangan pada Elemen Mesin 4. Penggunaan Diagram Tegangan-Regangan dalam Perancangan 5. Safety Factor 6. Teori Kegagalan	
	Sambungan	• <u>Klasifikasi Sambungan</u> • <u>Sambungan Tetap (Keling, Baut, Las)</u> • <u>Sambungan Bergerak</u> • Bantalan (gelinding, luncur) • Pegas	
	Transmisi Daya Mekanis	• <u>Jenis-Jenis Transmisi Daya</u> • <u>Speed Ratio</u> • Perancangan Poros • Sabuk, rantai, power screw • Sistem Rem	
		• Kopling tetap (coupling) dan gesek kopling (clutch) • Gears (system, geometri, roda gigi lurus, miring, kerucut, dll.)	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		• Sambungan poros: pasak, pin, spline, shrink fit • Pelumasan	
	Standard & Code	• <u>Pengenalan Standard & Code</u> • Pemilihan Elemen Mesin berbasis Katalog Industri	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Mesin Konversi Energi	1. Memahami profil energi	<u>1. Sumber energi</u> 2. Cadangan energi <u>3. Kebutuhan energi dunia dan nasional</u>	Mesin Konversi Energi
	2. Memahami energi dan konsep dasar sistem konversi energi	1. Jenis dan klasifikasi energi 2. Hukum dan persamaan dalam konversi energi 3. Sumber daya dan klasifikasi mesin konversi energi 4. Bahan bakar dalam konversi energi 5. Energi terbarukan dan tidak terbarukan 6. Energi terbarukan dan tidak terbarukan	
	3. Kalkulasi mesin konversi energi	1. Klasifikasi motor pembakaran 2. Perhitungan Unjuk Kerja Motor Pembakaran Dalam	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		3. Pembangkit Tenaga Uap 4. Mesin-Mesin Fluida 5. Klasifikasi Mesin Pendingin 6. Siklus Termodinamika Mesin Pendingin	
	4. Aplikasi sistem konversi energi	1. Teknik Konservasi Energi pada Kendaraan 2. Teknik Konservasi Energi pada Industri 3. Teknik Konservasi Energi pada Gedung	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Sistem Kendali/Kontrol	Pengantar pengendalian sistem	<u>a. Pengantar</u> b. Contoh dan studi kasus	Sistem Dinamik dan Pengendalian
	Pemodelan di frequency domain	<u>a. Transformasi Laplace</u> <u>b. Transformasi Laplace balik</u> c. Penyelesaian Sistem Persamaan Diferensial Biasa Linier (masalah nilai awal) d. Pemodelan Matematika	
	Pemodelan di time domain dan time response	<u>a. State-space representation</u> <u>b. Analisis Respon Transien: first order dan second order</u>	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		c. Aksi Kendali: Kontroler PID, Kontroler Elektronik, Kontroler Pneumatik dan Kontroler Hidrolik	
	Analisis sistem kendali dengan software	a. Praktikum dengan alat bantu software (misalnya: Matlab)	
	Pengendalian sistem dengan metode PID	a. <u>Kendali PID</u> b. Pendahuluan Kendali Robust	
	Analisis sistem kendali	a. <u>Analisis Respon Frekwensi</u> ; b. Analisis Kestabilan dengan Routh-Hurwitz c. Desain Sistem Kendali dengan bantuan Respon Frekwensi d. <u>Analisis root locus</u> e. <u>Sistem Waktu Diskrit dan Transformasi-Z</u> f. Desain Sistem Kendali dalam Ruang Keadaan; Analisis Kestabilan Liapunov g. Kendali Optimal Kuadratik	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Mekatronika	Pengantar mekatronika	a. Sistem mekatronika b. Contoh-contoh aplikasi mekatronika	Mekatronika Instrumentasi, pengukuran dan metrologi
	Sistem elektronika analog	a. Komponen elektronika dasar	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
		b. Kirchhoff's Laws c. Sirkuit AC d. Daya dan transformer e. Op-amp f. Analog signal processing	
	Sistem elektronika digital	a. Representasi digital b. Combinational logic c. Timing diagram d. Boolean diagram e. Design of logic networks f. Special purpose IC	
	Prinsip Mikroprosesor dan Mikrokontroler	a. Pengenalan dasar mikroprosesor b. Pengenalan dasar mikrokontroler c. Dasar pemrograman untuk mikrokontroler	
	Sensor dan aktuator	a. Sensor dan Aktuator (Motor Elektrik, Pneumatik, Hidrolik) b. Sistem data acquisition c. Motor control	
	Pengendalian sistem berbasis mikrokontroler	a. Pemrograman C/C++ untuk Pengendalian sistem mekatronika b. Programmable Logic Controller (PLC)	



	Pokok Bahasan / <i>Main Topic</i>	Sub pokok bahasan / <i>Sub-topic</i>	Mata Kuliah / <i>Course</i>
	Perancangan sistem mekatronika	a. Studi kasus dan control architecture sistem mekatronika b. Project-based learning	

Bahan Kajian	Pokok Bahasan	Sub pokok bahasan	Mata Kuliah
Capstone Design	Design requirement and objectives (DRO)	Identifikasi kebutuhan atau masalah, batasan realistik, persyaratan disain	Capstone #1
	Conceptual Design	Pengembangan dan evaluasi beberapa konsep alternatif	Capstone #2
	Detailed Design	Detil disain dari masing-masing komponen (ukuran, toleransi) dan proses manufaktur	
	Analisis keteknikan	Analisis gaya dan tegangan yang ada dan pemilihan material teknik	
	Gambar Teknik	Gambar teknik dan gambar proses manufaktur	
	Penulisan Laporan Akhir	Panduan penulisan ilmiah yang baku	

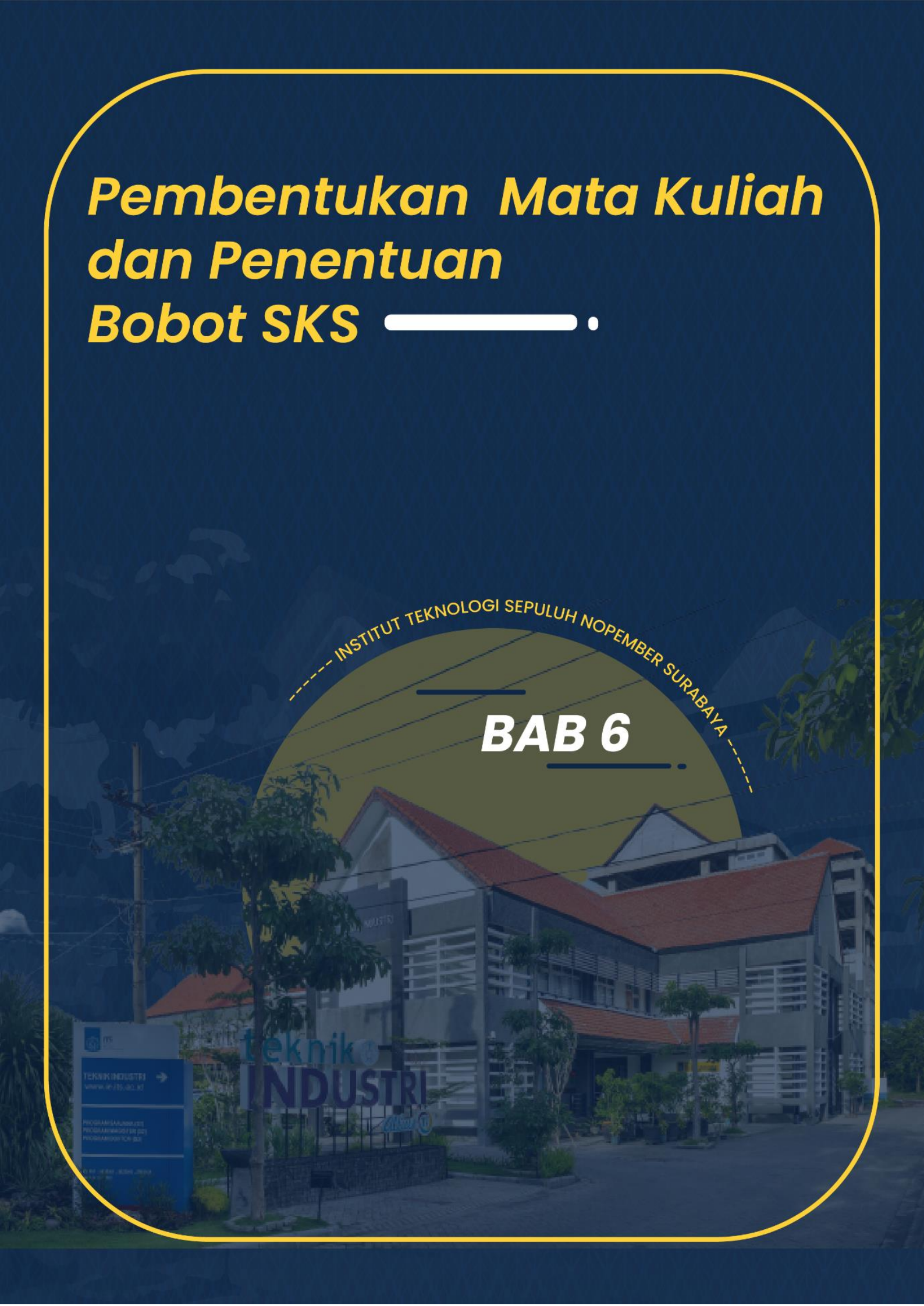
Pembentukan Mata Kuliah dan Penentuan Bobot SKS ——— •

----- INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA -----

BAB 6



teknika
INDUSTRI





6 Pembentukan Mata Kuliah dan Penentuan Bobot sks

Course Formation and Determination of Credit Weights

Mata kuliah dibentuk berdasarkan Capaian Pembelajaran (CPL) yang dibebankan pada mata kuliah dan bahan kajian yang sesuai dengan CPL. Pembentukannya dapat menggunakan pola matrik sebagai berikut:

Courses are established based on the Learning Outcomes (CPL) assigned to each course and the study materials that align with those CPLs. Their formation can follow a matrix pattern as illustrated below:

Tabel 6.1 Matriks kesesuaian CPL dengan Bahan Kajian
Matrix of CPL and Study Material Alignment

CPL	Bahan kajian <i>Related Study Materials</i>
CPL-1 Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>Able to demonstrate attitudes and character reflecting: faith in God Almighty, ethics and integrity, noble character, sensitivity and concern for social and environmental issues, appreciation for cultural differences and diversity, upholding the rule of law, prioritizing national and societal interests, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve optimal outcomes.</i>	1.1 Capstone Design



CPL	Bahan kajian <i>Related Study Materials</i>
CPL-2 Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>Able to analyze and utilize science and technology in the application of mechanical engineering, and to make appropriate decisions from individual or group work in the form of a final project report or other equivalent learning activities through logical, critical, systematic, and innovative thinking.</i>	2.1 Matematika / <i>Mathematics</i> 2.2 Fisika / <i>Physics</i> 2.3 Kimia / <i>Chemistry</i> 2.4 Mekanika dan Kekuatan Material/Statika Struktur <i>Mechanics and Strength of Materials/Statics</i> 2.5 Gambar Mesin / <i>Engineering Drawing</i> 2.6 Kinematika – Dinamika / <i>Kinematics - Dynamics</i> 2.7 Bahan/Material Teknik / <i>Engineering Materials</i> 2.8 Mekanika Fluida / <i>Fluid Mechanics</i> 2.9 Termodinamika / <i>Thermodynamics</i> 2.10 Proses Manufaktur / <i>Manufacturing Process</i>
CPL-3 Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi. <i>Able to manage self-learning and develop as a lifelong learner to compete nationally and internationally, contributing meaningfully to solving problems by implementing ICT and considering sustainability principles and technology-based entrepreneurship.</i>	
CPL-4 Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika.	4.1 Fisika / <i>Physics</i> 4.2 Kinematika – Dinamika / <i>Kinematics-Dynamics</i> 4.3 Mekanika dan Kekuatan Material/Statika Struktur /



CPL	Bahan kajian <i>Related Study Materials</i>
<i>Ability to apply mathematics, science, and engineering principles to solve mechanical system problems.</i>	<i>Mechanics and Strength of Materials / Static</i> 4.4 Mekanika Fluida / <i>Fluid Mechanics</i> 4.5 Mekatronika / <i>Mechatronics</i> 4.6 Bahan/Material Teknik / <i>Engineering Materials</i> 4.7 Termodinamika / <i>Thermodynamics</i> 4.8 Elemen Mesin / <i>Machine Elements</i> 4.9 Proses Manufaktur / <i>Manufacturing Processes</i> 4.10 Statistik / Statistika & Probabilitas / <i>statistic & Probability</i> 4.11 Sistem Kendali/Kontrol / <i>Control System</i> 4.12 Perpindahan Kalor dan Massa / <i>Heat and Mass Transfer</i> 4.13 Mesin Konversi Energi / <i>Energi Conversion Machines</i> 4.14 Getaran Mekanik / <i>Mechanical Vibration</i> 4.15 Pengukuran Teknik/Metrologi / <i>Engineering Measurement / Metrology</i> 4.16 Teknik Tenaga Listrik / <i>Electrical Power Engineering</i> 4.17 Capstone Design
CPL-5 Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan. <i>Ability to design mechanical components, systems and/or processes to meet desired needs using analytical engineering approaches based on the latest science & technology, considering technical</i>	5.1 Pengukuran Teknik/Metrologi / <i>Engineering Measurement / Metrology</i> 5.2 Bahan/Material Teknik / <i>Engineering Materials</i> 5.3 Elemen Mesin / <i>Machine Elements</i> 5.4 Sistem Kendali/Kontrol / <i>Control Systems</i> 5.5 Mekatronika / <i>Mechatronics</i> 5.6 Capstone Design



CPL	Bahan kajian <i>Related Study Materials</i>
<i>standards, performance, reliability, and usability.</i>	5.7 Perpindahan Kalor dan Massa / <i>Heat and Mass Transfer</i> 5.8 Mesin Konversi Energi / <i>Energi Conversion Machines</i> 5.9 Getaran Mekanik / <i>Mechanical Vibrations</i> 5.10 Teknik Tenaga Listrik / <i>Electrical Power Engineering</i>
CPL-6 Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>Ability to perform laboratory and/or field experiments and analyze and interpret data to strengthen engineering assessments.</i>	6.1 Pengukuran Teknik/Metrologi / <i>Engineering Measurement / Metrology</i> 6.2 Bahan/Material Teknik / <i>Engineering Materials</i> 6.3 Mekatronika / <i>Mechatronics</i> 6.4 Perpindahan Kalor dan Massa / <i>Heat and Mass Transfer</i> 6.5 Proses Manufaktur / <i>Manufacturing Processes</i> 6.6 Fisika / <i>Physcis</i> 6.7 Mekanika Fluida / <i>Fluid Mechanics</i> 6.8 Teknik Tenaga Listrik / <i>Electrical Power Engineering</i>
CPL-7 Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply modern technical methods, skills, and tools necessary for the practice of mechanical systems.</i>	7.1 Pengukuran Teknik/Metrologi / <i>Engineering Measurement / Metrology</i> 7.2 Sistem Kendali/Kontrol / <i>Control Systems</i> 7.3 Mekatronika / <i>Mechatronics</i> 7.4 Capstone Design 7.5 Proses Manufaktur / <i>Manufacturing Processes</i> 7.6 Getaran Mekanik / <i>Mechanical Vibration</i> 7.7 Teknik Tenaga Listrik / <i>Electrical Power Engineering</i> 7.8 Gambar Mesin / <i>Engineering Drawing</i>



CPL	Bahan kajian <i>Related Study Materials</i>
CPL-8 Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>Ability to identify, formulate, analyze, and solve engineering problems.</i>	8.1 Pengukuran Teknik/Metrologi / <i>Engineering Measurement / Metrology</i> 8.2 Bahan/Material Teknik / <i>Engineering Materials</i> 8.3 Elemen Mesin / <i>Machine Elements</i> 8.4 Sistem Kendali/Kontrol / <i>Control Systems</i> 8.5 Mekatronika / <i>Mechatronics</i> 8.6 Capstone Design 8.7 Perpindahan Kalor dan Massa / <i>Heat and Mass Transfer</i> 8.8 Mesin Konversi Energi / <i>Energy Conversion Machines</i> 8.9 Proses Manufaktur / <i>Manufacturing Process</i> 8.10 Getaran Mekanik / <i>Mechanical Vibrations</i> 8.11 Mekanika Fluida / <i>Fluid Mechanics</i> 8.12 Teknik Tenaga Listrik / <i>Electrical Power Engineering</i> 8.13 Gambar Mesin / <i>Engineering Drawing</i> 8.14 Mekanika dan Kekuatan Material/Statika Struktur / <i>Mechanics and Strength of Materials / Statics</i> 8.15 Kinematika – Dinamika / <i>Kinematics-Dynamics</i> 8.16 Termodinamika / <i>thermodynamics</i> 8.17 Statistik / Statistika & Probabilitas / <i>Statistic & Probability</i>
CPL-9 Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi.	9.1 Capstone Design



CPL	Bahan kajian <i>Related Study Materials</i>
<i>Ability to communicate effectively both orally and in writing, and apply technology-based entrepreneurship.</i>	
CPL-10 Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, complete, and evaluate tasks based on the analysis of information and data.</i>	10.1 Capstone Design 10.2 Statistik / Statistika & Probabilitas / <i>Statistic & Probability</i>
CPL-11 Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika <i>Ability to take responsibility to society and adhere to professional ethics in solving mechanical system problems.</i>	11.1 Capstone Design

Tabel 6.2 Perhitungan bobot sks setiap MK

Credit Weight Calculation for Each Course

No MK	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>CPL Assigned to the Course</i>	Indikator ketercapaian CPL <i>CPL Achievement Indicator</i>	Lama waktu ketercapaian CPL (dalam jam / sks) <i>Duration to Achieve CPL (in hours/credits)</i>	Total (dalam jam / sks) <i>Total (in hours/credits)</i>	Konversi ke sks <i>Conversion to Credits</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Kalkulus I	CPL 2	Min. 56%	66,86	119,1	3
2	Fisika Mekanika	CPL 2	Min. 56%	88,3	158,8	4
3	Kimia	CPL 2	Min. 56%	66,86	119,1	3



No MK	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>CPL Assigned to the Course</i>	Indikator ketercapaian CPL <i>CPL Achievement Indicator</i>	Lama waktu ketercapaian CPL (dalam jam / sks) <i>Duration to Achieve CPL (in hours/credits)</i>	Total (dalam jam / sks) <i>Total (in hours/credits)</i>	Konversi ke sks <i>Conversion to Credits</i>
4	Pengantar Teknik Mesin	CPL 2 CPL 3 CPL 8	Min. 56%	44,46	79,40	2
5	Fisika Statika	CPL 2 CPL 4 CPL 8	Min. 56%	44,46	79,40	2
6	Menggambar Mesin	CPL 2 CPL 7 CPL 8	Min. 56%	66,86	119,1	3
7	Kalkulus II	CPL 2	Min. 56%	66,86	119,1	3
8	Fisika Listrik dan Magnet	CPL 2 CPL 6	Min. 56%	88,3	158,8	4
9	Algoritma Dasar	CPL 2 CPL 3 CPL 7 CPL 8	Min. 56%	44,46	44,46	2
10	Kinematika dan Dinamika Teknik	CPL 2 CPL 4 CPL 8	Min. 56%	66,86	119,1	3
11	Mekanika Kekuatan Material	CPL 2 CPL 4 CPL 8	Min. 56%	88,3	158,8	4
12	Metalurgi I	CPL 2 CPL 4 CPL 8	Min. 56%	66,86	119,1	3
13	Matematika Rekayasa	CPL 2 CPL 4	Min. 56%	66,86	119,1	3
14	Dinamika Permesinan	CPL 2 CPL 4	Min. 56%	66,86	119,1	3
15	Mekanika Fluida Dasar I	CPL 2 CPL 4 CPL 6	Min. 56%	44,46	79,4	2



No MK	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>CPL Assigned to the Course</i>	Indikator ketercapaian CPL <i>CPL Achievement Indicator</i>	Lama waktu ketercapaian CPL (dalam jam / sks) <i>Duration to Achieve CPL (in hours/credits)</i>	Total (dalam jam / sks) <i>Total (in hours/credits)</i>	Konversi ke sks <i>Conversion to Credits</i>
		CPL 8				
16	Instrumentasi, Pengukuran & Metrologi	CPL 4 CPL 5 CPL 6 CPL 7 CPL 8	Min. 56%	88,3	158,8	4
17	Metalurgi II	CPL 4 CPL 5 CPL 6 CPL 8	Min. 56%	66,86	119,1	3
18	Termodinamika I	CPL 2 CPL 4 CPL 8	Min. 56%	44,46	79,4	2
19	Elemen Mesin I	CPL 4 CPL 5 CPL 8	Min. 56%	66,86	119,1	3
20	Proses Manufaktur I	CPL 2 CPL 4 CPL 6 CPL 8	Min. 56%	66,86	119,1	3
21	Mekanika Fluida Dasar II	CPL 2 CPL 4 CPL 6 CPL 8	Min. 56%	66,86	119,1	3
22	Elemen Mesin II	CPL 4 CPL 5 CPL 8	Min. 56%	66,86	119,1	3
23	Statistik dan Perencanaan Eksperimen	CPL 4 CPL 8 CPL 10	Min. 56%	88,3	158,8	4
24	Termodinamika II	CPL 2 CPL 4	Min. 56%	66,86	119,1	3



No MK	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>CPL Assigned to the Course</i>	Indikator ketercapaian CPL <i>CPL Achievement Indicator</i>	Lama waktu ketercapaian CPL (dalam jam / sks) <i>Duration to Achieve CPL (in hours/credits)</i>	Total (dalam jam / sks) <i>Total (in hours/credits)</i>	Konversi ke sks <i>Conversion to Credits</i>
		CPL 8				
25	Sistem Dinamik dan Pengendalian	CPL 4 CPL 5 CPL 7 CPL 8	Min. 56%	88,3	158,8	4
26	Analisa Numerik	CPL 4 CPL 7 CPL 8	Min. 56%	66,86	119,1	3
27	Mekatronika	CPL 4 CPL 5 CPL 6 CPL 7 CPL 8	Min. 56%	66,86	119,1	3
28	Capstone #1	CPL 1 CPL 4 CPL 5 CPL 7 CPL 8 CPL 9 CPL 10 CPL 11	Min. 56%	44,46	79,4	2
29	Perpindahan Panas	CPL 4 CPL 5 CPL 6 CPL 8	Min. 56%	88,3	158,8	4
30	Mesin Konversi Energi	CPL 4 CPL 5 CPL 8	Min. 56%	66,86	119,1	3
31	Proses Manufaktur II	CPL 4 CPL 6 CPL 7 CPL 8	Min. 56%	66,86	119,1	3



No MK	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>CPL Assigned to the Course</i>	Indikator ketercapaian CPL <i>CPL Achievement Indicator</i>	Lama waktu ketercapaian CPL (dalam jam / sks) <i>Duration to Achieve CPL (in hours/credits)</i>	Total (dalam jam / sks) <i>Total (in hours/credits)</i>	Konversi ke sks <i>Conversion to Credits</i>
32	Mekanika Getaran	CPL 4 CPL 5 CPL 7 CPL 8	Min. 56%	66,86	119,1	3
33	Pancasila	CPL 1 CPL 2	Min. 56%	44,46	79,4	2
34	Kewirausahaan Berbasis Teknologi	CPL 3 CPL 9	Min. 56%	44,46	79,4	2
35	Bahasa Inggris	CPL 3 CPL 9	Min. 56%	44,46	79,4	2
36	Pilihan Pengayaan	CPL 8 CPL 10	Min. 56%	66,86	119,1	3
37	Manajemen Operasional	CPL 4 CPL 5 CPL 8 CPL 10	Min. 56%	88,3	158,8	4
38	Capstone #2	CPL 1 CPL 4 CPL 5 CPL 7 CPL 8 CPL 9 CPL 10 CPL 11	Min. 56%	44,46	79,4	2
39	Pilihan I	CPL 5 CPL 7 CPL 8 CPL 10	Min. 56%	66,86	119,1	3
40	Pilihan II	CPL 5 CPL 7 CPL 8 CPL 10	Min. 56%	66,86	119,1	3



No MK	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>CPL Assigned to the Course</i>	Indikator ketercapaian CPL <i>CPL Achievement Indicator</i>	Lama waktu ketercapaian CPL (dalam jam / sks) <i>Duration to Achieve CPL (in hours/credits)</i>	Total (dalam jam / sks) <i>Total (in hours/credits)</i>	Konversi ke sks <i>Conversion to Credits</i>
41	Aplikasi Teknologi & Transformasi Digital	CPL 1 CPL 3 CPL 9	Min. 56%	66,86	119,1	3
42	Kewarganegaraan	CPL 1 CPL 3	Min. 56%	44,46	79,4	2
43	Pendidikan Agama	CPL 1 CPL 3	Min. 56%	44,46	79,4	2
44	Bahasa Indonesia	CPL 3 CPL 9	Min. 56%	44,46	79,4	2
45	Teknik dan Manajemen Perawatan	CPL 8 CPL 10	Min. 56%	66,86	119,1	3
46	Proposal Tugas Akhir	CPL 3 CPL 5 CPL 7 CPL 8 CPL 9 CPL 10 CPL 11	Min. 56%	44,46	79,4	2
47	Pilihan III	CPL 5 CPL 7 CPL 8 CPL 10	Min. 56%	66,86	119,1	3
48	Pilihan IV	CPL 5 CPL 7 CPL 8 CPL 10	Min. 56%	66,86	119,1	3
49	Kerja Praktek	CPL 1 CPL 3 CPL 8 CPL 9 CPL 10	Min. 56%	44,46	79,4	2



No MK	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>CPL Assigned to the Course</i>	Indikator ketercapaian CPL <i>CPL Achievement Indicator</i>	Lama waktu ketercapaian CPL (dalam jam / sks) <i>Duration to Achieve CPL (in hours/credits)</i>	Total (dalam jam / sks) <i>Total (in hours/credits)</i>	Konversi ke sks <i>Conversion to Credits</i>
		CPL 11				
50	Tugas Akhir	CPL 3 CPL 5 CPL 7 CPL 8 CPL 9 CPL 10 CPL 11	Min. 56%	88,83	158,8	4

Mata kuliah dibentuk berdasarkan Capaian Pembelajaran (CPL) yang dibebankan pada mata kuliah dan bahan kajian yang sesuai dengan CPL tersebut. Pembentukannya dapat menggunakan pola matrik sebagai berikut:

Courses are developed based on the Learning Outcomes (CPL) assigned to each course and the subject matter relevant to those CPLs. Their development can follow a matrix pattern as shown below.

Tabel 6.1 Matrik CPL dan Mata kuliah (Baru)

No	Mata Kuliah	CPL										
		CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	CPL 10	CPL 11
SEMESTER I												
1	KALKULUS I		v									
2	FISIKA MEKANIKA		v									
3	KIMIA		v									
4	PENGANTAR TEKNIK MESIN		v	v					v			



No	Mata Kuliah	CPL										
		CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	CPL 10	CPL 11
5	FISIKA STATIKA		v		v				v			
6	MENGGAHAMBAR MESIN		v					v	v			
SEMESTER II												
7	KALKULUS II		v									
8	FISIKA LISTRIK DAN MAGNET		v				v					
9	ALGORITMA DASAR		v	v				v	v			
10	KINEMATIKA DAN DINAMIKA TEKNIK		v		v				v			
11	MEKANIKA KEKUATAN MATERIAL		v		v				v			
12	METALURGI I		v		v				v			
SEMESTER III												
13	MATEMATIKA REKAYASA		v		v							
14	DINAMIKA PERMESINAN		v		v				v			
15	MEKANIKA FLUIDA DASAR I		v		v		v		v			
16	INSTRUMENTASI, PENGUKURAN & METROLOGI				v	v	v	v	v			
17	METALURGI II				v	v	v		v			
18	TERMODINAMIKA I		v		v				v			
19	ELEMEN MESIN I				v	v			v			
SEMESTER IV												
20	PROSES MANUFaktur I		v		v		v		v			
21	MEKANIKA FLUIDA DASAR II		v		v		v		v			
22	ELEMEN MESIN II				v	v			v			
23	STATISTIK & PERENCANAAN EKSPERIMEN				v				v		v	
24	TERMODINAMIKA II		v		v				v			
25	SISTEM DINAMIK DAN PENGENDALIAN				v	v		v	v			
SEMESTER V												



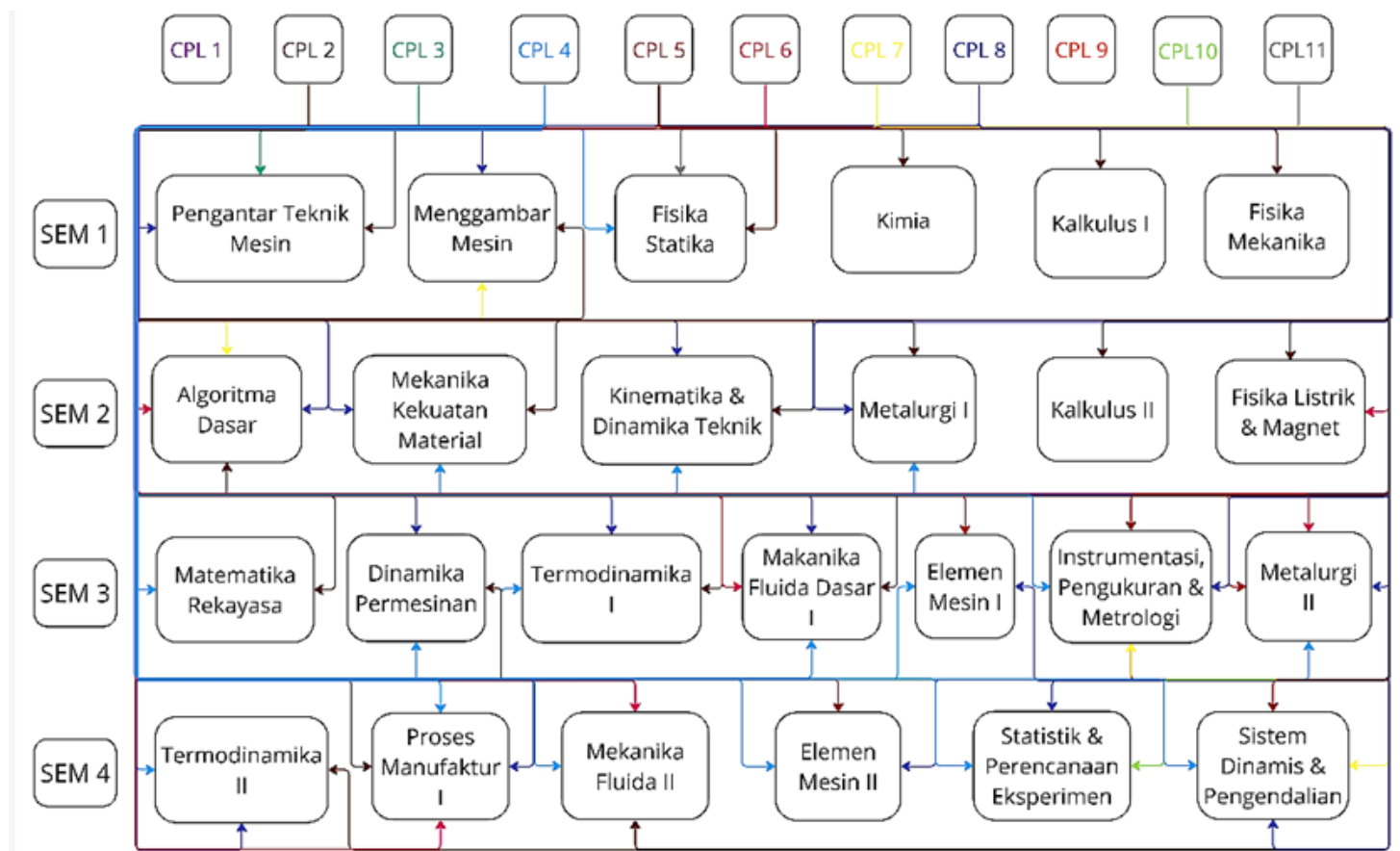
No	Mata Kuliah	CPL										
		CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	CPL 10	CPL 11
26	ANALISA NUMERIK				v			v	v			
27	MEKATRONIKA				v	v	v	v	v			
28	CAPSTONE #1	v			v	v		v	v	v	v	v
29	PERPINDAHAN PANAS				v	v	v		v			
30	MESIN KONVERSI ENERGI				v	v			v			
31	PROSES MANUFAKTUR II				v		v	v	v			
32	MEKANIKA GETARAN				v	v		v	v			
SEMESTER VI												
33	PANCASILA	v		v								
34	KEWIRAUSAHAAN BERBASIS TEKNOLOGI			v						v		
35	BAHASA INGGRIS			v						v		
36	PILIHAN PENGAYAAN								v		v	
37	MANAJEMEN OPERASIONAL				v	v			v		v	
38	CAPSTONE #2	v			v	v		v	v	v	v	v
39	PILIHAN I					v		v	v		v	
40	PILIHAN II					v		v	v		v	
SEMESTER VII												
41	APLIKASI TEKNOLOGI & TRANSFORMASI DIGITAL	v		v						v		
42	KEWARGANEGARAAN	v		v								
43	PENDIDIKAN AGAMA	v		v								
44	BAHASA INDONESIA			v						v		
45	TEKNIK DAN MANAJEMEN PERAWATAN								v		v	
46	PROPOSAL TUGAS AKHIR			v		v		v	v	v	v	v
47	PILIHAN III					v		v	v		v	
48	PILIHAN IV					v		v	v		v	
SEMESTER VIII												
49	KERJA PRAKTEK	v		v					v	v	v	v
50	TUGAS AKHIR			v		v		v	v	v	v	v

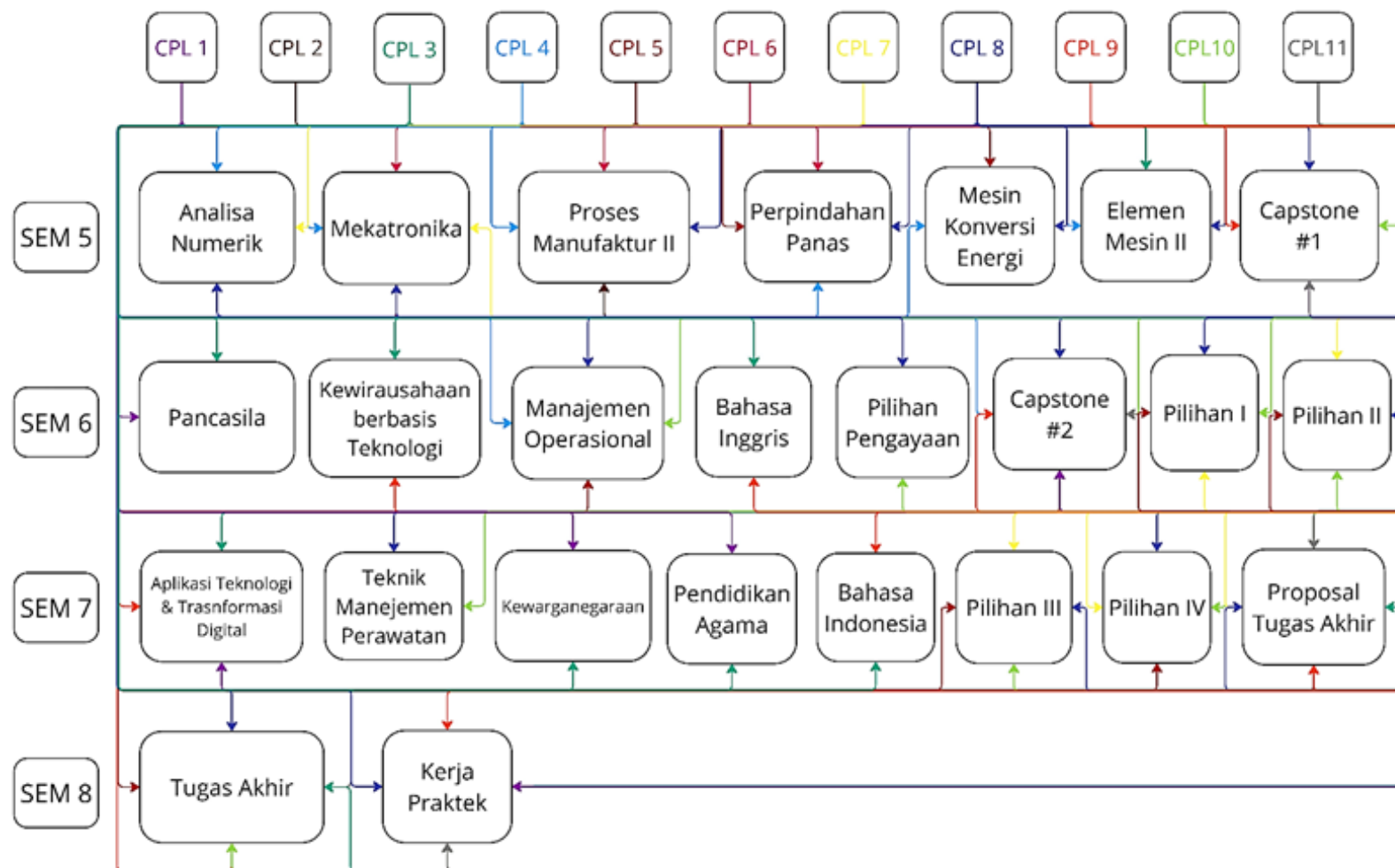




Susunan Peta CPL terhadap Mata Kuliah Prodi Sarjana Teknik Mesin per semester adalah sebagai berikut

The Mapping Structure of Learning Outcomes (CPL) to Courses in the Undergraduate Mechanical Engineering Program per semester is as follows.





Organisasi Mata Kuliah Program Studi — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 7





7 Organisasi Mata Kuliah Program Studi

Course Organization of the Study Program

Sebaran MK dalam kategori sesuai yang dituliskan dalam "Kelompok MK" dapat dilihat pada tabel 7.1 di bawah ini
The distribution of courses (MK) by category, as listed in the "Course Group," can be seen in Table 7.1 below.

Tabel 7.1. Organisasi Mata Kuliah Program Studi
Course Organization of the Study Program

NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)



NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Course s</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
SEMESTER 1									
1	3	Kalkulus I			v				
2	4	Fisika Mekanika			v				
3	3	Kimia			v				
4	2	Pengantar Teknik Mesin	v			v			
5	2	Fisika Statika	v		v				
6	3	Menggambar Mesin	v			v			
SEMESTER 2									
1	3	Kalkulus II			v				



NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
2	4	Fisika Listrik dan Magnet			v				
3	2	Algoritma Dasar	v		v				
4	3	Kinematika dan Dinamika Teknik	v			v			
5	4	Mekanika Kekuatan Material	v			v			
6	3	Metalurgi I	v			v			
SEMESTER 3									
1	3	Matematika Rekayasa	v		v				
2	3	Dinamika Permesinan	v			v			



NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
3	2	Mekanika Fluida Dasar I	v			v			
4	4	Instrumentasi, Pengukuran dan Metrologi	v			v			
5	3	Metalurgi II	v			v			
6	2	Termodinamika I	v			v			
7	3	Elemen Mesin I	v			v			
SEMESTER 4									
1	3	Proses Manufaktur I	v			v			
2	3	Mekanika Fluida Dasar II	v			v			



NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
3	3	Elemen Mesin II	v			v			
4	4	Statistik & Perencanaan Eksperimen	v		v				
5	3	Termodinamika II	v			v			
6	4	Sistem Dinamik dan Pengendalian	v					v	
SEMESTER 5									
1	3	Analisa Numerik	v		v				
2	3	Mekatronika	v					v	
3	2	Capstone #1	v					v	



NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
4	4	Perpindahan Panas	v			v			
5	3	Mesin Konversi Energi	v					v	
5	3	Proses Manufaktur II	v			v			
6	3	Mekanika Getaran	v					v	
SEMESTER 6									
1	2	Pancasila							v
2	2	Kewirausahaan Berbasis Teknologi							v
3	2	Bahasa Inggris							v
4	3	Pilihan Pengayaan							v



NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
5	4	Manajemen Operasional	v					v	
6	2	Capstone #2	v					v	
7	3	Pilihan I		v				v	
8	3	Pilihan II		v				v	
SEMESTER 7									
1	3	Aplikasi Teknologi & Transformasi Digital					v		
2	2	Kewarganegaraan							v
3	2	Pendidikan Agama							v
4	2	Bahasa Indonesia							v



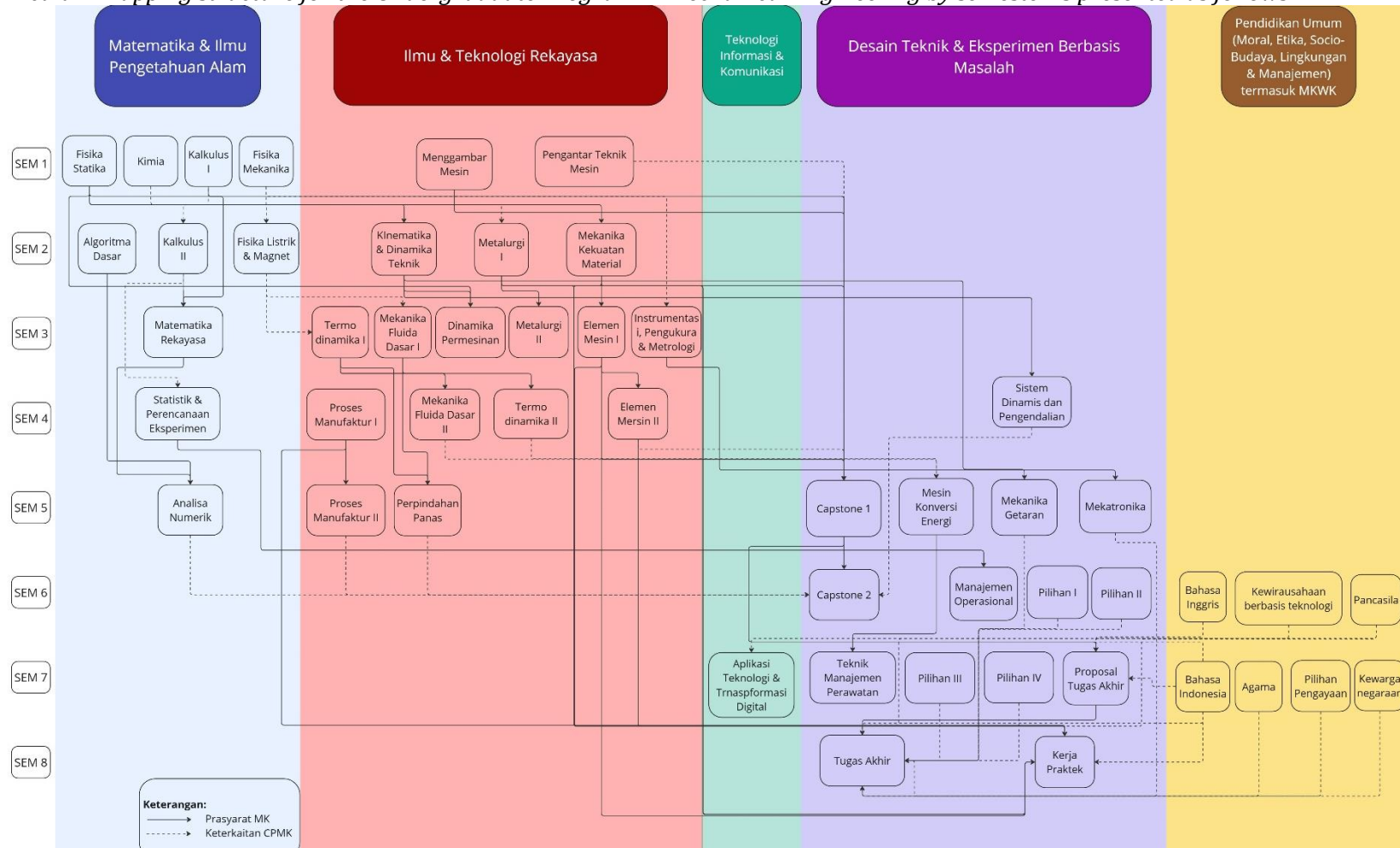
NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
5	3	Teknik Manajemen Perawatan	v					v	
6	2	Proposal Tugas Akhir	v					v	
7	3	Pilihan III		v				v	
8	3	Pilihan IV		v				v	
SEMESTER 8									
1	2	Kerja Praktek	v					v	
2	4	Tugas Akhir	v					v	
..									



NO	sks	Nama MK dan Kode <i>Course Name and Code</i>	KELOMPOK MATA KULIAH PROGRAM SARJANA						
			MK Inti <i>Core Courses</i>	MK Pilihan <i>Elective Courses</i>	MK Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Sciences Courses</i>	Ilmu dan teknologi rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan eksperimen berbasis masalah <i>Design, Engineering, and Problem-Based Experimentation</i>	Pendidikan umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio-cultural, environment, and management), including MKWK</i>
Total	144				31	51	3	44	15
					21.53%	35.42%	2.08%	30.55%	10.42%



Susunan pemetaan kurikulum terhadap mata kuliah Program Studi Sarjana Teknik Mesin per semester disajikan sebagai berikut.
The curriculum mapping structure for the Undergraduate Program in Mechanical Engineering by semester is presented as follows.





Catatan:

1. Mata Kuliah Wajib Kurikulum (MKWK) yaitu:

Compulsory Curriculum Courses (MKWK) include:

- a. Agama / *Religion* (2 sks);
- b. Pancasila (2 sks);
- c. Kewarganegaraan (2 sks); dan
- d. Bahasa Indonesia (2 sks).

2. MK Penciri ITS, yaitu:

ITS Distinctive Courses include:

- a. Aplikasi Teknologi dan Transformasi Digital / *Application of Technology and Digital Transformation* (3 sks)
- b. Bahasa Inggris / *English* (2 sks),
- c. Teknopreneur / *Technopreneurship* (2 sks)

Catatan : Poin 1 dan 2 diletakkan pada semester 6 dan 7

Note: Points 1 and 2 are scheduled in semesters 6 and 7

Daftar Sebaran Mata Kuliah Tiap Semester ———.

BAB 8

INSTITUT TEKNOLOGI SEPULUH NOPEMBER



Pengukuran CPL - Khusus bagi Prodi yang Berorientasi pada Akreditasi IABEE
CPL Measurement – Specifically for Programs Oriented Toward IABEE Accreditation

Tabel dituliskan tiap semester - untuk mengetahui sebaran MK, dan komposisi teori dan praktikum

The table is written per semester to identify the distribution of courses and the composition of theory and practical/laboratory sessions.

Tabel 8.1. Daftar Mata kuliah semester-I
List of Courses in Semester I

No	Kode MK <i>Course Code</i>	Mata Kuliah (MK) <i>Course Title</i>	Teori <i>Theory</i>	Praktikum <i>Practical</i>	Jumlah sks <i>Total Credits</i>	Nama MK Prasyarat <i>Prerequisite Course</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	SM234101	Kalkulus I	3		3	
2	SF234102	Fisika Mekanika	4		4	
3	SK234102	Kimia	3		3	
4	TM234101	Pengantar Teknik Mesin	2		2	
5	TM234102	Fisika Statika	2		2	
6	TM234103	Menggambar Mesin	3		3	
Jumlah Beban Studi Semester I <i>Total Study Load for Semester I</i>					17	

Tabel 8.2. Daftar Mata Kuliah semester-II
List of Courses in Semester II

No	Kode MK <i>Course Code</i>	Mata Kuliah (MK) <i>Course Title</i>	Teori <i>Theory</i>	Praktikum <i>Practical</i>	Jumlah sks <i>Total Credits</i>	Nama MK Prasyarat <i>Prerequisite Course</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	SM234201	Kalkulus II	3		3	
2	SF234202	Fisika Listrik Dan Magnet	4		4	
3	TM234201	Algoritma Dasar	2		2	



4	TM234202	Kinematika dan Dinamika Teknik	3		3	Fisika Statika
5	TM234203	Mekanika Kekuatan Material	4		4	Fisika Statika
6	TM234204	Metalurgi I	3		3	
Jumlah Beban Studi Semester II <i>Total Study Load for Semester II</i>					19	

Tabel 8.3. Daftar Mata Kuliah semester-III
List of Courses in Semester III

No	Kode MK <i>Course Code</i>	Mata Kuliah (MK) <i>Course Title</i>	Teori <i>Theory</i>	Praktikum <i>Practical</i>	Jumlah sks <i>Total Credits</i>	Nama MK Prasyarat <i>Prerequisite Course</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	TM234301	Matematika Rekayasa	3		3	Kalkulus 1 Kalkulus 2
2	TM234302	Dinamika Permesinan	3		3	Fisika Statika Kinematika & Dinamika Teknik
3	TM234303	Mekanika Fluida Dasar I	2		2	
4	TM234304	Instrumentasi, Pengukuran & Metrologi	4		4	
5	TM234305	Metalurgi II	3		3	Metalurgi I
6	TM234306	Termodinamika I	2		2	
7	TM234404	Elemen Mesin I	3		3	Mekanika Kekuatan Material
Jumlah Beban Studi Semester III <i>Total Study Load for Semester III</i>					20	

Tabel 8.4. Daftar Mata Kuliah semester-IV
List of Courses in Semester IV

No	Kode MK <i>Course Code</i>	Mata Kuliah (MK) <i>Course Title</i>	Teori <i>Theory</i>	Praktikum <i>Practical</i>	Jumlah sks <i>Total Credits</i>	Nama MK Prasyarat <i>Prerequisite Course</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)



1	TM234401	Proses Manufaktur I	3		3	
2	TM234402	Mekanika Fluida Dasar II	3		3	Mekanika Fluida Dasar I Termodinamika I
3	TM234403	Elemen Mesin II	3		3	Elemen Mesin I
4	TM234404	Statistik & Perencanaan Eksperimen	4		4	
5	TM234405	Termodinamika II	3		3	Termodinamika I
6	TM234405	Sistem Dinamik dan Pengendalian	4		4	Kinematika dan Dinamika Teknik
Jumlah Beban Studi Semester IV Total Study Load for Semester IV					20	

Tabel 8.5. Daftar Mata Kuliah semester-V
List of Courses in Semester V

No	Kode MK Course Code	Mata Kuliah (MK) Course Title	Teori Theory	Praktikum Practical	Jumlah sks Total Credits	Nama MK Prasyarat Prerequisite Course
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	TM234501	Analisa Numerik	3		3	Algoritma Dasar Matematika Rekayasa
2	TM234502	Mekatronika	3		3	Instrumentasi, Pengukuran & Metrologi
3	TM234503	Capstone #1	2		2	Fisika Statika Menggambar Mesin Mekanika Kekuatan Material Elemen Mesin I Elemen Mesin II
4	TM234504	Perpindahan Panas	4		4	Termodinamika I Mekanika Fluida Dasar I
5	TM234505	Mesin Konversi Energi	3		3	Mekanika Fluida Dasar I



						Termodinamika I
6	TM234506	Proses Manufaktur II	3		3	Proses Manufaktur I
7	TM234507	Mekanika Getaran	3		3	Kinematika dan Dinamika Teknik
Jumlah Beban Studi Semester V Total Study Load for Semester V					21	

Tabel 8.6 Daftar Mata Kuliah semester-VI
List of Courses in Semester VI

No	Kode MK Course Code	Mata Kuliah (MK) Course Title	Teori Theory	Praktikum Practical	Jumlah sks Total Credits	Nama MK Prasyarat Prerequisite Course
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	UG234911	Pancasila	2		2	
2	UG234915	Kewirausahaan Berbasis Teknologi	2		2	
3	UG234914	Bahasa Inggris	2		2	
4	XXXXXXXX	Pilihan Pengayaan	3		3	
5	TM234601	Manajemen Operasional	4		4	Statistik dan Perencanaan Eksperimen
6	TM234602	CAPSTONE 2	2		2	Capstone 1
7	TM2346XX	PILIHAN I	3		3	
8	TM2346XX	PILIHAN II	3		3	
Jumlah Beban Studi Semester VI Total Study Load for Semester VI					21	

Tabel 8.7. Daftar Mata Kuliah semester-VII
List of Courses in Semester VII

No	Kode MK Course Code	Mata Kuliah (MK) Course Title	Teori Theory	Praktikum Practical	Jumlah sks Total Credits	Nama MK Prasyarat Prerequisite Course
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	UG234916	Aplikasi Teknologi & Transformasi Digital	3		3	



2	UG234913	Kewarganegaraan	2		2	
3	UG234901-06	Pendidikan Agama	2		2	
4	UG234912	Bahasa Indonesia	2		2	
5	TM234701	Teknik Dan Manajemen Perawatan	3		3	Mekanika Getaran Mesin Konversi Energi
6	TM234702	Proposal Tugas Akhir	2		2	
7	TM2347XX	Pilihan III	3		3	
8	TM2347XX	Pilihan IV	3		3	
Jumlah Beban Studi Semester VII					20	

Tabel 8.8. Daftar Mata Kuliah semester-VIII

List of Courses in Semester VIII

No	Kode MK Course Code	Mata Kuliah (MK) Course Title	Teori Theory	Praktikum Practical	Jumlah sks Total Credits	Nama MK Prasyarat Prerequisite Course
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	TM234801	KERJA PRAKTEK	2		2	Mekanika Kekuatan Material Metalurgi I Elemen Mesin I Proses Manufaktur I Elemen Mesin II
2	TM234802	TUGAS AKHIR	4		4	
Jumlah Beban Studi Semester VIII					6	

Pembelajaran Melalui MB – KM ——— .

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 9





9. Pembelajaran melalui MB – KM

Learning through MB-KM

Pembelajaran MB - KM sesuai dengan Peraturan Rektor Nomor 21 Tahun 2021

The MB-KM learning process is implemented in accordance with Rector Regulation Number 21 of 2021.

Dalam rangka menyiapkan mahasiswa menghadapi perubahan sosial, budaya, dunia kerja dan kemajuan teknologi yang pesat, kompetensi mahasiswa harus disiapkan untuk lebih sesuai dengan kebutuhan zaman. Perguruan Tinggi dituntut untuk dapat merancang dan melaksanakan proses pembelajaran yang inovatif agar mahasiswa dapat meraih capaian pembelajaran mencakup aspek sikap, pengetahuan, dan keterampilan secara optimal dan selalu relevan. Dengan adanya Program MBKM diharapkan bisa mewadahi dan menjawab kebutuhan tersebut. Tim Akademik DTM telah menyusun panduan untuk 8 program MBKM yang akan memandu manajemen DTM, mahasiswa dan dosen dalam menjalankan program tersebut agar berjalan dengan baik.

To prepare students for rapid changes in society, culture, the job market, and technological advancement, student competencies must be better aligned with the needs of the times. Higher education institutions are expected to design and implement innovative learning processes so that students can achieve learning outcomes that encompass attitudes, knowledge, and skills in an optimal and continuously relevant manner. The implementation of the Merdeka Belajar – Kampus Merdeka (MBKM) Program is expected to accommodate and address these needs. The Academic Team of the Department of Mechanical Engineering (DTM) has developed a guide for the 8 MBKM programs, which will serve as a reference for DTM management, students, and faculty members to ensure the effective implementation of these programs.

Kegiatan MB KM merupakan proses pembelajaran yang dilaksanakan di luar Program Studi baik yang ada di internal ITS maupun di luar ITS yang terdiri atas:

. MBKM activities are learning processes conducted outside the students' primary study program, both within ITS and outside ITS, and consist of:

1. pembelajaran dalam Program Studi lain di internal ITS;



Learning in a different study program within ITS;

2. pembelajaran dalam Program Studi yang sama pada Perguruan Tinggi di luar ITS;

Learning in the same study program at a university outside ITS;

3. pembelajaran dalam Program Studi lain pada Perguruan Tinggi di luar ITS;

Learning in a different study program at a university outside ITS

4. pembelajaran pada lembaga non Perguruan Tinggi

Learning at non-university institutions.

Ruang lingkup kegiatan MB - KM adalah 8 (delapan) kegiatan pembelajaran yang meliputi:

The scope of MBKM activities includes eight (8) types of learning activities, which are:



Magang MBKM



Pertukaran Pelajar



Asistensi Mengajar



Penelitian



Studi/Proyek Independen



Proyek Kemanusiaan



Kegiatan Wirausaha



KKN TEMATIK

9.1. Kegiatan MB - KM

MBKM Activities

MB - KM yang akan dilaksanakan menyesuaikan dengan CPL Prodi dan dapat ditambahkan dengan kompetensi tambahan atau dalam rangka mendukung ke pencapaian Tujuan Pendidikan Prodi

The MBKM (Merdeka Belajar – Kampus Merdeka) activities to be implemented are aligned with the Program Learning Outcomes (CPL) and may be supplemented with additional competencies or designed to support the achievement of the Program Educational Objectives.

1. Magang MBKM; mahasiswa dapat memperoleh pengalaman belajar di industri

MBKM Internship: Students can gain hands-on learning experience in the industry.



2. Pertukaran pelajar; mahasiswa dapat memiliki pengalaman belajar di kampus mitra ITS
Student Exchange: Students can experience learning at ITS partner universities.
3. Asistensi mengajar; mahasiswa dapat memiliki pengalaman mengajar
Teaching Assistance: Students can gain experience in teaching.
4. Penelitian; mahasiswa dapat memiliki pengalaman untuk melakukan penelitian termasuk proses penulisan dan penyusunan hasil karya tulis.
Research: Students can participate in research activities, including the process of writing and preparing scientific papers.
5. Studi/Proyek Independen; mahasiswa dapat berperan aktif dalam kegiatan yang terkait dengan aktivitas keprofesian seperti lomba-lomba keteknikmesinan.
Independent Study/Project: Students can actively engage in activities related to professional engineering practices such as mechanical engineering competitions.
6. Proyek kemanusiaan; mahasiswa dapat mengembangkan jiwa sosial dan kepedulian di lingkungan sekitar.
Humanitarian Project: Students can cultivate social awareness and contribute to their surrounding communities.
7. Kegiatan Wirausaha; mahasiswa dapat mengasah jiwa kewirausahaan dan berani untuk memulai usaha baru.
Entrepreneurship: Students can develop entrepreneurial skills and the courage to start new business ventures.
8. KKN Tematik; mahasiswa memiliki kepekaan sosial untuk menggali dan menyelami permasalahan yang ada serta turut memberikan solusi dengan minat dan keahlian teknik mesin
Thematic Community Service (KKN Tematik): Students demonstrate social sensitivity by exploring, understanding, and addressing real-world problems while contributing solutions based on their mechanical engineering interests and expertise.



9.2. Struktur Kurikulum MB – KM

Curriculum Structure MB - KM

Pada dasarnya MB KM memenuhi CPMK dari suatu MK yang dibebani CPL, sehingga CPL yang dibebankan ke MK MK konversi hasil magang sama dengan CPMK yang berada di MK tersebut. Kegiatan MBKM yang lainnya merupakan pendukung CPL atau masuk dalam CPL general yang bisa dikonsersi ke dalam MK MK yang sifatnya MK Pengayaan. Hanya kegiatan magang dapat dikonversi kedalam MK Magang yang merupakan MK pilihan prodi. *Essentially, MBKM activities fulfill the Course Learning Outcomes (CPMK) of a course that carries specific Program Learning Outcomes (CPL). Therefore, the CPL assigned to a course that is replaced by internship conversion is the same as the CPMK of that course. Other MBKM activities serve as support for CPL or are included under general CPL, which can be converted into enrichment courses. Only internship activities can be converted into Internship Courses, which are elective courses within the program.*

Kegiatan magang dapat dikonversi ke dalam sks dan nilai Mata Kuliah Kerja Praktek, Mata Kuliah Pilihan Magang 1 (3 sks) dan Magang 2 (3 sks), serta Mata Kuliah pilihan lainnya yang sesuai dengan capaian pembelajaran mata kuliah pada Tabel 1 berikut ini. *Internship activities can be converted into credits and grades for the Industrial Training Course (Kerja Praktek), Internship Elective Course 1 (3 credits), Internship Elective Course 2 (3 credits), and other elective courses that are aligned with the learning outcomes of the respective courses as listed in Table 1 below.*

Tabel 9.1. Konversi Mata Kuliah Kegiatan Magang
Course Conversion for Internship Activities

Lama Magang <i>Internship Duration</i>	Mata Kuliah <i>Courses</i>	Jumlah SKS yang diperoleh



		Number of Credits Earned
3 bulan 3 months	Magang 1, Kerja Praktik*, MK Pilihan**, MK Pengayaan <i>Internship 1, Industrial Training*, Elective Course**, Enrichment Course</i>	6 – 8 SKS <i>6 – 8 credits</i>
6 bulan 6 months	Magang 1, Magang 2, Kerja Praktik*, MK Pilihan**, MK Pengayaan, Proposal dan TA <i>Internship 1, Internship 2, Industrial Training*, Elective Course**, Enrichment Course, Proposal and Final Project (TA)</i>	14 – 20 SKS <i>14 – 20 credits</i>
Note: * Kerja Praktek bisa diklaim jika memenuhi prosedur Kerja Praktek / <i>Industrial Training can be claimed if it meets the Industrial Training procedures.</i> ** MK pilihan diberikan jika mahasiswa mengikuti program program yang dibuat oleh dosen pengampu MK tersebut / <i>Elective courses are granted if students participate in programs organized by the course instructor.</i>		

Konversi Mata Kuliah dapat diusulkan oleh mahasiswa yang mempunyai kompetensi sesuai dengan capaian pembelajaran Mata Kuliah dengan mengikuti *assessment* oleh dosen pengampu MK yang bersangkutan dengan persetujuan dosen wali yang telah berkoordinasi dengan tim akademik.

Course conversion can be proposed by students who have competencies aligned with the Course Learning Outcomes (CLO) by undergoing an assessment conducted by the relevant course instructor, with approval from the academic advisor who has coordinated with the academic team.

Rencana Pembelajaran Semester (RPS) —•

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 10





10 Rencana Pembelajaran Semester (RPS)

		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM – ITS						
MATA KULIAH		KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Direvisi
PESAWAT PEMINDAH BAHAN		TM234711	MEKANIKA BENDA PADAT		T=3	P=0	Pilihan	04 Januari 2022
OTORISASI		Pengembang RP		Koordinator RMK		KETUA PRODI		
		Achmad Syaifudin		Alief Wikarta		Suwarno		
Capaian Pembelajaran	Program Studi	B. Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu dan teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. D. Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. E. Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. G. Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data.						
	Mata Kuliah	1. [E] Mahasiswa mampu memahami prinsip Material Handling, karakteristik dan klasifikasi material. 2. [G] Mahasiswa mampu menguasai strategi pemilihan crane dan forklift yang sesuai untuk jenis dan lokasi material. 3. [B, D] Mampu menghitung kebutuhan daya dan kapasitas salah satu jenis pesawat pemindah bahan: crane dan atau forklift. 4. [G] Mahasiswa mampu menguasai strategi pemilihan conveyor yang sesuai untuk jenis material (unit dan curah) dan lokasi material. 5. [B, D] Mahasiswa mampu menghitung kebutuhan daya dan kapasitas salah satu jenis pesawat pemindah bahan: conveyor dan atau elevator.						
	Bahan Kajian							



Diskripsi Bahan Kajian & Pokok Bahasan	Pesawat pemindah bahan: conveyor, crane dan forklift	
	Pokok Bahasan	
	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Prinsip material handling - Karakter dan klasifikasi material - Jenis pesawat pemindah bahan untuk unit material dan bulk material. - Perancangan daya dan kapasitas pesawat pemindah bahan: crane, conveyor dan forklift	



Pustaka	Utama :	
	1. Slide handout	
	Pendukung :	
	2. Raymond A. Kulwicz, "Material Handling Handbook", 2 nd Edition, John Wiley and Sons, ASME, USA. 3. CEMA, "Belt Conveyor for Bulk Materials", 5 th Edition, CEMA, USA 4. KWS Inc., "Screw Conveyor Engineering Guide", KWS Manufacturing Company, USA.	
Media Pembelajaran	Software :	Hardware :
	-	PC & LCD Projector
Team Teaching	-	
Assessment	Lembar kerja mandiri Peer teaching / Presentasi / Laporan kelompok Asesmen terjadwal (Kuis 1-2) Evaluasi terjadwal (ETS dan EAS)	
Matakuliah Syarat	Statika, Mekanika Kekuatan Material, Elemen Mesin (1, 2), Kinematika dan Dinamika Teknik	



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
1	- Mampu menjelaskan dan menerapkan prinsip-prinsip Material Handling - Mampu menjelaskan berbagai jenis Material Transport Equipment - Mampu menjelaskan klasifikasi dan karakterisasi material - Mampu memilih jenis Material Transport Equipment sesuai klasifikasi dan karakterisasi material	- Kecakapan dalam menjelaskan prinsip Material Handling - Kecakapan dalam menjelaskan Material Transport Equipment - Kecakapan dalam menjelaskan klasifikasi dan karakterisasi material - Ketepatan dalam memilih jenis Material Transport Equipment sesuai klasifikasi dan karakterisasi material	Oral Post-Test (acak): Sistematika dan komprehensivitas deskripsi	Perkuliahan [TM: 3x50"] Contextual Teaching and Learning (CTL) Penugasan Terstruktur [TM: 3x60"] Pahami perbedaan pengertian Material Handling dan Material Transport. Pahami klasifikasi dan karakterisasi material dan pemilihan Material Transport Equipment yang sesuai. Belajar Mandiri [TM: 3x60"] Persiapkan oral-pretest untuk kuliah ke-2 mengenai prinsip Material Handling dan Material Transport Equipment; klasifikasi dan karakterisasi material. Pelajari klasifikasi crane dan hoist.	Kontrak kuliah Prinsip Material Handling Material Transport Equipment Klasifikasi dan karakterisasi material Konsep Unit Load [1] : Handout di myITS Calssroom [2] : Bab 1, 4-5	-
2	- Mampu menjelaskan klasifikasi crane dan hoist - Mampu menjelaskan prinsip kerja crane dan hoist	- Kecakapan dalam menjelaskan klasifikasi crane dan hoist - Kecakapan dalam menjelaskan prinsip kerja crane dan hoist	Forum Diskusi: Keaktifan dalam diskusi	Perkuliahan [TM: 3x50"] Flipped Learning (FL) Penugasan Terstruktur [TM: 3x60"] Pahami klasifikasi crane dan hoist, serta prinsip kerjanya. Kerjakan tugas yang diberikan di kelas. Belajar Mandiri [TM: 3x60"] Pelajari segala sesuatu mengenai tower crane, terutama analisis beban, kapasitas, daya dan kestabilan. Ikuti diskusi dalam forum Teams.	Klasifikasi crane dan hoist Prinsip kerja crane dan hoist [1] : Handout di myITS Calssroom [2] : Bab 10	-



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
3	- Mampu menganalisis gaya dan kebutuhan daya pada Tower crane - Mampu menganalisis kapasitas dan kestabilan pada Tower crane	- Kecakapan dalam menganalisis gaya, kebutuhan daya dan kapasitas pada Tower crane - Kecakapan dalam menganalisis kapasitas dan kestabilan pada Tower crane	Tugas Personal: Lihat rubrik Asesmen	Perkuliahan [TM: 3x50"] Flipped Learning (FL) Penugasan Terstruktur [TM: 3x60"] Pahami analisis gaya dan kebutuhan daya pada Tower crane. Pahami kapasitas dan kestabilan pada Tower crane. Kerjakan tugas yang diberikan di kelas. Belajar Mandiri [TM: 3x60"] Pelajari kapasitas dan prinsip kestabilan untuk Tower crane.	Penurunan gaya, analisis kebutuhan daya dan kapasitas Tower crane. Analisis kapasitas dan kestabilan pada Tower crane. [1] : Handout di myITS Calsroom [2] : Bab 10	10%
4	- Mampu menganalisis gaya dan kapasitas pada Forklift - Mampu menganalisis kapasitas dan kestabilan pada Forklift - Mampu menjelaskan tipping load area dari Forklift	- Kecakapan dalam menganalisis gaya dan kapasitas pada Forklift - Kecakapan dalam menganalisis kapasitas dan kestabilan pada Forklift	Tugas Personal: Lihat rubrik Asesmen	Perkuliahan [TM: 3x50"] Flipped Learning (FL) Penugasan Terstruktur [TM: 3x60"] Pahami prinsip kerja dan klasifikasi Forklift. Pahami analisis gaya dan kapasitas pada Forklift. Kerjakan tugas yang diberikan di kelas. Pahami tipping load area dan kestabilan pada Forklift. Belajar Mandiri [TM: 3x60"] Persiapkan mengikuti pembelajaran sistem PBL untuk crane and hoist.	Prinsip kerja dan klasifikasi Forklift Forklift: analisis beban dan kapasitas. Tipping load area Kestabilan Forklift [1] : Handout di myITS Calsroom [2] : Bab 10	10%



5 - 8	• Mampu menerapkan pengetahuan PPB dalam memecahkan problem spesifik	• Kecakapan dalam pengidentifikasian masalah (M5). • Kecakapan dalam mencari sumber literatur yang bereputasi (M6). • Kecakapan dalam bekerja bersama kelompok (M7). • Kecakapan dalam menyusun dan	Laporan dan presentasi: Lihat rubrik Asesmen	Perkuliahan [TM: 3x50"] Problem Based Learning (PBL) Penugasan Terstruktur [TM: 3x60"] Identifikasi masalah (M5); Penyusunan LKM (M6); Peer teaching (M7); Presentasi (M8) Belajar Mandiri [TM: 3x60"] Pelajari step-by-step pemecahan masalah teknik; pelajari penggunaan sumber literatur yang bereputasi; pelajari metode presentasi yang baik; pelajari sistematika penyusunan laporan yang baik	Studi literatur mandiri [1]: Handout di myITS Calssroom	30%



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
		mendesiminasi laporan Engineering Solution(M8).				
9	- Mampu menjelaskan klasifikasi Conveyor berdasarkan jenis material dan posisi pemasangan - Mampu memilih tipe Conveyor sesuai kebutuhan pemindahan material	- Kecakapan dalam menjelaskan klasifikasi Conveyor berdasarkan jenis material dan posisi pemasangan - Ketepatan dalam memilih tipe Conveyor sesuai kebutuhan pemindahan material	Forum Diskusi: Keaktifan dalam diskusi	Perkuliahan [TM: 3x50"] Contextual Teaching and Learning (CTL) Penugasan Terstruktur [TM: 3x60"] Pahami klasifikasi dan strategi pemilihan Conveyor sesuai dengan jenis material dan posisi instalasinya. Belajar Mandiri [TM: 3x60"] Pelajari segala sesuatu mengenai Belt Conveyor.	Klasifikasi Conveyor Strategi Pemilihan Conveyor [1]: Handout di myITS Calsroom [3]: Bab 1	-
10	- Mampu menganalisis pemilihan jenis belt dan kapasitas pada Belt Conveyor. - Mampu menganalisis kebutuhan daya pada Belt Conveyor.	- Kecakapan dalam menganalisis kebutuhan daya dan kapasitas pada Belt Conveyor. - Kecakapan dalam menganalisis kebutuhan daya pada Belt Conveyor.	Tugas Personal: Lihat rubrik Asesmen	Perkuliahan [TM: 3x50"] Flipped Learning (FL) Penugasan Terstruktur [TM: 3x60"] Pahami jenis-jenis belt untuk conveyor dan prosedur analisis kapasitas. Kuasai prosedur analisis kebutuhan daya pada Belt Conveyor. Belajar Mandiri [TM: 3x60"] Pelajari segala sesuatu mengenai Screw Conveyor.	Belt Conveyor: typical travel paths, nomenclature of components, belts selection, conveyor take-up Belt Conveyor: analisis daya [1]: Handout di myITS Calsroom [3]: Bab 2, 4, 6, dan 7	10%



11	• Mampu menganalisis penentuan kecepatan dan kapasitas Screw Conveyor. • Mampu menganalisis kebutuhan daya Screw Conveyor.	• Kecakapan dalam menganalisis penentuan kecepatan putar dan kapasitas Screw Conveyor. • Kecakapan dalam menganalisis kebutuhan daya Screw Conveyor.	Tugas Personal: Lihat rubrik Asesmen	Perkuliahan [TM: 3x50"] Flipped Learning (FL) Penugasan Terstruktur [TM: 3x60"] Pahami dasar, tipe dan karakteristik Screw Conveyor, terutama penentuan kecepatan dan analisis kapasitas. Kuasai prosedur analisis kebutuhan daya pada Screw Conveyor. Belajar Mandiri [TM: 3x60"] Pelajari analisis kebutuhan daya pada Bucket Elevator.	Screw Conveyor: basic, types, and characteristics, analisis daya. [1]: Handout di myITS Calssroom [4]: Semua Bab	5%



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
12	- Mampu menganalisis pemilihan jenis feeder, kecepatan dan kapasitas pada Bucket Conveyor. - Mampu menganalisis kebutuhan daya pada Bucket Conveyor..	- Kecakapan dalam menganalisis jenis feeder, kecepatan dan kapasitas pada Bucket Elevator. - Kecakapan dalam menganalisis kebutuhan daya pada Bucket Elevator.	Tugas Personal: Lihat rubrik Asesmen	Perkuliahan [TM: 3x50"] Flipped Learning (FL) Penugasan Terstruktur [TM: 3x60"] Pahami jenis-jenis Bucket Elevator, prosedur analisis kecepatan dan kapasitas. Kuasai prosedur analisis kebutuhan daya pada Bucket Elevator. Belajar Mandiri [TM: 3x60"] Pelajari analisis kebutuhan daya pada Bucket Elevator.	Bucket Elevator: typical feeder, nomenclature of components, bucket selection, analisis kecepatan dan kapasitas, analisis daya. [1]: Handout di myITS Calssroom	5%
13 - 16	Mampu menerapkan pengetahuan PPB dalam memecahkan problem spesifik	- Kecakapan dalam pengidentifikasian masalah (M13). - Kecakapan dalam mencari sumber literatur yang bereputasi (M14). - Kecakapan dalam bekerja bersama kelompok (M15). - Kecakapan dalam menyusun dan mendesiminasikan laporan Engineering Solution(M16).	Laporan dan presentasi: Lihat rubrik Asesmen	Perkuliahan [TM: 3x50"] Problem Based Learning (PBL) Penugasan Terstruktur [TM: 3x60"] Identifikasi masalah (M13); Penyusunan LKM (M14); Peer teaching (M15); Presentasi (M16) Belajar Mandiri [TM: 3x60"] Pelajari step-by-step pemecahan masalah teknik; pelajari penggunaan sumber literatur yang bereputasi; pelajari metode presentasi yang baik; pelajari sistematika penyusunan laporan yang baik	Studi literatur mandiri [1]: Handout di myITS Calssroom	30%



 RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM						Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER						
MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
Adhesive dan Sambungan Adhesive	TM234738	MEKANIKA BENDA PADAT	T=3	P=0	1	5 Mei 2019
OTORISASI	Pengembang RPS		Koordinator RMK		Ketua PRODI	
	Dr. Eng. Yohanes, ST., MSc.		Dr. Eng. Yohanes, ST., MSc.		Dr. Ir. Atok Setiyawan, M.Eng.Sc.	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK					
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi.				
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika.				
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian Teknik.				
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika.				
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan Teknik.				
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data.				
	Capaian Pembelajaran Mata Kuliah (CPMK)					



	CPMK-1	Mahasiswa mampu memahami dan menjelaskan deformasi, tegangan, kriteria kegagalan, dan konsentrasi tegangan.																																			
	CPMK-2	Students are able to understand and explain deformation, stress, failure criterion, and stress concentration.																																			
	CPMK-3	Mahasiswa mampu memahami pengaruh cacat/retakan serta penjalaran retakan terhadap kehandalan material logam (paduan).																																			
	CPMK-4	Students are able to understand the effect of defects/cracks and crack propagation on the reliability of metals (alloys).																																			
	Matrik CPL – CPMK <table><tr><td></td><td>CPL-4</td><td>CPL-5</td><td>CPL-6</td><td>CPL-7</td><td>CPL-8</td><td>CPL-10</td></tr><tr><td>CPMK-1</td><td>✓</td><td>✓</td><td></td><td></td><td>✓</td><td></td></tr><tr><td>CPMK-2</td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td></tr><tr><td>CPMK-3</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td>✓</td></tr><tr><td>CPMK-4</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr></table>			CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-10	CPMK-1	✓	✓			✓		CPMK-2			✓	✓	✓		CPMK-3	✓	✓				✓	CPMK-4	✓	✓		✓	✓	✓
	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-10																															
CPMK-1	✓	✓			✓																																
CPMK-2			✓	✓	✓																																
CPMK-3	✓	✓				✓																															
CPMK-4	✓	✓		✓	✓	✓																															
Deskripsi Singkat MK	Mata kuliah Adhesive dan Sambungan Adhesive membahas prinsip dasar ilmu adhesive, jenis-jenis adhesive, mekanisme perekatan, desain sambungan, serta aplikasi dan analisis kegagalan sambungan adhesive dalam bidang teknik mesin.																																				
Bahan Kajian: Materi Pembelajaran	• Pendahuluan: Definisi, sejarah, keuntungan dan kerugian adhesive, aplikasi dan tren terkini. • Prinsip Dasar Perekatan: Teori perekatan, tegangan permukaan, pembasahan, viskositas. • Klasifikasi Adhesive: Jenis alami dan sintetik (termoplastik, termoset, elastomerik, reaktif), adhesive berbasis air dan pelarut, pemilihan adhesive. • Faktor yang Mempengaruhi Kekuatan: Persiapan permukaan, kondisi lingkungan, desain sambungan, aplikasi adhesive, proses pengerasan, kompatibilitas. • Desain Sambungan: Analisis tegangan, optimasi desain, penggunaan FEA (pengenalan), standar desain.																																				



	• Pengujian Sambungan: Standar pengujian, pengujian kekuatan (tarik, geser, kelupas, impak, kelelahan), pengujian ketahanan lingkungan, interpretasi hasil. • Analisis Kegagalan: Jenis kegagalan, fractography, identifikasi penyebab, pencegahan kegagalan. • Aplikasi Industri: Adhesive dalam otomotif, penerbangan, elektronik, dan medis. • Teknologi Masa Depan: Adhesive performa tinggi, smart adhesive, bio-based adhesive, nanotechnology, keberlanjutan.						
Pustaka	Utama :						
	[1] R. D. Adams, Ed., Adhesive bonding: science, technology and applications, Second edition. in Woodhead Publishing series in welding and other joining technologies. Oxford: Woodhead Publishing, 2021.						
	[2] A. S. Q. F. Barbosa, L. F. M. da Silva, R. J. C. Carbas, E. A. S. Marques, and A. Akhavan-Safar, <i>Adhesive Bonding Technology and Testing</i> . Wiley-VCH, 2023. Accessed: Apr. 26, 2025.						
	[3] K. L. Mittal and S. K. Panigrahi, Eds., Structural adhesive joints: design, analysis and testing. Hoboken, NJ: Wiley-Scrivener, 2020.						
Dosen Pengampu	Pendukung :						
	-						
Dosen Pengampu		Dr. Eng. Yohanes, ST., MSc.					
Matakuliah syarat		-					
Mg Ke	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)



1	Mahasiswa mampu memahami definisi, sejarah, keuntungan dan kerugian adhesive.	Memahami konsep dasar adhesive.	Kuis singkat.	Ceramah interaktif, diskusi kelompok. [3 sks]		Pengantar: definisi, perkembangan teknologi, keuntungan & kerugian dan aplikasi adhesive dan sambungan adhesive. [1]	5
2	Mahasiswa mampu menjelaskan prinsip dasar perekatan adhesive.	Menjelaskan teori perekatan.	Tugas individu (rangkuman).	Ceramah, demonstrasi sederhana, diskusi. [3 sks]		Prinsip Dasar Perekatan Adhesive: - Teori-teori perekatan. - Konsep tegangan permukaan dan energi permukaan. - Pembasahan (wetting) dan penyebaran adhesive. - Viskositas dan reologi adhesive. [1]	5
3	Mahasiswa mampu mengklasifikasikan jenis-jenis adhesive (bagian 1).	Mengidentifikasi jenis adhesive alami dan sintetik.	Penilaian presentasi.	Ceramah, presentasi mahasiswa. [3 sks]		Klasifikasi Jenis-Jenis Adhesive (Bagian 1): - Adhesive alami. - Adhesive sintetik (termoplastik dan termoset). [1]	5



4	Mahasiswa mampu mengklasifikasikan jenis-jenis adhesive (bagian 2).	Mengidentifikasi jenis adhesive elastomerik dan reaktif.	Tugas kelompok (studi kasus).	Ceramah, diskusi kelompok. [3 sks]		Klasifikasi Jenis-Jenis Adhesive (Bagian 2): - Adhesive elastomerik dan reaktif. - Adhesive berbasis air dan pelarut. - Pemilihan jenis adhesive. [1]	5
5	Mahasiswa mampu menganalisis faktor-faktor yang mempengaruhi kekuatan sambungan adhesive (bagian 1).	Menjelaskan pengaruh persiapan permukaan dan kondisi lingkungan.	Kuis	Ceramah, demonstrasi. [3 sks]		Faktor-Faktor yang Mempengaruhi Kekuatan Sambungan Adhesive (Bagian 1): - Persiapan permukaan substrat. - Pengaruh kondisi lingkungan. - Desain sambungan. [1]	5
6	Mahasiswa mampu menganalisis faktor-faktor yang mempengaruhi kekuatan sambungan adhesive (bagian 2).	Menjelaskan pengaruh aplikasi dan proses pengerasan adhesive.	Tugas individu (analisis literatur).	Ceramah, diskusi, pemutaran video. [3 sks]		Faktor-Faktor yang Mempengaruhi Kekuatan Sambungan Adhesive (Bagian 2): - Aplikasi adhesive. - Proses pengeringan dan pengerasan (curing). - Kompatibilitas	5



						adhesive dan substrat. [1]	
7	Mahasiswa mampu mendesain sambungan adhesive (bagian 1).	Menganalisis tegangan pada sambungan.	Latihan soal.	Ceramah, pemecahan soal. [3 sks]		Desain Sambungan Adhesive (Bagian 1): - Analisis tegangan pada sambungan adhesive. - Konsep distribusi tegangan. - Faktor-faktor desain. [2]	5
8	Evaluasi Tengah Semester / Ujian Tengan Semester						15
9	Mahasiswa mampu mendesain sambungan adhesive (bagian 2).	Mengoptimalkan desain sambungan.	Tugas kelompok (proposal desain).	Ceramah, studi kasus, pengenalan FEA. [3 sks]		Desain Sambungan Adhesive (Bagian 2): - Optimasi desain sambungan. - Penggunaan FEA (pengenalan). - Standar dan pedoman desain. [2]	5
10	Mahasiswa mampu menjelaskan pengujian sambungan adhesive (bagian 1).	Memahami standar dan jenis pengujian kekuatan.	Laporan praktikum/pengujian.	Ceramah, demonstrasi. [3 sks]		Pengujian Sambungan Adhesive (Bagian 1): - Standar pengujian. - Pengujian kekuatan tarik. - Pengujian kekuatan geser. -	5



						Pengujian kekuatan kelupas. [2]	
11	Mahasiswa mampu menjelaskan pengujian sambungan adhesive (bagian 2).	Memahami jenis pengujian dampak, kelelahan, dan lingkungan.	Tugas individu (analisis data).	Ceramah, diskusi studi kasus. [3 sks]		Pengujian Sambungan Adhesive (Bagian 2): - Pengujian kekuatan dampak. - Pengujian kelelahan. - Pengujian ketahanan lingkungan. - Interpretasi hasil pengujian. [2]	5
12	Mahasiswa mampu menganalisis kegagalan sambungan adhesive.	Mengidentifikasi jenis dan penyebab kegagalan.	Tugas kelompok (analisis studi kasus).	Ceramah, studi kasus, diskusi. [3 sks]		Analisis Kegagalan Sambungan Adhesive: - Jenis-jenis kegagalan. - Metode analisis permukaan patahan (fractography). - Identifikasi penyebab kegagalan. - Strategi pencegahan kegagalan. [2]	5
13	Mahasiswa mampu menjelaskan aplikasi	Memahami aplikasi adhesive di industri transportasi.	Kuis.	Ceramah, presentasi praktisi, pemutaran video. [3 sks]		Aplikasi Sambungan Adhesive dalam Industri Otomotif dan Penerbangan: -	5



	sambungan adhesive dalam industri otomotif dan penerbangan.					Penggunaan adhesive dalam perakitan komponen otomotif. - Aplikasi adhesive pada struktur pesawat terbang. - Keuntungan penggunaan adhesive dalam industri transportasi. [2]	
14	Mahasiswa mampu menjelaskan aplikasi sambungan adhesive dalam industri.	Memahami aplikasi adhesive di industri	Tugas individu (makalah).	Ceramah, diskusi, studi kasus. [3 sks]		Aplikasi Sambungan Adhesive dalam Industri: - Penggunaan adhesive dalam perakitan produk. - Persyaratan khusus adhesive. [1]	5
15	Mahasiswa mampu menjelaskan teknologi adhesive masa depan dan tren inovasi.	Memahami perkembangan teknologi adhesive.	Penilaian presentasi.	Ceramah, diskusi, presentasi mahasiswa. [3 sks]		Teknologi Adhesive Masa Depan dan Tren Inovasi: - Pengembangan adhesive dengan performa tinggi. - Smart adhesive. - Bio-based adhesive. - Nanotechnology	5



						dalam adhesive. - Aspek keberlanjutan dan daur ulang adhesive. [1]	
16	Evaluasi Akhir Semester / Ujian Akhir Semester						15



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
	RENCANA PEMBELAJARAN SEMESTER					
MATA KULIAH (MK) (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
ALGORITMA PEMROGRAMAN PROGRAMMING ALGORITHM	TM184202		T=2	P=0	II	
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Undergraduate Program)	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam				



		bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>(Able to study and utilize science and technology in order to apply them to the field of mechanical engineering, and able to make appropriate decisions based on individual or group work in the form of final project reports or other forms of learning activities whose output is equivalent to the final project through logical, critical, systematic, and innovative thinking)</i>
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi. <i>(Able to manage one's own learning and develop oneself as a lifelong learner to compete at the national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability and understanding technology-based entrepreneurship)</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>(Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan Teknik <i>(Ability to identify, formulate, analyze, and solve technical problems)</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>	
	CPMK-1	Mahasiswa mampu memahami, menganalisa, dan menyusun berbagai macam algoritma dan pemrograman untuk menyelesaikan permasalahan umum dan engineering, baik secara individu maupun dalam kelompok. (CPL 2, 3, 7, 8)
	Matrik CPL – CPMK	



		CPMK	CPL-2	CPL-3	CPL-7	CPL-8
		CPMK-1	V	V	V	V
Deskripsi Singkat MK (Short Description of Course)	Tuliskan relevansi & cakupan materi/bahan kajian sesuai dengan matakuliah ini dan sesuai dengan Sub-CPMK					
Bahan Kajian: Materi Pembelajaran (Course Materials)						
Pustaka (References)C	Utama : (Main)					
	1. Textbook					
	Pendukung : (Supplementary)					
	2. Handout Kuliah					
Dosen Pengampu (Lecturers)	Alief Wikarta					
Mata kuliah syarat (Prerequisites)	-					



Mg Ke- (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>(Final Ability of Each Learning Stage (LLO))</i>	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>(Learning Model; Learning Method; Student Assignment)</i>		Materi Pembelajaran <i>(Learning Materials)</i>	Bobot Penilaian (%) <i>(Assesment Credit (%))</i>
		Indikator <i>(Indicator)</i>	Kriteria & Bentuk <i>(Criteria & Model)</i>	Luring (offline) <i>(Offline)</i>	Daring (online) <i>(Online)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami tentang Bahasa Pemrograman, dan menyusun Algoritma, serta Flowchart <i>Student capable understand about Programming Languages , and compiling Algorithms , and Flowcharts</i>	Mampu dan terampil menyusun algoritma dan flowchart untuk menyelesaikan sebuah permasalahan <i>Capable and skilled compile algorithm and flowchart for finish A problem</i>	Oral Post-Test (acak): <i>Oral Post-Test (random):</i>	Perkuliahan [TM: 3x50"] Kuliah Pengantar & Brainstorming Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"] Lecture [TM: 3x50"] Studying Introduction & Brainstorming Study Structured [TM: 3x60"] Exercises		Kontrak kuliah Bahasa pemrograman Komputer untuk Engineering [1]: Bab 1, 3 dan 5 [2]: Handout di myITS Calssroom Contract studying Programming language Computer for Engineering [1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calssroom	-



				<i>Study Independent</i> [TM: 3x60"]			
2	Mahasiswa mampu memahami tentang Bahasa Pemrograman, dan menyusun Algoritma, serta Flowchart <i>Student capable understand about Programming Languages , and compiling Algorithms , and Flowcharts</i>	Mampu dan terampil menyusun algoritma dan flowchart untuk menyelesaikan sebuah permasalahan <i>Capable and skilled compile algorithm and flowchart for finish A problem</i>	Oral Post-Test (acak): Latihan Soal Tugas Mandiri: <i>Oral Post-Test (random):</i> <i>Exercises</i> <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Kuliah Pengantar & Brainstorming Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying Introduction & Brainstorming</i> <i>Study Structured [TM: 3x60"]</i> <i>Exercises</i> <i>Study Independent</i> [TM: 3x60"]		Kontrak kuliah Bahasa pemrograman Komputer untuk Engineering [1]: Bab 8 [2]: Handout di myITS Calssroom <i>Contract studying</i> <i>Programming language</i> <i>Computer for Engineering</i> [1]: Chapter 8 [2]: Handout on myITS Calssroom	-



3	Mahasiswa mampu menganalisa bermacam operator dasar pemrograman dan struktur dasar algoritma: sequence, repetition/looping, dan selection <i>Student capable analyze various basic operators programming and structure base algorithm : sequence, repetition/looping , and selection</i>	Mampu dan terampil menyelesaikan bermacam struktur dasar algoritma <i>Capable and skilled finish various structure base algorithm</i>	Oral Post-Test (acak): Latihan Soal Tugas Mandiri: <i>Oral Post-Test (random) : Exercises</i> <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Kuliah & Brainstorming Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Lecture & Brainstorming</i> <i>Study Structured [TM: 3x60"] Exercises</i> <i>Study Independent [TM: 3x60"]</i>		Operator dasar pemrograman Struktur dasar algoritma [1]: Bab 8 [2]: Handout di myITS Calssroom <i>Basic operators programming</i> <i>Structure base algorithm</i> [1]: Chapter 8 [2]: Handout on myITS Calssroom	-
4	Mahasiswa mampu menganalisa bermacam operator dasar	Mampu dan terampil menyelesaikan bermacam	Oral Post-Test (acak): Latihan Soal Tugas Mandiri:	Perkuliahan [TM: 3x50"] Kuliah & Brainstorming		Operator dasar pemrograman Struktur dasar algoritma	4/15



	pemrograman dan struktur dasar algoritma: sequence, repetition/looping, dan selection <i>Student capable analyze various basic operators programming and structure base algorithm : sequence, repetition/looping , and selection</i>	struktur dasar algoritma <i>Capable and skilled finish various structure base algorithm</i>	<i>Oral Post-Test (random) : Exercises</i> <i>Task Independent :</i>	Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Lecture & Brainstorming</i> <i>Study Structured [TM: 3x60"] Exercises</i> <i>Study Independent [TM: 3x60"]</i>		[1]: Bab 8 [2]: Handout di myITS Calssroom - <i>Basic operators programming</i> - <i>Structure base algorithm</i> [1]: Chapter 8 [2]: Handout on myITS Calssroom	
5	- Mahasiswa mampu menyusun sebuah modul bahasa pemrograman yang terdiri dari beberapa function dan struktur dasar algoritma	- Mampu dan terampil menyusun modul bahasa pemrograman, running, menganalisa error, hingga modul tersebut	Oral Post-Test (acak): Project 1 Project 2 <i>Oral Post-Test (random) : Project 1 Project 2</i>	Perkuliahan [TM: 3x50"] Video tutorial menggunakan bahasa pemrograman Kuliah Belajar Terstruktur [TM: 3x60"]		- Modul yang terdiri dari sequence dan repetition while - Modul yang terdiri dari sequence dan repetition for - Modul yang terdiri dari sequence,	-



	<i>Student capable compile A module Language programming consisting of from some functions and structures base algorithm</i>	berjalan sesuai tujuan. <i>Capable and skilled compile module Language programming , running, analyzing errors, to module the walk in accordance objective .</i>		Belajar Mandiri [TM: 3x60"] Project 1: secret message Project 2: menghitung hari di kalender Lecture [TM: 3x50"] Video tutorial using Language programming Studying Study Structured [TM: 3x60"] Study Independent [TM: 3x60"] Project 1: secret message Project 2: counting day in the calendar		repetition, dan selection [1]: Bab 9 [2]: Handout di myITS Calssroom - The module consists of from sequence and repetition while - The module consists of from sequence and repetition for - The module consists of from sequence, repetition, and selection [1]: Chapter 9 [2]: Handout on myITS Calssroom	



6	Mahasiswa mampu menyusun sebuah modul bahasa pemrograman yang terdiri dari beberapa function dan struktur dasar algoritma <i>Student capable compile A module Language programming consisting of from some functions and structures base algorithm</i>	Mampu dan terampil menyusun modul bahasa pemrograman, running, menganalisa error, hingga modul tersebut berjalan sesuai tujuan. <i>Capable and skilled compile module Language programming , running, analyzing errors, to module the walk in accordance objective .</i>	Oral Post-Test (acak): Project 1 Project 2 Tugas Mandiri: <i>Oral Post-Test (random):</i> Project 1 Project 2 <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Video tutorial menggunakan bahasa pemrograman Kuliah Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Project 1: secret message Project 2: menghitung hari di kalender <i>Lecture [TM: 3x50"] Video tutorial using Language programming Studying</i> <i>Study Structured [TM: 3x60"]</i>	Modul yang terdiri dari sequence dan repetition while Modul yang terdiri dari sequence dan repetition for Modul yang terdiri dari sequence, repetition, dan selection [1]: Bab 9 [2]: Handout di myITS Calssroom <i>The module consists of from sequence and repetition while</i> <i>The module consists of from sequence and repetition for</i> <i>The module consists of from sequence, repetition, and selection</i> [1]: Chapter 9	-



				<i>Study Independent</i> <i>[TM: 3x60"]</i> <i>Project 1: secret message</i> <i>Project 2: counting day in the calendar</i>		<i>[2]: Handout on myITS Calssroom</i>	
7	Mahasiswa mampu menyusun sebuah modul bahasa pemrograman yang terdiri dari beberapa function dan struktur dasar algoritma <i>Student capable compile A module Language programming consisting of from some functions and structures base algorithm</i>	Mampu dan terampil menyusun modul bahasa pemrograman, running, menganalisa error, hingga modul tersebut berjalan sesuai tujuan. <i>Capable and skilled compile module Language programming , running, analyzing errors, to module the</i>	Kuis: 2 soal 100 mnt Project 1 Project 2 Quiz : 2 questions 100 min Project 1 Project 2	Perkuliahan [TM: 3x50"] Video tutorial menggunakan bahasa pemrograman Kuliah Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Project 1: secret message Project 2: menghitung hari di kalender Lecture [TM: 3x50"]		Modul yang terdiri dari sequence dan repetition while Modul yang terdiri dari sequence dan repetition for Modul yang terdiri dari sequence, repetition, dan selection [1]: Bab 9 [2]: Handout di myITS Calssroom The module consists of from sequence and repetition while The module consists of from sequence and repetition for	3/15



		walk in accordance objective .		Video tutorial using Language programming Studying Study Structured [TM: 3x60"] Study Independent [TM: 3x60"] Project 1: secret message Project 2: counting day in the calendar		The module consists of from sequence, repetition, and selection [1]: Chapter 9 [2]: Handout on myITS Calssroom	
8	Evaluasi Tengah Semester / Ujian Tengan Semester (Midterm Exam)						
9	Mahasiswa mampu memahami dan menerapkan konsep object oriented programming Student capable understand and apply draft object	Mampu memahami persoalan dan menyusun program berbasis object Able to understand problems and develop object-	Oral Pre-Test (acak): Project 3 Tugas Mandiri: Oral Pre-Test (random): Project 3 Task Independent :	Perkuliahan [TM: 3x50"] Kuliah & Brainstorming Video Tutorial Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Project 3: turtle class		Object oriented programming [1]: Bab 5 dan 7 [2]: Handout di myITS Calssroom Object oriented programming [1]: Chapters 5 and 7	-



	<i>oriented programming</i>	<i>based programs</i>		<i>Lecture [TM: 3x50"]</i> <i>Lecture & Brainstorming</i> <i>Video Tutorial</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i> <i>Project 3: turtle class</i>		[2]: Handout on myITS Calssroom	
10	Mahasiswa mampu memahami dan menerapkan konsep object oriented programming <i>Student capable understand and apply draft object oriented programming</i>	Mampu memahami persoalan dan menyusun program berbasis object <i>Able to understand problems and develop object-based programs</i>	Oral Pre-Test (acak): Project 3 Tugas Mandiri: <i>Oral Pre-Test (random):</i> <i>Project 3</i> <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Kuliah & Brainstorming Video Tutorial Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Project 3: turtle class <i>Lecture [TM: 3x50"]</i> <i>Lecture & Brainstorming</i>		Object oriented programming [1]: Bab 6 dan 7 [2]: Handout di myITS Classroom Object oriented programming [1]: Chapters 6 and 7 [2]: Handouts in myITS Classroom	-



				<i>Video Tutorial</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i> <i>Project 3: turtle class</i>			
11	Mahasiswa mampu memahami dan menerapkan bermacam struktur data: list, sets, dictionary <i>Student capable understand and apply various data structures : list, sets, dictionary</i>	Mampu menganalisa dan menunjukkan tegangan-regangan akibat Beban Aksial <i>Able to analyze and demonstrate stress-strain due to Axial Load</i>	Kuis: 3 soal 150 mnt Latihan Soal <i>Quiz : 3 questions 150 min</i> <i>Exercises</i>	Perkuliahan [TM: 3x50"] Kuliah Video Tutorial Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Video Tutorial</i> <i>Study Structured [TM: 3x60"]</i>		Struktur data: list, sets, dictionary [1]: Bab 7 [2]: Handout di myITS Classroom - <i>structures : lists, sets, dictionaries</i> [1]: Chapter 7 [2]: Handouts in myITS Classroom	4/15



				<i>Study Independent</i> [TM: 3x60"]			
12	Mahasiswa mampu memahami dan menerapkan bermacam struktur data: list, sets, dictionary <i>Student capable understand and apply various data structures : list, sets, dictionary</i>	Mampu menganalisa dan menunjukkan tegangan-regangan akibat Beban Aksial <i>Able to analyze and demonstrate stress-strain due to Axial Load</i>	Oral Post-Test (acak): Latihan Soal Tugas Mandiri: <i>Oral Post-Test (random):</i> <i>Exercises</i> <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Kuliah Video Tutorial Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Video Tutorial</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent</i> [TM: 3x60"]		Struktur data: list, sets, dictionary [1]: Bab 16 [2]: Handout di myITS Calssroom <i>structures : lists, sets, dictionaries</i> [1]: Chapter 16 [2]: Handout on myITS Calssroom	-
13	Mahasiswa mampu	Mampu menganalisa	Kuis: 2 soal 100 mnt Project 4	Perkuliahan [TM: 3x50"]		Bahasa pemrograman	2/15



	menganalisa dan menyusun program untuk menyelesaikan problem engineering: matrix <i>Student capable analyze and develop programs for solving engineering problems: matrix</i>	dan menyusun program implementasi matrix: inverse, determinant, transpose, perkalian <i>Able to analyze and compile matrix implementation programs : inverse, determinant, transpose, multiplication</i>	<i>Quiz : 2 questions 100 min</i> <i>Project 4</i>	Kuliah Video Tutorial Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Project 4: implementasi matrix <i>Lecture [TM: 3x50"]</i> <i>Studying Video Tutorial</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i> <i>Project 4: matrix implementation</i>		untuk problem engineering [1]: Bab 16 [2]: Handout di myITS Calssroom - <i>Programming language for engineering problems</i> [1]: Chapter 16 [2]: Handout on myITS Calssroom	
14	- Mahasiswa mampu menganalisa dan menyusun program untuk menyelesaikan	- Mampu menganalisa dan menyusun program implementasi matrix: inverse,	Oral Post-Test (acak): Project 4 Tugas Mandiri:	Perkuliahan [TM: 3x50"] Kuliah Video Tutorial		- Bahasa pemrograman untuk problem engineering [1]: Bab 10	-



	problem engineering: matrix <i>Student capable analyze and develop programs for solving engineering problems: matrix</i>	determinant, transpose, perkalian <i>Able to analyze and compile matrix implementation programs : inverse, determinant, transpose, multiplication</i>	<i>Oral Post-Test (random):</i> <i>Project 4</i> <i>Task Independent :</i>	Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Project 4: implementasi matrix <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Video Tutorial</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i> <i>Project 4: matrix implementation</i>		[2]: Handout di myITS Calssroom - <i>Programming language for engineering problems</i> [1]: Chapter 10 [2]: Handout on myITS Calssroom	
15	- Mahasiswa mampu menganalisa dan menyusun program bersama-sama dalam satu kelompok	- Mampu menyusun program dan bekerjasama dalam tim untuk menyelesaikan project	Kuis: 2 soal 100 mnt Project 5 <i>Quiz : 2 questions 100 min</i> <i>Project 5</i>	Perkuliahan [TM: 3x50"] Kuliah Video Tutorial Belajar Terstruktur [TM: 3x60"]		- Menggabungkan Program yang disusun oleh anggota kelompok [1]: Bab 10 [2]: Handout di myITS Calssroom	2/15



	<i>Student capable analyze and develop programs together in One group</i>	<i>Able to organize programs and collaborate in team For complete the project</i>		Belajar Mandiri [TM: 3x60"] Project 5: movie website Lecture [TM: 3x50"] Studying Video Tutorial Study Structured [TM: 3x60"] Study Independent [TM: 3x60"] Project 5: movie website		- <i>Incorporating Programs prepared by members group</i> [1]: Chapter 10 [2]: Handout on myITS Calssroom	
16	Evaluasi Akhir Semester / Ujian Akhir Semester (Final Exam)						



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
	RENCANA PEMBELAJARAN SEMESTER					
MATA KULIAH (MK) (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
ELEMEN MESIN I MACHINE ELEMENTS I	TM184414		T=3	P=0	IV	
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Undergraduate Program)	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics				



CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan <i>Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience</i>		
CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan Teknik <i>Ability identify , formulate , analyze and solve problem technique</i>		
Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)			
CPMK-1	Mahasiswa mampu memahami konsep perancangan elemen mesin dan teori kegagalan lelah (fatigue) (CPL 4,8) <i>Student capable understand draft design element machines and theories failure fatigue (CPL 4.8)</i>		
CPMK-2	Mahasiswa mampu merancang berbagai macam elemen mesin (sambungan, poros dan pasak, kopling, rem, pegas) (CPL 5) <i>Student capable to design various type element engine (connections , axles and pins , clutches , brakes, springs) (CPL 5)</i>		
CPMK-3	Mahasiswa mampu menganalisa kekuatan material elemen mesin yang dipilih, baik secara individu maupun bersama-sama dalam sebuah kelompok (CPL 5,8) <i>Student capable analyze material strength of elements the selected machine , either in a way individual and together in A group (CPL 5.8)</i>		
Matrik CPL – CPMK			
CPMK	CPL-4	CPL-5	CPL-8
CPMK-1	V		V
CPMK-2		V	
CPMK-3		V	V



Deskripsi Singkat MK (Short Description of Course)		Tuliskan relevansi & cakupan materi/bahan kajian sesuai dengan matakuliah ini dan sesuai dengan Sub-CPMK			
Bahan Kajian: Materi Pembelajaran (Course Materials)		Perancangan elemen sambungan dan poros dengan pengaruh beban statik – dinamik <i>Design element joints and axles with influence burden static – dynamic</i>			
Pustaka (References)C		Utama : (Main)			
		3. Shigley, Joseph E., Mechanical Engineering Design, 10th Edition, Mc Graw Hill 2014			
		Pendukung : (Supplementary)			
		4. Handout Kuliah			
Dosen Pengampu (Lecturers)		Achmad Syaifudin, Alief Wikarta, Aida Annisa AD., Julendra Ariatedja			
Mata kuliah syarat (Prerequisites)		Pengetahuan Bahan Teknik dan Mekanika Kekuatan Material <i>Knowledge of Engineering Materials and Mechanics of Material Strength</i>			
Mg Ke (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian (Assesment)	Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)	Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))



	(Final Ability of Each Learning Stage (LLO))	Indikator (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (offline) (Offline)	Daring (online) (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami konsep perancangan dan unit system <i>Student capable understand draft design and system unit</i>	Mampu menjelaskan konsep perancangan dan rekayasa Terampil menerapkan unit system dalam Analisa <i>Able to explain draft design and engineering</i> <i>Skilled implementing system units in analysis</i>	Oral Post-Test (acak): <i>Oral Post-Test (random):</i>	Perkuliahan [TM: 3x50"] Kuliah pengantar & Brainstorming Transfer materi Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying Introduction & Brainstorming</i> <i>Transfer of materials</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>		Kontrak kuliah Konsep perancangan dan rekayasa Unit system [1]: Bab 1, 3 dan 5 [2]: Handout di myITS Classroom <i>Contract studying</i> <i>Draft design and engineering</i> <i>System unit</i> [1]: Chapters 1, 3 and 5 [2]: Handouts in myITS Classroom	-
2	Mahasiswa mampu menganalisa	Mampu menjelaskan klasifikasi	Oral Post-Test (acak): Tugas Mandiri:	Perkuliahan [TM: 3x50"] Kuliah		Review beban – tegangan	-



	beban, tegangan dan memahami dengan baik teori kegagalan beban statik <i>Student capable analyze load , stress and understanding with Good theory failure burden static</i>	beban dan tegangan yang dihasilkan - Mampu menjelaskan sifat mekanik material - Terampil menerapkan teori kegagalan beban statik - Able to explain classification load and resulting voltage - Able to explain characteristic material mechanics <i>Skilled apply theory failure burden static</i>	<i>Oral Post-Test (random):</i> <i>Task Independent :</i>	Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying</i> <i>Study Structured [TM: 3x60"] Studies Case</i> <i>Study Independent [TM: 3x60"]</i>		Review sifat mekanik material Teori kegagalan beban statik (MNS, MSS dan DE) [1]: Bab 8 [2]: Handout di myITS Classroom <i>Load – voltage review Review properties material mechanics Theory failure burden static (MNS, MSS and DE)</i> [1]: Chapter 8 [2]: Handouts in myITS Classroom	



3	Mahasiswa mampu merancang sambungan keling akibat beban merata dan eksentris, beserta penerapan teori kegagalannya <i>Student capable to design connection rivet consequence burden even and eccentric , along with implementation theory his failure</i>	Mampu menganalisa sambungan keling dengan beban merata dan eksentris Mampu menganalisa kegagalan sambungan keling akibat beban merata dan eksentris <i>Able to analyze connection rivet with burden even and eccentric failure connection rivet consequence burden even and eccentric</i>	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework <i>Oral Pre-Test (random):</i> <i>Task Independent : Post-test/Homework</i>	Perkuliahhan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying</i> <i>Study Structured [TM: 3x60"] Studies Case</i> <i>Study Independent [TM: 3x60"]</i>	Perancangan sambungan keling dengan beban merata dan eksentris Analisa kegagalan sambungan keling akibat beban merata dan eksentris [1]: Bab 8 [2]: Handout di myITS Calssroom <i>Design connection rivet with burden even and eccentric</i> <i>Failure analysis connection rivet consequence burden even and eccentric</i> [1]: Chapter 8 [2]: Handout on myITS Calssroom	2,5 %



4	Mahasiswa mampu merancang sambungan keling akibat beban merata dan eksentris, beserta penerapan teori kegagalannya <i>Student capable to design connection rivet consequence burden even and eccentric , along with implementation theory his failure</i>	Mampu menganalisa sambungan keling dengan beban merata dan eksentris Mampu menganalisa kegagalan sambungan keling akibat beban merata dan eksentris <i>Able to analyze connection rivet with burden even and eccentric</i> <i>Able to analyze failure connection rivet consequence burden even and eccentric</i>	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework <i>Oral Pre-Test (random):</i> <i>Task Independent : Post-test/Homework</i>	Perkuliahahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying</i> <i>Study Structured [TM: 3x60"] Studies Case</i> <i>Study Independent [TM: 3x60"]</i>	Perancangan sambungan keling dengan beban merata dan eksentris Analisa kegagalan sambungan keling akibat beban merata dan eksentris [1]: Bab 8 [2]: Handout di myITS Classroom <i>Design connection rivet with burden even and eccentric</i> <i>Failure analysis connection rivet consequence burden even and eccentric</i> [1]: Chapter 8 [2]: Handouts in myITS Classroom	2,5 %



5	Mahasiswa mampu merancang sambungan las akibat beban merata dan eksentris, beserta penerapan teori kegagalannya <i>Student capable to design welding joint due to burden even and eccentric , along with implementation theory his failure</i>	Mampu menganalisa sambungan las dengan beban merata dan eksentris Mampu menganalisa kegagalan sambungan las akibat beban merata dan eksentris Able to analyze welding joint with burden even and eccentric Able to analyze failure welding joint due to burden	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework Oral Pre-Test (random): Task Independent : Post-test/Homework	Perkuliahahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Studies Case Study Independent [TM: 3x60"]		Perancangan sambungan las dengan beban merata dan eksentris Analisa kegagalan sambungan las akibat beban merata dan eksentris [1]: Bab 9 [2]: Handout di myITS Classroom <i>Design welding joint with burden even and eccentric</i> <i>Failure analysis welding joint due to burden even and eccentric</i> [1]: Chapter 9 [2]: Handouts in myITS Classroom	2,5 %



		<i>even and eccentric</i>					
6	Mahasiswa mampu merancang sambungan las akibat beban merata dan eksentris, beserta penerapan teori kegagalannya <i>Student capable to design welding joint due to burden even and eccentric , along with implementation theory his failure</i>	- Mampu menganalisa sambungan las dengan beban merata dan eksentris - Mampu menganalisa kegagalan sambungan las akibat beban merata dan eksentris - Able to analyze welding joint with burden even and eccentric - Able to analyze failure welding joint due to burden	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework <i>Oral Pre-Test (random):</i> <i>Task Independent : Post-test/Homework</i>	Perkuliahahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying</i> <i>Study Structured [TM: 3x60"] Studies Case</i> <i>Study Independent [TM: 3x60"]</i>		Perancangan sambungan las dengan beban merata dan eksentris Analisa kegagalan sambungan las akibat beban merata dan eksentris [1]: Bab 9 [2]: Handout di myITS classroom <i>Design welding joint with burden even and eccentric</i> <i>Failure analysis welding joint due to burden even and eccentric</i> [1]: Chapter 9 [2]: Handouts in myITS classroom	2,5 %



		<i>even and eccentric</i>					
7	Mahasiswa mampu merancang sambungan baut dengan beban aksial dan preload, beserta penerapan teori kegagalannya <i>Student capable to design connection bolt with burden axial and preload, along with implementation theory his failure</i>	Mampu menganalisa sambungan baut dengan beban merata dan eksentris Mampu menganalisa kegagalan sambungan baut akibat beban merata dan eksentris Able to analyze connection bolt with burden even and eccentric Able to analyze failure connection bolt consequence	Kuis: 2 soal 100 mnt Individual reposrt/ Quiz 1 <i>Quiz : 2 questions 100 min</i> <i>Individual reposrt / Quiz 1</i>	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying</i> <i>Study Structured [TM: 3x60"] Studies Case</i> <i>Study Independent [TM: 3x60"]</i>		Standarisasi ulir dan baut Perancangan sambungan baut dengan beban aksial dan preload Analisa kegagalan sambungan keling akibat beban aksial dan preload eksentrik [1]: Bab 9 [2]: Handout di myITS Classroom <i>Standardization thread and bolt</i> <i>Design connection bolt with burden axial and preload</i> <i>Failure analysis connection rivet consequence burden axial and eccentric preload</i>	10 %



		burden even and eccentric				[1]: Chapter 9 [2]: Handouts in myITS Classroom	
8	Evaluasi Tengah Semester / Ujian Tengah Semester						
9	- Mahasiswa mampu memahami kriteria beban dinamik dan mampu menganalisa kegagalan sambungan baut akibat beban dinamik <i>Student capable understand criteria burden dynamic and capable analyze failure connection bolt consequence burden dynamic</i>	- Mampu menjelaskan kriteria beban dinamis - Mampu menjelaskan teori kegagalan beban dinamik - Mampu menerapkan teori kegagalan sambungan baut akibat beban dinamik dalam perancangan <i>Able to explain criteria</i>	Oral Pre-Test (acak): Tugas Mandiri: <i>Oral Pre-Test (random):</i> <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying</i> <i>Study Structured [TM: 3x60"] Studies Case</i> <i>Study Independent [TM: 3x60"]</i>		Fatigue strength dan fatigue limit Teori kegagalan beban dinamik (Soderberg dan Goodman) Analisa kegagalan sambungan baut akibat beban dinamik [1]: Bab 5 dan 7 [2]: Handout di myITS Classroom <i>Fatigue strength and fatigue limit Theory failure burden dynamic (Soderberg and Goodman) Failure analysis connection bolt consequence burden dynamic</i> [1]: Chapters 5 and 7	-



		<i>burden dynamic</i> <i>Able to explain theory failure burden dynamic</i> <i>Able to apply theory failure connection bolt consequence burden dynamic in design</i>				[2]: Handouts in myITS Classroom	
10	Mahasiswa mampu memahami kriteria beban dinamik dan mampu menganalisa kegagalan sambungan baut akibat beban dinamik <i>Student capable understand</i>	Mampu menjelaskan kriteria beban dinamis Mampu menjelaskan teori kegagalan beban dinamik Mampu menerapkan teori kegagalan	Oral Pre-Test (acak): Tugas Mandiri: <i>Oral Pre-Test (random):</i> <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Study Structured [TM: 3x60"]</i>		Fatigue strength dan fatigue limit Teori kegagalan beban dinamik (Soderberg dan Goodman) Analisa kegagalan sambungan baut akibat beban dinamik [1]: Bab 6 dan 7 [2]: Handout di myITS Classroom	-



	<i>criteria burden dynamic and capable analyze failure connection bolt consequence burden dynamic</i>	sambungan baut akibat beban dinamik dalam perancangan - Able to explain criteria burden dynamic - Able to explain theory failure burden dynamic - Able to apply theory failure connection bolt consequence burden dynamic in design		<i>Studies Case Study Independent [TM: 3x60"]</i>		<i>Fatigue strength and fatigue limit</i> <i>Theory failure burden dynamic (Soderberg and Goodman)</i> <i>Failure analysis connection bolt consequence burden dynamic</i> <i>[1]: Chapters 6 and 7</i> <i>[2]: Handouts in myITS Classroom</i>	
11	- Mahasiswa mampu merancang poros dengan beban	- Mampu menganalisa poros dengan	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework	Perkuliahan [TM: 3x50"] Kuliah		Review beban kombinasi	2,5%



	statik kombinasi dan memahami penerapan teori kegagalan poros akibat beban statik <i>Student capable to design axis with burden static combination and understanding implementation theory failure axis consequence burden static</i>	beban statik kombinasi Mampu menganalisa kegagalan poros akibat beban statik kombinasi <i>Able to analyze axis with burden static combination</i> Mampu menganalisa kegagalan poros akibat beban statik kombinasi <i>Able to analyze failure axis consequence burden static combination</i>	<i>Oral Pre-Test (random):</i> <i>Task Independent : Post-test/Homework</i>	Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying</i> <i>Study Structured [TM: 3x60"] Studies Case</i> <i>Study Independent [TM: 3x60"]</i>		Perancangan poros dengan beban kombinasi Analisa kegagalan poros akibat beban statik kombinasi [1]: Bab 7 [2]: Handout di myITS Classroom <i>Load review combination Design axis with burden combination Failure analysis axis consequence burden static combination</i> [1]: Chapter 7 [2]: Handouts in myITS Classroom	
12	Mahasiswa mampu merancang poros dengan beban statik kombinasi dan memahami	Mampu menganalisa poros dengan beban statik kombinasi	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus		Review beban kombinasi Perancangan poros dengan beban kombinasi	2,5%



	penerapan teori kegagalan poros akibat beban statik <i>Student capable to design axis with burden static combination and understanding implementation theory failure axis consequence burden static</i>	Mampu menganalisa kegagalan poros akibat beban statik kombinasi <i>Able to analyze axis with burden static combination failure axis consequence burden static combination</i>	<i>Oral Pre-Test (random):</i> <i>Task Independent : Post-test/Homework</i>	Belajar Mandiri [TM: 3x60"] Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Studies Case Study Independent [TM: 3x60"]		Analisa kegagalan poros akibat beban statik kombinasi [1]: Bab 16 [2]: Handout di myITS Classroom <i>Load review combination Design axis with burden combination Failure analysis axis consequence burden static combination</i> [1]: Chapter 16 [2]: Handouts in myITS Classroom	
13	Mahasiswa mampu merancang poros dengan beban dinamik, dan memahami penerapan teori kegagalan poros	Mampu merancang poros dengan beban dinamik Mampu menganalisa kegagalan poros akibat	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework <i>Oral Pre-Test (random):</i> <i>Task Independent :</i>	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"]		Perancangan poros dengan beban dinamik Analisa kegagalan poros akibat beban dinamik. [1]: Bab 16 [2]: Handout di myITS Classroom	2,5%



	akibat beban dinamik <i>Student capable to design axis with burden dynamic , and understanding implementation theory failure axis consequence burden dynamic</i>	beban dinamik <i>Able to design axis with burden dynamic Able to analyze failure axis consequence burden dynamic</i>	<i>Post-test/Homework</i>	<i>Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Studies Case Study Independent [TM: 3x60"]</i>		<i>Design axis with burden dynamic Failure analysis axis consequence burden dynamic . [1]: Chapter 16 [2]: Handouts in myITS Classroom</i>	
14	Mahasiswa mampu memahami karakteristik pasak, dan mampu menganalisa kegagalan pasak <i>Student capable understand characteristics pegs , and able to analyze failure peg</i>	Mampu menjelaskan karakteristik pasak Mampu memilih jenis pasak yang sesuai Mampu menjelaskan penyebab kegagalan pasak <i>Able to explain</i>	Oral Pre-Test (acak): Tugas Mandiri: Post-test/Homework <i>Oral Pre-Test (random):</i> <i>Task Independent : Post-test/Homework</i>	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Studies Case</i>		Karakteristik pasak Pemilihan jenis pasak Analisa kegagalan pasak [1]: Bab 10 [2]: Handout di myITS Classroom <i>Characteristics peg Election type peg Failure analysis peg [1]: Chapter 10 [2]: Handouts in myITS Classroom</i>	2,5%



		<i>characteristics peg</i> <i>Able to choose type appropriate peg</i> <i>Able to explain reason failure peg</i>		<i>Study Independent [TM: 3x60"]</i>			
15	- Mahasiswa mampu memahami karakteristik pegas, dan mampu menganalisa kegagalan pegas <i>Student capable understand characteristics springs , and capable analyze failure spring</i>	- Mampu menjelaskan klasifikasi pasak - Mampu memilih jenis pegas yang sesuai - Mampu menjelaskan penyebab kegagalan pegas - <i>Able to explain classification peg</i>	Kuis: 2 soal 100 mnt Individual reposrt/ Quiz 2 <i>Quiz : 2 questions 100 min</i> <i>Individual reposrt / Quiz 2</i>	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Study Structured [TM: 3x60"]</i> <i>Studies Case</i> <i>Study Independent [TM: 3x60"]</i>		- Karakteristik pasak - Pemilihan jenis pasak - Analisa kegagalan pasak [1]: Bab 10 [2]: Handout di myITS Classroom - <i>Characteristics peg</i> - <i>Election type peg</i> - <i>Failure analysis peg</i> [1]: Chapter 10 [2]: Handouts in myITS Classroom	10 %



		- Able to choose type the right spring - Able to explain reason failure spring					
16	Evaluasi Akhir Semester / Ujian Akhir Semester						

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
	RENCANA PEMBELAJARAN SEMESTER					
MATA KULIAH (MK) (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
ELEMEN MESIN II MACHINE ELEMENTS II	TM184522		T=3	P=0	V	
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Undergraduate Program)	



Capaian Pembelajaran <i>(Learning Outcomes)</i>	CPL-PRODI yang dibebankan pada MK <i>(PLO Program Charged to The Course)</i>		
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics</i>	
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan <i>Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience</i>	
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan Teknik <i>Ability identify , formulate , analyze and solve problem technique</i>	
	Capaian Pembelajaran Mata Kuliah (CPMK)		
	CPMK-1	Mahasiswa mampu menganalisis beban, kekuatan, dan keausan pada perancangan roda gigi: spur – helical (CPL 4, 8) <i>Student capable analyze load , strength , and wear in design wheel teeth : spur – helical (CPL 4, 8)</i>	
	CPMK-2	Mahasiswa mampu menganalisis beban, kekuatan, keausan dan efisiensi pada perancangan roda gigi: bevel – worm (CPL 4, 8) <i>Student capable analyze load , strength , wear and efficiency in design wheel teeth : bevel – worm (CPL 4, 8)</i>	
	CPMK-3	Mahasiswa mampu menganalisis beban dan kapasitas pada perancangan sistem transmisi fleksibel: belt dan chain (CPL 4, 8) <i>Student capable analyze load and capacity in design system transmission flexible : belt and chain (CPL 4, 8)</i>	



	CPMK-4	Mahasiswa mampu menentukan jenis sistem transmisi yang sesuai dengan kebutuhan perancangan (CPL 5) <i>Student capable determine type system appropriate transmission with need design (CPL 5)</i>																														
	CPMK-5	Mahasiswa mampu memahami karakteristik sistem transmisi otomatis (planetary gear) dan kontinyu (CVT) (CPL 4) <i>Student capable understand characteristics system transmission automatic (planetary gear) and continuous (CVT) (CPL 4)</i>																														
	CPMK-6	Mahasiswa mampu menentukan tipe bantalan sesuai karakter beban dan umur (CPL 5) <i>Student capable determine type bearing in accordance character load and age (CPL 5)</i>																														
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-4</td><td>CPL-5</td><td>CPL-8</td></tr><tr><td>CPMK-1</td><td>V</td><td></td><td>V</td></tr><tr><td>CPMK-2</td><td>V</td><td></td><td>V</td></tr><tr><td>CPMK-3</td><td>V</td><td></td><td>V</td></tr><tr><td>CPMK-4</td><td></td><td>V</td><td></td></tr><tr><td>CPMK-5</td><td>V</td><td></td><td></td></tr><tr><td>CPMK-6</td><td></td><td>V</td><td></td></tr></table>			CPMK	CPL-4	CPL-5	CPL-8	CPMK-1	V		V	CPMK-2	V		V	CPMK-3	V		V	CPMK-4		V		CPMK-5	V			CPMK-6		V	
CPMK	CPL-4	CPL-5	CPL-8																													
CPMK-1	V		V																													
CPMK-2	V		V																													
CPMK-3	V		V																													
CPMK-4		V																														
CPMK-5	V																															
CPMK-6		V																														
Deskripsi Singkat MK	Tuliskan relevansi & cakupan materi/bahan kajian sesuai dengan matakuliah ini dan sesuai dengan Sub-CPMK																															
Bahan Kajian: Materi Pembelajaran	Perancangan sistem transmisi, elemen sistem transmisi dan sistem pelumasan <i>Design system transmission , element system transmission and systems lubrication</i>																															
Pustaka	Utama :																															
	5. Shigley, Joseph E., Mechanical Engineering Design, 10th Edition, Mc Graw Hill 2014																															



		Pendukung : 6. Slide handout					
Dosen Pengampu		Achmad Syaifudin, Alief Wikarta, Aida Annisa AD., Julendra Ariatedja					
Mata kuliah syarat		Elemen Mesin 1 <i>Element Engine 1</i>					
Mg Ke (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (offline) (Offline)	Daring (online) (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	- Mampu menjelaskan karakteristik sistem transmisi: konvensional, otomatis,	- Kecakapan dalam menjelaskan konsep perancangan dan karakteristik	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis:	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK		- Review: - Konsep perancangan - Hubungan beban-tegangan - Konsep sistem transmisi: konvensional,	4/15



kontinyu dan magnetic - Mampu menjelaskan karakteristik gerakan dan penurunan beban pada spur-helical gear - Mampu menganalisis kekuatan dan keausan roda gigi (spur-helical) dengan metode AGMA - <i>Able to explain characteristics system Transmission : conventional , automatic , continuous and magnetic</i> - <i>Able to explain characteristics</i>	sistem transmisi: konvensional, otomatis, kontinyu dan magnetik - Kecakapan dalam menjelaskan karakteristik gerakan dan menentukan beban pada spur- helical gear. - Kecakapan dalam menerapkan metode AGMA dalam analisis kekuatan dan keausan spur-helical gear. - <i>Skills in explain draft design and characteristics</i>	Komponen jawaban, kalkulasi <i>Task independent / group :</i> <i>Plagiarism Completeness (format and content)</i> <i>Quiz :</i> <i>Component answer , calculation</i>	Kuis pada minggu ke-4 Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying Collaborative Learning Discovery Learning (Online via Classroom) Task each sub-CPMK Quiz on week 4</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>	otomatik, kontinyu dan magnetik (pengenalan) - Terminologi dan karakteristik: spur-helical gear - Analisis beban, kekuatan, dan keausan pada spur-helical gear [1]: Bab 1, 3 dan 5 [2]: Handout di myITS Calsroom - <i>Reviews:</i> - <i>Draft design</i> - <i>Connection load-voltage</i> - <i>Draft system Transmission : conventional , automatic , continuous and magnetic (introduction)</i>	



	<i>movement and decline load on spur-helical gear</i> <i>-Able to analyze strength and wear wheel teeth (spur-helical) with AGMA method</i>	<i>system Transmission : conventional , automatic , continuous and magnetic</i> <i>- Skills in explain characteristics movement and determination load on the spur-helical gear.</i> <i>- Skills in apply AGMA method in analysis strength and wear of spur-helical gears.</i>				<i>Terminology and characteristics : spur-helical gear</i> <i>- Analysis loads , forces , and wear on spur-helical gears</i> <i>[1]: Chapters 1, 3 and 5</i> <i>[2]: Handout on myITS Calssroom</i>	
2	- Mampu menjelaskan karakteristik sistem transmisi: konvensional, otomatis,	- Kecakapan dalam menjelaskan konsep perancangan dan karakteristik sistem	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis:	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis pada minggu ke-4		- Review: - Konsep perancangan - Hubungan beban-tegangan - Konsep sistem transmisi: konvensional, otomatis, kontinyu	4/15



- kontinyu dan magnetic - Mampu menjelaskan karakteristik gerakan dan penurunan beban pada spur-helical gear - Mampu menganalisis kekuatan dan keausan roda gigi (spur-helical) dengan metode AGMA - <i>Able to explain characteristics system</i> - <i>Transmission : conventional , automatic , continuous and magnetic</i> - <i>Able to explain characteristics</i>	- transmisi: konvensional, otomatis, kontinyu dan magnetik - Kecakapan dalam menjelaskan karakteristik gerakan dan menentukan beban pada spur- helical gear. - Kecakapan dalam menerapkan metode AGMA dalam analisis kekuatan dan keausan spur-helical gear. - <i>Skills in explain draft design and characteristics system</i>	Komponen jawaban, kalkulasi <i>Task independent / group :</i> <i>Plagiarism</i> <i>Completeness (format and content)</i> <i>Quiz :</i> <i>Component answer , calculation</i>	Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Collaborative Learning</i> <i>Discovery Learning (Online via Classroom)</i> <i>Task each sub-CPMK</i> <i>Quiz on week 4</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>		- dan magnetik (pengenalan) - Terminologi dan karakteristik: spur-helical gear - Analisis beban, kekuatan, dan keausan pada spur-helical gear - [1]: Bab 8 - [2]: Handout di myITS Calsroom - <i>Reviews:</i> - <i>Draft design</i> - <i>Connection load-voltage</i> - <i>Draft system</i> - <i>Transmission : conventional , automatic , continuous and magnetic (introduction)</i> - <i>Terminology and characteristics : spur-helical gear</i>	



	<i>movement and decline load on spur-helical gear</i> <i>Able to analyze strength and wear wheel teeth (spur-helical) with AGMA method</i>	<i>Transmission : conventional , automatic , continuous and magnetic</i> <i>Skills in explain characteristics movement and determination load on the spur-helical gear.</i> <i>Skills in apply AGMA method in analysis strength and wear of spur-helical gears</i>				<i>Analysis loads , forces , and wear on spur-helical gears</i> <i>[1]: Chapter 8</i> <i>[2]: Handout on myITS Calssroom</i>	
3	- Mampu menjelaskan karakteristik sistem transmisi: konvensional, otomatis, kontinyu dan magnetic	- Kecakapan dalam menjelaskan konsep perancangan dan karakteristik sistem transmisi:	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis: Komponen jawaban, kalkulasi	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis pada minggu ke-4		- Review: - Konsep perancangan - Hubungan beban-tegangan - Konsep sistem transmisi: konvensional, otomatis, kontinyu	4/15



- Mampu menjelaskan karakteristik gerakan dan penurunan beban pada spur-helical gear - Mampu menganalisis kekuatan dan keausan roda gigi (spur-helical) dengan metode AGMA - <i>Able to explain characteristics system</i> <i>Transmission : conventional , automatic , continuous and magnetic</i> - <i>Able to explain characteristics movement and decline load on</i>	- konvensional, otomatis, kontinyu dan magnetik - Kecakapan dalam menjelaskan karakteristik gerakan dan menentukan beban pada spur- helical gear. - Kecakapan dalam menerapkan metode AGMA dalam analisis kekuatan dan keausan spur-helical gear. - <i>Skills in explain draft design and characteristics system</i> <i>Transmission : conventional ,</i>	<i>Task independent / group :</i> <i>Plagiarism</i> <i>Completeness (format and content)</i> <i>Quiz :</i> <i>Component answer , calculation</i>	Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Collaborative Learning</i> <i>Discovery Learning (Online via Classroom)</i> <i>Task each sub-CPMK</i> <i>Quiz on week 4</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>	dan magnetik (pengenalan) - Terminologi dan karakteristik: spur-helical gear - Analisis beban, kekuatan, dan keausan pada spur-helical gear [1]: Bab 8 [2]: Handout di myITS Calsroom - <i>Reviews:</i> - <i>Draft design</i> - <i>Connection load-voltage</i> - <i>Draft system</i> <i>Transmission : conventional , automatic , continuous and magnetic (introduction)</i> - <i>Terminology and characteristics : spur-helical gear</i>	



	<i>spur-helical gear</i> <i>Able to analyze strength and wear wheel teeth (spur-helical) with AGMA method</i>	<i>automatic , continuous and magnetic</i> <i>Skills in explain characteristics movement and determination load on the spur-helical gear.</i> <i>Skills in apply AGMA method in analysis strength and wear of spur-helical gears</i>				<i>Analysis loads , forces , and wear on spur-helical gears</i> <i>[1]: Chapter 8</i> <i>[2]: Handout on myITS Calssroom</i>	
4	Mampu menjelaskan karakteristik gerakan dan penurunan beban pada bevel-worm gear Mampu merancang roda gigi (bevel-worm gear)	Kecakapan dalam menjelaskan karakteristik gerakan dan menentukan beban pada bevel-worm gear. Kecakapan dalam menerapkan	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis: Komponen jawaban, kalkulasi <i>Task independent / group :</i> <i>Plagiarism</i>	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis pada minggu ke-8 Belajar Terstruktur [TM: 3x60"]		Terminologi dan karakteristik: bevel-worm gear Analisis beban, kekuatan, dan keausan pada bevel-worm gear [1]: Bab 8 [2]: Handout di myITS Calssroom	4/15



	berdasarkan kekuatan dan keausannya dengan metode AGMA - Able to explain characteristics movement and decline load on bevel-worm gear Able to design wheel bevel-worm gear based on strength and wear with AGMA method	metode AGMA dalam analisis kekuatan dan keausan bevel-worm gear. - Skills in explain characteristics movement and determination load on the bevel-worm gear. Skills in apply AGMA method in analysis strength and wear of bevel-worm gears	<i>Completeness (format and content)</i> Quiz : Component answer , calculation	Belajar Mandiri [TM: 3x60"] Lecture [TM: 3x50"] Studying Collaborative Learning Discovery Learning (Online via Classroom) Task each sub-CPMK Quiz on week 8 Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Terminology and characteristics : bevel-worm gear - Analysis load , force , and wear on bevel-worm gear [1]: Chapter 8 [2]: Handout on myITS Calssroom	
5	- Mampu menjelaskan karakteristik gerakan dan penurunan beban pada bevel-worm gear	- cakapan dalam menjelaskan karakteristik gerakan dan menentukan beban pada bevel-worm gear.	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis: Komponen jawaban, kalkulasi	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis pada minggu ke-8	- Terminologi dan karakteristik: bevel-worm gear - Analisis beban, kekuatan, dan keausan pada bevel-worm gear [1]: Bab 9	4/15



	- Mampu merancang roda gigi (bevel-worm gear) berdasarkan kekuatan dan keausannya dengan metode AGMA - <i>Able to explain characteristics movement and decline load on bevel-worm gear</i> - <i>Able to design wheel bevel-worm gear based on strength and wear with AGMA method</i>	- Kecakapan dalam menerapkan metode AGMA dalam analisis kekuatan dan keausan bevel-worm gear. - <i>conversation in explain characteristics movement and determination load on the bevel-worm gear.</i> - <i>Skills in apply AGMA method in analysis strength and wear of bevel-worm gears</i>	<i>Task independent / group :</i> <i>Plagiarism Completeness (format and content)</i> <i>Quiz : Component answer , calculation</i>	Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying Collaborative Learning Discovery Learning (Online via Classroom)</i> <i>Task each sub-CPMK Quiz on week 8</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>		[2]: Handout di myITS Calsroom - <i>Terminology and characteristics : bevel-worm gear</i> - <i>Analysis load , force , and wear on bevel-worm gear</i> [1]: Chapter 9 [2]: Handout on myITS Calsroom	
6	- Mampu menjelaskan karakteristik gerakan dan penurunan	- cakapan dalam menjelaskan karakteristik gerakan dan menentukan	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten)	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning		- Terminologi dan karakteristik: bevel-worm gear - Analisis beban, kekuatan, dan	4/15



	beban pada bevel-worm gear - Mampu merancang roda gigi (bevel-worm gear) berdasarkan kekuatan dan keausannya dengan metode AGMA - <i>Able to explain characteristics movement and decline load on bevel-worm gear</i> <i>Able to design wheel bevel-worm gear based on strength and wear with AGMA method</i>	beban pada bevel-worm gear. - Kecakapan dalam menerapkan metode AGMA dalam analisis kekuatan dan keausan bevel-worm gear. - <i>conversation in explain characteristics movement and determination load on the bevel-worm gear.</i> <i>Skills in apply AGMA method in analysis strength and wear of bevel-worm gears.</i>	Kuis: Komponen jawaban, kalkulasi <i>Task independent / group :</i> <i>Plagiarism</i> <i>Completeness (format and content)</i> <i>Quiz :</i> <i>Component answer , calculation</i>	Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis pada minggu ke-8 Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Collaborative Learning</i> <i>Discovery Learning (Online via Classroom)</i> <i>Task each sub-CPMK</i> <i>Quiz on week 8</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>		keausan pada bevel-worm gear [1]: Bab 9 [2]: Handout di myITS Calsroom - <i>Terminology and characteristics : bevel-worm gear</i> - <i>Analysis load , force , and wear on bevel-worm gear</i> [1]: Chapter 9 [2]: Handout on myITS Calsroom	



7	- Mampu menjelaskan karakteristik gerakan dan penurunan beban pada bevel-worm gear - Mampu merancang roda gigi (bevel-worm gear) berdasarkan kekuatan dan keausannya dengan metode AGMA <i>Able to explain characteristics movement and decline load on bevel-worm gear</i> <i>Able to design wheel gear (bevel- worm gear) based on</i>	- cakapan dalam menjelaskan karakteristik gerakan dan menentukan beban pada bevel-worm gear. - Kecakapan dalam menerapkan metode AGMA dalam analisis kekuatan dan keausan bevel-worm gear. <i>conversation in explain characteristics movement and determination load on the bevel-worm gear.</i> <i>Skills in apply AGMA method in analysis</i>	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis: Komponen jawaban, kalkulasi <i>Task independent / group :</i> <i>Plagiarism</i> <i>Completeness (format and content)</i> <i>Quiz :</i> <i>Component answer , calculation</i>	Perkuliahahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis pada minggu ke-8 Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Collaborative Learning</i> <i>Discovery Learning (Online via Classroom)</i> <i>Task each sub-CPMK</i> <i>Quiz on week 8</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>	Terminologi dan karakteristik: bevel-worm gear Analisis beban, kekuatan, dan keausan pada bevel-worm gear [1]: Bab 9 [2]: Handout di myITS Calssroom <i>Terminology and characteristics : bevel-worm gear</i> <i>Analysis load , force , and wear on bevel-worm gear</i> [1]: Chapter 9 [2]: Handout on myITS Calssroom	4/15



	<i>strength and wear with AGMA method</i>	<i>strength and wear of bevel-worm gears.</i>					
8	Evaluasi Tengah Semester / Ujian Tengah Semester						
9	- Mampu menjelaskan karakteristik gerakan pada sistem transmisi belt-chain - Mampu menentukan penurunan beban dan menghitung kapasitas pada sistem transmisi belt-chain. - Mampu memilih jenis belt menurut kondisi kerja dalam perancangan - <i>Able to explain characteristics movement on</i>	- Kecakapan dalam menjelaskan karakteristik gerakan sistem transmisi fleksibel (belt-chain) - Kecakapan dalam menganalisis beban dan kapasitas sistem transmisi belt-chain - Ketepatan dalam memilih tipe belt-chain yang sesuai dengan kebutuhan	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis: Komponen jawaban, kalkulasi <i>Task independent / group :</i> <i>Plagiarism Completeness (format and content)</i> Quiz : <i>Component answer , calculation</i>	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Lecture [TM: 3x50"] Studying Collaborative Learning Discovery Learning (Online via Classroom) Task each sub-CPMK Study Structured [TM: 3x60"]		- Terminologi dan karakteristik: belt-chain - Analisis beban, tipe dan kapasitas pada belt-chain gear [1]: Bab 5 dan 7 [2]: Handout di myITS Calsssroom - <i>Terminology and characteristics : belt-chain</i> - <i>Analysis load , type and capacity on belt-chain gear</i> [1]: Chapters 5 and 7 [2]: Handout on myITS Calsssroom	-



	<i>the system belt-chain transmission</i> <i>Able to determine decline load and count capacity on the system belt-chain transmission .</i> <i>Able to choose belt types according to condition Work in design</i>	<i>Skills in explain characteristics movement system transmission flexible (belt-chain)</i> <i>Skills in analyze load and capacity system belt-chain transmission</i> <i>Accuracy in choose suitable belt-chain type with need</i>		<i>Study Independent [TM: 3x60"]</i>			
10	- Mampu menjelaskan karakteristik gerakan pada sistem transmisi belt-chain - Mampu menentukan penurunan beban dan menghitung	- Kecakapan dalam menjelaskan karakteristik gerakan sistem transmisi fleksibel (belt-chain) - Kecakapan dalam menganalisis	Tugas mandiri/ kelompok : Plagiasi Kelengkapan (format dan konten) Kuis: Komponen jawaban, kalkulasi	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Belajar Terstruktur [TM: 3x60"]		- Terminologi dan karakteristik: belt-chain - Analisis beban, tipe dan kapasitas pada belt-chain gear [1]: Bab 6 dan 7 [2]: Handout di myITS Calsroom	-



kapasitas pada sistem transmisi belt-chain. Mampu memilih jenis belt menurut kondisi kerja dalam perancangan <i>Able to explain characteristics movement on the system belt-chain transmission</i> <i>Able to determine decline load and count capacity on the system belt-chain transmission.</i> <i>Able to choose belt types according to condition Work in design</i>	beban dan kapasitas sistem transmisi belt-chain Ketepatan dalam memilih tipe belt-chain yang sesuai dengan kebutuhan <i>Skills in explain characteristics movement system transmission flexible (belt-chain)</i> <i>Skills in analyze load and capacity system belt-chain transmission</i> <i>Accuracy in choose suitable</i>	<i>Task independent / group :</i> <i>Plagiarism</i> <i>Completeness (format and content)</i> <i>Quiz :</i> <i>Component answer , calculation</i>	Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying</i> <i>Collaborative Learning</i> <i>Discovery Learning</i> <i>(Online via Classroom)</i> <i>Task each sub-CPMK</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>	<i>Terminology and characteristics : belt-chain</i> <i>Analysis load , type and capacity on belt-chain gear</i> <i>[1]: Chapters 6 and 7</i> <i>[2]: Handout on myITS Calssroom</i>	



		<i>belt-chain type with need</i>					
11	- Mampu menentukan sistem transmisi konvensional (tetap atau fleksibel) sesuai kebutuhan perancangan - Mampu menjelaskan karakteristik sistem transmisi otomatis dan kontinyu. <i>Able to determine system transmission conventional (fixed) or flexible) according to need design</i> <i>Able to explain characteristics system</i>	- Kecakapan dalam menentukan sistem transmisi konvensional (tetap atau fleksibel) sesuai kebutuhan perancangan. - Kecakapan dalam menjelaskan karakteristik sistem transmisi otomatis dan kontinyu berdasarkan klasifikasi dan efisiensinya. <i>Skills in determine system transmission</i>	- Tugas mandiri/ kelompok: Plagiasi Kelengkapan (format dan konten) - Kuis: Komponen jawaban, kalkulasi <i>Task independent / group : Plagiarism Completeness (format and content)</i> <i>Quiz : Component answer , calculation</i>	- Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis pada minggu ke-12 - Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"] Studying Collaborative Learning Discovery Learning (Online via Classroom) Task each sub-CPMK Quiz on week 12</i> <i>Study Structured [TM: 3x60"]</i>		- Karakteristik sistem transmisi: kontinyu (CVT) dan otomatis (planetary gear) [1]: Bab 7 [2]: Handout di myITS Calssroom <i>Characteristics system Transmission : continuous (CVT) and automatic (planetary gear)</i> [1]: Chapter 7 [2]: Handout on myITS Calssroom	4/15



	<i>transmission automatic and continuous .</i>	<i>conventional (fixed) or flexible) according to need design .</i> <i>Skills in explain characteristics system transmission automatic and continuous based on classification and its efficiency .</i>		<i>Study Independent [TM: 3x60"]</i>			
12	- Mampu menentukan sistem transmisi konvensional (tetap atau fleksibel) sesuai kebutuhan perancangan - Mampu menjelaskan karakteristik sistem transmisi	- Kecakapan dalam menentukan sistem transmisi konvensional (tetap atau fleksibel) sesuai kebutuhan perancangan. - Kecakapan dalam menjelaskan	- Tugas mandiri/ kelompok: Plagiasi Kelengkapan (format dan konten) - Kuis: Komponen jawaban, kalkulasi - <i>Task independent / group : Plagiarism</i>	- Perkuliahan [TM: 3x50"] - Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) - Tugas setiap sub-CPMK Kuis pada minggu ke-12 - Belajar Terstruktur [TM: 3x60"]		- Karakteristik sistem transmisi: kontinyu (CVT) dan otomatis (planetary gear) - [1]: Bab 16 - [2]: Handout di myITS Calsroom - <i>Characteristics system Transmission : continuous (CVT) and</i>	4/15



	otomatik dan kontinyu. <i>Able to determine system transmission conventional (fixed) or flexible) according to need design</i> <i>Able to explain characteristics system transmission automatic and continuous .</i>	karakteristik sistem transmisi otomatis dan kontinyu berdasarkan klasifikasi dan efisiensinya. <i>Skills in determine system transmission conventional (fixed) or flexible) according to need design .</i> <i>Skills in explain characteristics system transmission automatic and continuous based on classification and its efficiency .</i>	<i>Completeness (format and content)</i> <i>Quiz : Component answer , calculation</i>	Belajar Mandiri [TM: 3x60"] <i>Lecture [TM: 3x50"]</i> <i>Studying Collaborative Learning Discovery Learning (Online via Classroom) Task each sub-CPMK Quiz on week 12</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>		<i>automatic (planetary gear)</i> <i>[1]: Chapter 16</i> <i>[2]: Handout on myITS Calsroom</i>	



13	- Mampu menentukan sistem transmisi konvensional (tetap atau fleksibel) sesuai kebutuhan perancangan - Mampu menjelaskan karakteristik sistem transmisi otomatis dan kontinyu. - <i>Able to determine system transmission conventional (fixed) or flexible) according to need design</i> - <i>Able to explain characteristics system transmission</i>	- Kecakapan dalam menentukan sistem transmisi konvensional (tetap atau fleksibel) sesuai kebutuhan perancangan. - Kecakapan dalam menjelaskan karakteristik sistem transmisi otomatis dan kontinyu berdasarkan klasifikasi dan efisiensinya. - <i>Skills in determine system transmission conventional (fixed) or</i>	- Tugas mandiri/ kelompok: - Plagiasi - Kelengkapan (format dan konten) - Kuis: - Komponen jawaban, kalkulasi - <i>Task independent / group :</i> - <i>Plagiarism</i> - <i>Completeness (format and content)</i> - <i>Quiz :</i> - <i>Component answer , calculation</i>	- Perkuliahan [TM: 3x50"] - Kuliah - Collaborative Learning - Discovery Learning (Daring via Classroom) - Tugas setiap sub-CPMK - Kuis pada minggu ke-12 - Belajar Terstruktur [TM: 3x60"] - Belajar Mandiri [TM: 3x60"] - <i>Lecture [TM: 3x50"]</i> - <i>Studying</i> - <i>Collaborative Learning</i> - <i>Discovery Learning (Online via Classroom)</i> - <i>Task each sub-CPMK</i> - <i>Quiz on week 12</i> - <i>Study Structured [TM: 3x60"]</i>	- Karakteristik sistem transmisi: kontinyu (CVT) dan otomatis (planetary gear) - [1]: Bab 16 - [2]: Handout di myITS Calsroom - <i>Characteristics system Transmission : continuous (CVT) and automatic (planetary gear)</i> - [1]: Chapter 16 - [2]: Handout on myITS Calsroom	4/15



	<i>automatic and continuous .</i>	<i>flexible) according to need design . Skills in explain characteristics system transmission automatic and continuous based on classification and its efficiency .</i>		<i>Study Independent [TM: 3x60"]</i>			
14	- Mampu menganalisis jenis pelumas yang sesuai pada journal bearing - Mampu menganalisis umur rolling bearing berdasarkan tipe beban dan memahami dengan baik	- Kecakapan dalam menganalisis jenis pelumas yang sesuai pada journal bearing - Kecakapan dalam menganalisis umur rolling bearing berdasarkan tipe beban dan memahami	- Tugas mandiri/ kelompok - Plagiasi - Kelengkapan (format dan konten) - Kuis: Komponen jawaban, kalkulasi - Task independent / group - Plagiarism - Completeness (format and content)	- Perkuliahan [TM: 3x50"] - Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) - Tugas setiap sub-CPMK - Kuis dan remedi pada minggu ke-16 - Belajar Terstruktur [TM: 3x60"] - Belajar Mandiri [TM: 3x60"]		- Karakteristik journal-rolling bearing: tipe beban, pelumasan, umur [1]: Bab 10 [2]: Handout di myITS Calsroom - Characteristics of journal-rolling bearings: types load , lubrication , life [1]: Chapter 10	3/15



	sistem pelumasannya <i>Able to analyze type suitable lubricant for journal bearing</i> <i>Able to analyze rolling bearing life based on type burden and understanding with Good system lubrication</i>	dengan baik sistem pelumasannya <i>Skills in analyze type suitable lubricant for journal bearing</i> <i>Skills in analyze rolling bearing life based on type burden and understanding with Good system lubrication</i>	Quiz : <i>Component answer , calculation</i>	Lecture [TM: 3x50"] <i>Studying Collaborative Learning Discovery Learning (Online via Classroom) Task each sub-CPMK Quiz and remediation at week 16</i> <i>Study Structured [TM: 3x60"]</i> <i>Study Independent [TM: 3x60"]</i>		[2]: Handout on myITS Calssroom	
15	Mampu menganalisis jenis pelumas yang sesuai pada journal bearing Mampu menganalisis umur rolling bearing berdasarkan	Kecakapan dalam menganalisis jenis pelumas yang sesuai pada journal bearing Kecakapan dalam menganalisis umur rolling	Tugas mandiri/ kelompok Plagiasi Kelengkapan (format dan konten) Kuis: Komponen jawaban, kalkulasi	Perkuliahan [TM: 3x50"] Kuliah Collaborative Learning Discovery Learning (Daring via Classroom) Tugas setiap sub-CPMK Kuis dan remedi pada minggu ke-16		Karakteristik journal-rolling bearing: tipe beban, pelumasan, umur [1]: Bab 10 [2]: Handout di myITS Calssroom <i>Characteristics of journal-rolling</i>	3/15



	tipe beban dan memahami dengan baik sistem pelumasannya <i>Able to analyze type suitable lubricant for journal bearing</i> <i>Able to analyze rolling bearing life based on type burden and understanding with Good system lubrication</i>	bearing berdasarkan tipe beban dan memahami dengan baik sistem pelumasannya <i>Skills in analyze type suitable lubricant for journal bearing</i> <i>Skills in analyze rolling bearing life based on type burden and understanding with Good system lubrication</i>	<i>Task independent / group</i> <i>Plagiarism</i> <i>Completeness (format and content)</i> <i>Quiz : Component answer , calculation</i>	Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"] Lecture [TM: 3x50"] Studying Collaborative Learning Discovery Learning (Online via Classroom) Task each sub-CPMK Quiz and remediation at week 16 Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]		<i>bearings: types load , lubrication , life</i> <i>[1]: Chapter 10</i> <i>[2]: Handout on myITS Calsroom</i>	
16	Evaluasi Akhir Semester / Ujian Akhir Semester						



 RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen	
RENCANA PEMBELAJARAN SEMESTER						
MATA KULIAH (MK) (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
FISIKA STATIKA <i>STATIC PHYSICS</i>	TM184204	Mekanika Benda Padat <i>Solid State Mechanics</i>	T=2	P=0	I	
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Undergraduate Program)	
	Alief Wikarta		Agus Sigit Pramono			
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>Able to study and utilize science and technology in order to apply it to the field of mechanical engineering, and able to make appropriate decisions from the results of one's own work or group work in the form of final assignment reports or other forms of learning activities whose output is equivalent to the final assignment through logical, critical, systematic and innovative thinking.</i>				



CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (mechanical system) <i>The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.</i>																		
CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>Ability to identify, formulate, analyze and solve engineering problems.</i>																		
Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)																			
CPMK-1	Mahasiswa mampu menganalisa keseimbangan statis partikel dan struktur (CPL-4), <i>Students are able to analyze the static equilibrium of particles and structures (CPL-4),</i>																		
CPMK-2	Mahasiswa mampu menyusun sistem dan diagram bidang gaya pada keseimbangan benda tegar (CPL-2, CPL-4, CPL-8), dan <i>Students are able to compile systems and force field diagrams for rigid body equilibrium (CPL-2, CPL-4, CPL-8), and</i>																		
CPMK-3	Mahasiswa mampu menerapkan konsep center of gravity, centroid, friction, dan virtual work untuk analisa struktur(CPL-2, CPL-4, CPL-8) <i>Students are able to apply the concepts of center of gravity, centroid, friction, and virtual work for structural analysis (CPL-2, CPL-4, CPL-8)</i>																		
	Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-2</td><td>CPL-4</td><td>CPL-8</td></tr><tr><td>CPMK-1</td><td></td><td>V</td><td></td></tr><tr><td>CPMK-2</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td>V</td></tr></table>			CPMK	CPL-2	CPL-4	CPL-8	CPMK-1		V		CPMK-2	V	V	V	CPMK-3	V	V	V
CPMK	CPL-2	CPL-4	CPL-8																
CPMK-1		V																	
CPMK-2	V	V	V																
CPMK-3	V	V	V																



Deskripsi Singkat MK (Short Description of Course)		Pokok Bahasan				
Bahan Kajian: Materi Pembelajaran (Course Materials)		Mekanika Teknik : Statika Engineering Mechanics: Statics				
Pustaka (References)C		Utama : (Main)				
		1. Russel C. Hibbeler, Engineering Mechanics: Statics, 12th edition, Prentice Hall 2. Russel C. Hibbeler, Mechanics of Materials, 8th edition, Prentice Hall				
		Pendukung : (Supplementary)				
		3. F. P. Beer and E. R. Johnston Jr., Vector Mechanics for Engineers: Statics, SI Metric Edition, 9th Edition, McGraw-Hill, 4. F. P. Beer and E. R. Johnston Jr., Mechanics of Materials, 6th Edition, McGraw-Hill				
Dosen Pengampu (Lecturers)		Alief Wikarta, Agus Sigit Pramono, Wahyu Wijanarko, Yohannes				
Mata kuliah syarat (Prerequisites)		-				
Mg Ke (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian (Assesment)	Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa,	Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%)	



	(Final Ability of Each Learning Stage (LLO))			(Learning Model; Learning Method; Student Assignment)			(Assesment Credit (%))
		Indikator (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (offline) (Offline)	Daring (online) (Online)		
(1)	(2)	(2)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menganalisa vektor dan resultan sistem gaya pada koordinat kartesian 2D dan 3D <i>Students are able to analyze vectors and resultant force systems in 2D and 3D Cartesian coordinates.</i>	Mampu dan terampil menyelesaikan permasalahan vektor dan resultan sistem gaya <i>Able and skilled at solving vector and resultant force system problems</i>		- Video Crane fail compilation - Kuliah Pengantar & Brainstorming - Latihan soal [TM: 1x(2x50'')] - Video Crane file compilation - Introductory Lecture & Brainstorming - Practice questions [TM: 1x(2x50'')]		- Kontrak Kuliah - General principles - Force vectors [1:Hibbeler Bab 1-2] - Study Contract - General principles - Force vectors [1:Hibbeler Chapter 1-2]	
2	Mahasiswa mampu menganalisa resultan sistem gaya pada keseimbangan partikel	Mampu dan terampil menyelesaikan permasalahan resultan sistem gaya pada keseimbangan partikel		- Kuliah - Latihan soal [TM: 1x(2x50'')]		- Keseimbangan Partikel [1: Hibbeler Bab 3]	



	<i>Students are able to analyze the resultant force system in particle equilibrium.</i>	<i>Able and skilled in solving problems of the resultant force system in particle equilibrium</i>		- Studying - Exercises [TM: 1x(2x50'')]		- Particle Equilibrium [1: Hibbeler Chapter 3]	
3	Mahasiswa mampu menyusun sistem gaya pada keseimbangan benda tegar <i>Students are able to construct a system of forces in the equilibrium of rigid objects.</i>	Mampu dan terampil menyusun sistem resultan gaya dan menyelesaikan permasalahan keseimbangan benda tegar <i>Able and skilled in compiling resultant force systems and solving rigid body equilibrium problems</i>	Quis Quiz	- Kuliah - Latihan soal [TM: 2x(2x50'')] - Studying - Exercises [TM: 2x(2x50'')]		- Sistem resultan gaya - Keseimbangan Benda Tegar [1: Hibbeler Bab 4-5] - Resultant force system - Equilibrium of Rigid Objects [1: Hibbeler Chapter 4-5]	
4	Quiz 1						20%
5-6	Mahasiswa mampu menganalisa dan menyusun resultan sistem gaya pada truss <i>Students are able to analyze and compile the resultant force system on the truss.</i>	Mampu menjelaskan dengan tepat bermacam tipe struktur. Mampu menyusun dan menyelesaikan permasalahan resultan gaya pada truss menggunakan metode joint dan section. <i>Able to explain various types of structures accurately. Able to compile and solve the problem</i>	Presentasi tentang jenis dan aplikasi struktur Latihan Soal Homework Presentation on types and applications of structures	- Kuliah - Latihan soal - Software MD Solid [TM: 2x(2x50'')] - Studying - Exercises - MD Solid Software [TM: 2x(2x50'')]		Structural analysis [1: Hibbeler Bab 6] <i>Structural analysis</i> [1: Hibbeler Chapter 6]	



		<i>of resultant forces on trusses using joint and section methods.</i>	<i>Homework Practice Questions</i>				
7	Mahasiswa mampu menganalisa dan menyusun resultan sistem gaya pada frame <i>Students are able to analyze and compile the resultant force system on the frame.</i>	Mampu menjelaskan dengan tepat bermacam tipe struktur. Mampu menyusun dan menyelesaikan permasalahan resultan gaya pada frame. <i>Able to explain various types of structures accurately. Able to compile and solve the problem of the resultant force on the frame.</i>		- Kuliah - Latihan soal - Software MD Solid [TM: 1x(2x50'')] - Studying - Exercises - MD Solid Software [TM: 1x(2x50'')]		Structural analysis [1: Hibbeler Bab 6] <i>Structural analysis [1: Hibbeler Chapter 6]</i>	
8	Evaluasi Tengah Semester / Ujian Tengah Semester						30%
9-10	Mahasiswa mampu menyusun diagram bidang gaya internal pada keseimbangan benda tegar <i>Students are able to compile internal force field diagrams for rigid body equilibrium.</i>	Mampu dan terampil menyusun diagram bidang gaya internal pada keseimbangan benda tegar <i>Able and skilled in compiling internal force field diagrams in rigid body equilibrium</i>		- Kuliah - Latihan soal - Software MD Solid [TM: 1x(2x50'')] - Studying - Exercises - MD Solid Software [TM: 1x(2x50'')]		- Internal forces [1: Hibbeler Bab 7] <i>- Internal forces [1: Hibbeler Chapter 7]</i>	
11	Mahasiswa mampu menguasai konsep tentang	Mahasiswa mampu memilih jenis koefisien gesek,		- Kuliah - Latihan soal		- Friction [1: Hibbeler Bab 8]	



	gesekan, koefisien gesek, dan gaya gesek serta mampu menerapkannya pada masalah kesetimbangan statik. <i>Students are able to master the concepts of friction, coefficient of friction, and frictional force and are able to apply them to static equilibrium problems.</i>	menggambarkan FBD yang melibatkan gaya gesek, dan mampu menghitung gaya gesek pada system setimbang statik <i>Students are able to choose the type of friction coefficient, describe FBD involving frictional force, and are able to calculate frictional force in a static equilibrium system.</i>		[TM: 1x(2x50'')] - Studying Exercises [TM: 1x(2x50'')]		- Friction [1: Hibbeler Chapter 8]	
12	Quiz 2 Quiz 2						20%
13	Mahasiswa mampu menguasai konsep tentang center of gravity dan centroid untuk menentukan pusat beban terdistribusi dan pusat area. <i>Students are able to master the concept of center of gravity and centroid to determine the center of distributed loads and center of area.</i>	Mahasiswa mampu menentukan lokasi pusat beban dan pusat area untuk bentuk sederhana dan komposit. <i>Students are able to determine the location of the center of load and center of area for simple and composite shapes.</i>		- Kuliah - Latihan soal [TM: 1x(2x50'')] - Studying Exercises [TM: 1x(2x50'')]		- Center of gravity and Centroid [1: Hibbeler Bab 9] - Center of gravity and Centroid [1: Hibbeler Chapter 9]	



14	Mahasiswa mampu menguasai konsep tentang momen inersia area untuk menentukan kekakuan penampang terhadap bending dan torsi. <i>Students are able to master the concept of area inertia to determine the stiffness of the cross-section against bending and torsion.</i>	Mahasiswa mampu menentukan momen inersia dan inersia polar suatu penampang terhadap suatu sumbu dan sumbu lain yang parallel. <i>Students are able to determine the moment of inertia and polar inertia of a cross-section with respect to an axis and another parallel axis.</i>		- Kuliah - Latihan soal [TM: 1x(2x50'')] - Studying Exercises [TM: 1x(2x50'')]		- Momen inertia of area [1: Hibbeler Bab 10] - Moment of inertia of area [1: Hibbeler Chapter 10]	
15	Mahasiswa mampu menguasai prinsip kerja virtual dan menerapkannya untuk system keseimbangan statis. <i>Students are able to master the principles of virtual work and apply them to static equilibrium systems.</i>	Mahasiswa mampu menentukan konfigurasi kesetimbangan statis untuk struktur dengan pin join. Mahasiswa mampu Menyusun fungsi energi potensial system dan menggunakannya untuk menentukan jenis kesetimbangan system statis. <i>Students are able to determine the static equilibrium configuration for structures with pin joints. Students are able to compile the potential energy function of a system and use it to determine</i>		- Kuliah - Latihan soal [TM: 1x(2x50'')] - Studying Exercises [TM: 1x(2x50'')]		- Virtual work [1: Hibbeler Bab 11] - Virtual work [1: Hibbeler Chapter 11]	



		<i>the type of static system equilibrium.</i>					
16	Evaluasi Akhir Semester / Ujian Akhir Semester						30%



RENCANA PEMBELAJARAN SEMESTER **PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN** **FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM – ITS**

SEMESTER LEARNING PLAN
BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING - ITS

MATA KULIAH (MK) <i>SUBJECT</i>		KODE <i>CODE</i>	Rumpun MK <i>COURSE SUBJECT</i>	BOBOT (sks) <i>WEIGHTS (SKS)</i>		SEMESTE R <i>SEMESTE R</i>	Direvisi <i>REVISED</i>
Kontruksi Plat dan Cangkang <i>Plate and Shell Construction</i>				T=3	P=0	7	
OTORISASI <i>OTORIZATION</i>		Pengembang RP <i>RP DEVELOPER</i>		Koordinator RMK <i>RMK COORDINATOR</i>		KETUA PRODI <i>HEAD OF PRODI</i>	
		Agus Sigit Pramono		Yohanes		Is Bunyamin Suryo	
Capaian Pembelajaran MK <i>Learning Outcomes (CP)</i>	CPL-PRODI yang dibebankan pada MK <i>CPL-PRODI charged to MK</i>						
	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif.					



		<i>Able to study and utilize science and technology in order to apply it to the field of mechanical engineering, and able to make appropriate decisions from the results of one's own work or group work in the form of final assignment reports or other forms of learning activities whose output is equivalent to the final assignment through logical, critical, systematic and innovative thinking.</i>
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan Teknik <i>Ability to identify, formulate, analyze and solve engineering problems</i>
	Capaian Pembelajaran Mata Kuliah (CPMK)	
	CPMK-1	Merumuskan persamaan keseimbangan dari free body diagram plat serta mendapatkan solusi persamaan tersebut sesuai dengan beban, jenis dan jumlah tumpuan dan menunjukkan defleksi serta tegangan-regangan yang terjadi akibat dari bermacam beban dan jenis serta jumlah tumpuan yang digunakan. <i>Formulate the equilibrium equations from the free body diagram of plates and obtain solutions to these equations according to the loads, types and number of supports and show the deflections and stress-strains that occur due to various loads and types and number of supports used.</i>
	CPMK-2	Merumuskan persamaan keseimbangan dari free body diagram cangkang serta mendapatkan solusi persamaan tersebut sesuai dengan beban, jenis dan jumlah tumpuan dan menunjukkan defleksi serta tegangan-regangan yang terjadi akibat dari bermacam beban dan jenis serta jumlah tumpuan yang digunakan.



		<i>Formulate the equilibrium equations from the free body diagram of shells and obtain solutions to these equations according to the loads, types and number of supports and show the deflections and stress-strains that occur due to various loads and types and number of supports used.</i>																
	CPMK-3	Mahasiswa mampu merancang dan menganalisa kekuatan dan kekakuan pada bejana bertekanan, tangki dan perpipaan sesuai standard yang berlaku. <i>Students are able to design and analyze the strength and stiffness of pressure vessels, tanks, and piping according to applicable standards.</i>																
		Matrik CPL – CPMK <i>Matrix of CPL – CPMK</i> <table><tr><th>CPMK</th><th>CPL-2</th><th>CPL4</th><th>CPL - 8</th></tr><tr><td>CPMK 1</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK 2</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK 3</td><td>V</td><td>V</td><td>V</td></tr></table>	CPMK	CPL-2	CPL4	CPL - 8	CPMK 1	V	V	V	CPMK 2	V	V	V	CPMK 3	V	V	V
CPMK	CPL-2	CPL4	CPL - 8															
CPMK 1	V	V	V															
CPMK 2	V	V	V															
CPMK 3	V	V	V															
Deskripsi Singkat MK <i>Short description of MK</i>	Pada dasarnya mata kuliah ini ditujukan untuk menentukan kekuatan struktur plat dan cangkang serta mendapatkan kekakuannya melalui perumusan defleksi. Dengan demikian mahasiswa dapat memutuskan apakah struktur plat maupun cangkang kuat menahan beban serta mendapatkan kekakuan yang dibutuhkan. <i>Basically, this course is intended to determine the strength of plate and shell structures and obtain their stiffness through deflection formulation. Thus, students can decide whether the plate or shell structure is able to withstand strong loads and obtain the required stiffness.</i>																	



Bahan Kajian : Materi Pembelajaran <i>Study Materials:</i> <i>Learning Material</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: Plat circular, plat rectangular, plat dengan bentuk geometri bervariasi, plat rectangular dengan beban kombinasi lateral dan membran, plat dengan defleksi besar, beban termal pada plat, cangkang dengan beban membran, cangkang dengan beban bending. <i>In this course, the following topics will be studied:</i> <i>Circular plates, rectangular plates, plates with varying geometric shapes, rectangular plates with combined lateral and membrane loads, plates with large deflections, thermal loads on plates, shells with membrane loads, and shells with bending loads.</i>				
Pustaka (<i>Literatures</i>)	<table><tr><td>Utama (<i>Primary</i>) :</td><td>Ugural, A. C, "Stresses in Beams, Plates, and Shells", Third Edition , CRC Press, 2011</td></tr><tr><td>Pendukung (<i>Proponents</i>) :</td><td> 1. Dennis Moss, " Pressure Vessel Design Manual", Third Edition, Gulf Professional Publishing, 2004. 2. Amin Ghali, " Circular Storage Tanks and Silos, Second Edition, CRC Press, 2000 3. Peng, L. P and Peng , T. L,"Pipe Stress Engineering", ASME Press, 2009 </td></tr></table>	Utama (<i>Primary</i>) :	Ugural, A. C, "Stresses in Beams, Plates, and Shells", Third Edition , CRC Press, 2011	Pendukung (<i>Proponents</i>) :	1. Dennis Moss, " Pressure Vessel Design Manual", Third Edition, Gulf Professional Publishing, 2004. 2. Amin Ghali, " Circular Storage Tanks and Silos, Second Edition, CRC Press, 2000 3. Peng, L. P and Peng , T. L,"Pipe Stress Engineering", ASME Press, 2009
Utama (<i>Primary</i>) :	Ugural, A. C, "Stresses in Beams, Plates, and Shells", Third Edition , CRC Press, 2011				
Pendukung (<i>Proponents</i>) :	1. Dennis Moss, " Pressure Vessel Design Manual", Third Edition, Gulf Professional Publishing, 2004. 2. Amin Ghali, " Circular Storage Tanks and Silos, Second Edition, CRC Press, 2000 3. Peng, L. P and Peng , T. L,"Pipe Stress Engineering", ASME Press, 2009				
Dosen Pengampu (<i>Lecturer</i>)	Agus Sigit Pramono				
Mata kuliah Syarat <i>prerequisite courses</i>	Fisika Statika (<i>Static Physics</i>) Mekanika Kekuatan Material (<i>mechanics of strength materials</i>)				



Pertemuan Ke- <i>Meet to</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (Sub-CPMK)</i>	Penilaian <i>evaluation</i>		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Forms, Learning Methods, Student Assignments, [Estimasi Waktu] [times estimations]</i>		Materi Pembelajaran [Pustaka] <i>Learning Materials [Literatures]</i>	Bobot Penilaian <i>[assessment weight]</i> (%)
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria & Form</i>	Luring <i>(offline)</i>	Daring <i>(online)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Diagram benda bebas dan penjabarkan persamaan differensial membran dan bending plat dalam koordinat Cartesian <i>Free body diagram and description to obtain the differential equations of membrane and plate bending in Cartesian coordinates.</i>	Mampu menuliskan dan menjelaskan persamaan differensial membran dan bending plat dalam koordinat Cartesian <i>Able to write and explain the differential equations of membranes and bending plates in Cartesian coordinates.</i>	membuat ringkasan persamaan membran dan bending plat pada koordinat kartesian <i>make a summary of the membrane and plate bending equations in Cartesian coordinates</i>	- Kuliah (<i>Lecture</i>) - Brainstorming		Ugural, Chapter 3	5



2	Tranformasi persamaan differensial bending plat dari koord. Cartesian ke koord. Circular <i>Transformation of plate bending differential equations from Cartesian coordinates to Circular coordinates.</i>	Mampu menjelaskan persamaan bending plat pada koordinat polar dan mampu menyelesaikan pada kasus beban axis simetri. <i>Able to explain plate bending equations in polar coordinates and able to solve cases of axial symmetry loads.</i>	Mengerjakan soal di rumah bending plat circular dengan tumpuan sederhana maupun jepit dengan beban axis simetri <i>Doing homework on bending circular plates with simple or clamped supports with axial symmetry loads</i>	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 4	5
3	Defleksi dan tegangan pada plat circular berlubang se sumbu.	Mampu menyelesaikan defleksi dan tegangan pada plat circular berlubang	Mengerjakan soal di rumah untuk plat circular berlubang sesumbu dengan	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 4	



	<i>Deflection and stress in a circular plate with a coaxial hole.</i>	sesumbu dengan tumpuan sederhana dan jepit. <i>Able to solve deflection and stress on circular co-axial hole plates with simple and clamped supports</i>	tumpuan sederhana dan jepit. <i>Doing homework on circular co-axial hole plates with simple and clamped supports.</i>				5
4	Analisa defleksi dan tegangan pada plat rectangular dengan tumpuan sederhana pada semua sisinya. <i>Deflection and stress analysis of rectangular plates with simple supports on all sides.</i>	Mampu menyelesaikan persamaan differensial plat dengan tumpuan sederhana pada semua sisi dengan menggunakan metode Navier <i>Able to solve differential equations of plates with simple supports on all edges</i>	Pekerjaan rumah plat rectangular tumpuan sederhana pada semua sisi akibat beban merata, merata sebagian terpusat dan momen. <i>Complete the homework of rectangular plate simply supported on all sides due to uniform, partially</i>	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 5	5



		<i>using the Navier method</i>	<i>concentrated loads and moments.</i>				
5	Analisa defleksi dan tegangan pada plat rectangular dengan tumpuan sederhana untuk sisi yang saling berhadapan sedangkan sisi yang lain bisa tumpuan sederhana, tumpuan jepit, maupun ujung bebas. <i>Deflection and stress analysis on rectangular plates with simple supports for the opposite sides while the other sides can be simple supports, fixed supports, or free ends.</i>	Mampu menyelesaikan persamaan diff. plat dengan tumpuan sederhana pada dua sisi yang berhadapan dengan menggunakan metode Levy <i>Able to solve plate differential equations with simple supports on two opposite edges using the Levy method</i>	Pekerjaan rumah plat rectangular menggunakan metode Levy pada berbagai macam kasus tumpuan <i>Rectangular plate homework using Levy's method on various support cases.</i>	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 5	5
			Pekerjaan rumah menyelesaikan			Ugural, Chapter 5	



6	Analisa defleksi dan tegangan rectangular plat menggunakan metode strip serta metode superposisi <i>Analysis of deflection and stress of rectangular plates using the strip method and superposition method</i>	Mampu menyelesaikan persamaan differensial plat rectangular dengan metode strip serta superposisi <i>Able to solve differential equations of rectangular plates using strip and superposition methods</i>	defleksi dan tegangan plat rectangular dengan metode strip dan superposisi. <i>Homework to solve the deflection and stress of rectangular plates using the strip and superposition methods.</i>	- Kuliah (Lecture) - Brainstorming			5
7	Analisa defleksi dan tegangan rectangular plat akibat tumpuan elastis dan tumpuan kolom. <i>Analysis of deflection and stress of rectangular plates due to elastic</i>	Mampu menyelesaikan persamaan differensial plat rectangular dengan tumpuan elastis dan tumpuan column <i>Able to solve differential equations</i>	Pekerjaan rumah menyelesaikan defleksi dan tegangan plat rectangular dengan tumpuan elastis dan tumpuan kolom. <i>Homework to solve the deflection and</i>	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 5	5



	<i>support and column support.</i>	<i>of rectangular plates with elastic supports and column supports</i>	<i>stress of rectangular plates with elastic supports and column supports.</i>				
8	Evaluasi Tengah Semester						15
9	Analisa Tegangan – Regangan cangkang berdinding tipis pada tabung silinder, bola, ellips. <i>Stress-Strain Analysis in thin-walled shells of cylindrical, spherical, elliptical tubes.</i>	Mampu menjabarkan persamaan differensial cangkang berdinding tipis dan menyelesaikannya untuk kasus Silinder, bola, ellips. <i>Able to describe the differential equations of thin-walled shells and solve them for the cases of cylinders, spheres, ellipses.</i>	Pekerjaan rumah menyelesaikan defleksi dan tegangan cangkang berdinding tipis berupa tabung berbentuk silinder, bola dan elips. <i>Homework to complete the deflection and stress of thin-walled shells in the form of cylindrical, spherical and elliptica.</i>	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 12	5



10	Analisa Tegangan – Regangan cangkang berdinding tipis pada tabung kerucut, kubah, dan donat <i>Stress – Strain Analysis in Thin-walled Shells for Cone, Dome, and Donut Tubes</i>	Mampu menjabarkan persamaan differensial cangkang berdinding tipis dan menyelesaikannya untuk kasus kerucut, kubah, donat. <i>Able to describe the differential equations of thin-walled shells and solve them for the cases of cones, domes, donuts.</i>	Pekerjaan rumah menyelesaikan defleksi dan tegangan cangkang berdinding tipis berupa tabung berbentuk kerucut, kubah dan donat. <i>Homework to complete the deflection and stress of thin-walled shells in the form of cones, domes, donuts.</i>	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 12	5
11	Analisa Tegangan – Regangan cangkang berdinding tebal pada tabung silinder, bola, dan ellips,	Mampu menjabarkan persamaan differensial cangkang berdinding tebal	Pekerjaan rumah menyelesaikan defleksi dan tegangan cangkang berdinding tebal berupa tabung	- Kuliah (Lecture) - Brainstorming		Ugural, Chapter 12	



	<i>Stress – Strain Analysis in Thin-walled Shells for cylindrical, spherical, elliptical tubes.</i>	dan menyelesaikannya untuk kasus Silinder dengan adanya tumpuan <i>Able to describe the differential equations of thin-walled shells and solve them for the cases of cylinders with support</i>	berbentuk silinder, bola dan elips. <i>Homework to complete the deflection and stress of thick-walled shells in the form of cylindrical, spherical and elliptical tubes.</i>				5
12	Analisa Tegangan – Regangan cangkang berdinding tebal pada tabung kerucut dan kubah. <i>Stress – Strain Analysis in Thick walled Shells for Cone, Dome and Donut Tubes</i>	Mampu menjabarkan persamaan differensial cangkang berdinding tebal dan menyelesaikannya untuk kasus Silinder, bola, ellips, kerucut, kubah	Pekerjaan rumah menyelesaikan defleksi dan tegangan cangkang berdinding tebal berupa tabung berbentuk kerucut, kubah dan donat. <i>Homework to complete the deflection and stress</i>	- Kuliah (<i>Lecture</i>) - Brainstorming		Ugural, Chapter 13	5



		<i>Able to describe the differential equations of thin-walled shells and solve them for the cases of cylinders, spheres, ellipses, cones, domes</i>	<i>of thick-walled shells in the form of cones, domes, donuts. tubes.</i>				
13	Analisa Tegangan - Regangan bejana bertekanan dengan Standard ASME <i>Stress-Strain Analysis of Pressure Vessels with ASME Standard</i>	Mampu merancang pressure vessel menggunakan standar ASME <i>Able to design pressure vessels using ASME standards</i>	Proyek Desain Bejana Tekan dengan Standar ASME <i>Design Project of Pressure Vessel with ASME Standard</i>	- Kuliah (Lecture) - Brainstorming		Dennis Moss	5
14	Analisa Tegangan - Regangan Tangki dengan Standard API	Mampu merancang storage tank dengan menggunakan standar API	Proyek Desain Tangki Penyimpanan dengan Standar API	- Kuliah (Lecture) - Brainstorming		Amin Ghali	5



	<i>Stress-Strain Analysis of Tanks with API Standard</i>	<i>Able to design storage tanks using API standards</i>	<i>Design Project of Storage Tank with API Standard</i>				
15	Analisa Tegangan - Regangan pada sistem perpipaan dengan Standard ASME <i>Stress-Strain Analysis on Piping System with ASME Standard</i>	Mampu merancang sistem perpipaan sederhana menggunakan standard ASME <i>Able to design simple piping systems using ASME standards</i>	Proyek Desain Sistem Perpipaan Sederhana dengan Standar ASME <i>Design Project of simple Piping System with ASME Standard</i>	Kuliah (Lecture) - Brainstorming		Peng L.P	5
16	Evaluasi Akhir Semester						15



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM – ITS <i>SEMESTER LEARNING PLAN</i> <i>BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING - ITS</i>						
	RENCANA PEMBELAJARAN SEMESTER <i>SEMESTER LEARNING PLAN</i>						
	MATA KULIAH (MK) <i>SUBJECT</i>	KODE <i>CODE</i>	Rumpun MK <i>COURSE SUBJECT</i>	BOBOT (sks) <i>WEIGHT (SKS)</i>		SEMESTER <i>SEMESTER</i>	Direvisi <i>REVISED</i>
	MEKANIKA KEKUATAN MATERIAL <i>mechanics of strength materials</i>	TM141334	MEKANIKA BENDA PADAT <i>Solid Mechanics</i>	T=3	P=0	2	
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>RPS Developer</i>		Koordinator RMK <i>RMK Coordinator</i>		Ketua PRODI <i>Head of PRODI</i>		
	Achmad Syaifudin		Agus Sigit Pramono		Is Bunyamin Suryo		
Capaian Pembelajaran (CP) <i>Learning Outcomes (CP)</i>	CPL-PRODI yang dibebankan pada MK <i>CPL-PRODI charged to MK</i>						
	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif.					



		<i>Able to study and utilize science and technology in order to apply it to the field of mechanical engineering, and able to make appropriate decisions from the results of one's own work or group work in the form of final assignment reports or other forms of learning activities whose output is equivalent to the final assignment through logical, critical, systematic and innovative thinking.</i>			
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.</i>			
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan Teknik <i>Ability to identify, formulate, analyze and solve engineering problems</i>			
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcomes (CPMK)</i>				
	CPMK-1	Mahasiswa mampu menganalisis tegangan kombinasi akibat beban tunggal maupun beban kombinasi (CPL-4, CPL-8) <i>Students are able to analyze combination stresses due to single loads and combination loads (CPL-4, CPL-8).</i>			
	CPMK-2	Mahasiswa mampu melakukan transformasi tegangan-regangan 2D dan 3D secara analitis dan atau grafis (CPL-4, CPL-8) <i>Students are able to perform 2D and 3D stress-strain transformations analytically and/or graphically (CPL-4, CPL-8)</i>			
	CPMK-3	Mahasiswa mampu menganalisis defleksi struktur statis tertentu dan tak tentu (CPL-4, CPL-8) <i>Students are able to analyze the deflection of statically determinate and indeterminate structures (CPL-4, CPL-8)</i>			
		Matrik CPL – CPMK <i>Matrix of CPL - CPMK</i>			
		CPMK	CPL-2	CPL-4	CPL-8
		CPMK-1		V	V



		CPMK-2		V	V
		CPMK-3		V	V
Deskripsi Singkat MK <i>Short description of MK</i>	Pada dasarnya mata kuliah ini ditujukan untuk menentukan kekuatan struktur, frame maupun mesin serta mendapatkan kekakuannya melalui perumusan defleksi baik pada kondisi 1D, 2D, maupun 3D. Dengan demikian mahasiswa dapat memutuskan apakah sturktur, frame maupun machine kuat menahan beban serta mendapatkan kekakuan yang dibutuhkan. <i>Basically, this course is intended to determine the strength of structures, frames and machines and obtain their stiffness through the formulation of deflection in 1D, 2D, and 3D conditions. Thus, students can decide whether the structure, frame or machine is strong enough to withstand the load and obtain the required stiffness</i>				
Bahan Kajian: Materi Pembelajaran <i>Study Material: Learning Material</i>	Mata kuliah ini mempelajari mengenai tegangan kombinasi akibat beban tunggal maupun beban kombinasi, tegangan-tegangan ekstrem dalam analisis kegagalan suatu komponen mesin, defleksi pada struktur statis tertentu dan tak tentu, dan penerapan metode energi/kerja virtual dalam perancangan. <i>This course studies combination stresses due to single loads and combination loads, extreme stresses in the failure analysis of a machine component, deflections in statically determinate and indeterminate structures, and the application of virtual energy/work methods in design.</i>				
Pustaka Literatures	Utama : <i>(Primary) :</i>				
		7. Russel C. Hibbeler, Mechanics of Materials, 8th edition, Prentice Hall			
	Pendukung : <i>Proponents :</i>				
		8. F.P. Beer and E. R. Johnston Jr., Mechanics of Materials, 6th Edition, McGraw-Hill 9. J.M. Gere and B. J. Goodno, Mechanics of Materials Brief, SI Edition, 2012, Cengage Learning			



Dosen Pengampu <i>Lectures</i>	Alief Wikarta, Agus Sigit Pramono, Achmad Syaifudin, Julendra Ariatedja, Yusuf Kaelani, Yohanes						
Matakuliah <i>prerequisite course</i>	Fisika Statika <i>Static Physics</i>						
Pertemuan Ke- <i>Meet to</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (Sub-CPMK)</i>	Penilaian <i>evaluation</i>		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Forms, Learning Methods, Student Assignments, [Estimasi Waktu] [times estimations]</i>		Materi Pembelajaran [Pustaka] <i>Learning Materials [Literatures]</i>	Bobot Penilaian <i>[assessment weight]</i> (%)
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria & Form</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menerapkan konsep tegangan dan regangan pada material <i>Students are able to apply the concept of stress and strain to materials.</i>	- Mampu membedakan dan menjelaskan tentang stress dan strain - Mampu menjelaskan mechanical properties dan	Membuat ringkasan dalam makalah sederhana <i>Making a summary in a simple paper</i>	- Kuliah (<i>Lecture</i>) - Brainstorming - Video Strain measurement, Mechanical test. [TM: 1x(2x50'')]		- Stress - Strain - Mechanical Properties of Material [2:Hibbeler Bab (<i>Ch.</i>) 1-3]	



		bermacam pengujiannya - <i>Able to differentiate and explain stress and strain</i> - <i>Able to explain mechanical properties and various tests</i>					
2-3	Mahasiswa mampu menghitung tegangan dan regangan yang terjadi akibat beban aksial, torsi, bending, transverse shear <i>Students are able to calculate the stress and strain that occurs due to axial loads, torque, bending, transverse shear.</i>	Mampu menganalisa tegangan-regangan akibat Beban Aksial, torsi, bending, dan transverse shear <i>Able to analyze stress-strain due to axial load, torsion, bending, and transverse shear</i>	Latihan Soal <i>exercises</i>	- Kuliah (<i>Lecture</i>) - E-learning: Konsep Tegangan (<i>Stresses Concept</i>) - Latihan soal (<i>exercises</i>) [TM: 3x(2x50'')]		- Axial Load. - Torsion. [2:Hibbeler Bab (<i>Ch.</i>) 4-7]	
4-5	Mahasiswa mampu menunjukkan tegangan dan regangan yang terjadi akibat beban kombinasi	Mampu menganalisa tegangan-regangan akibat Beban Kombinasi	Latihan Soal <i>Exercises</i> Tugas <i>Homework</i>	- Kuliah (<i>Lecture</i>) - E-learning: Konsep Tegangan (<i>Stresses Concept</i>) - Latihan soal (<i>exercises</i>) [TM: 2x(2x50'')]		- Combined Loadings. [2:Hibbeler Bab (<i>Ch.</i>) 8]	



	<i>Students are able to demonstrate the stress and strain that occurs due to combination loads.</i>	<i>Able to analyze stress-strain due to Combined Loads</i>					
6	QUIZ 1 [TM: 2x(2x50'')]						20%
7	Mahasiswa mampu membuat elemen tegangan pada suatu material/komponen yang dikenakan berbagai jenis beban <i>Students are able to create stress elements on a material/component subjected to various types of loads.</i>	Cakap membuat elemen tegangan: menentukan jenis tegangan dan arahnya serta penampang kerjanya. <i>Capable of making stress elements: determining the type of stress and its direction as well as its working cross-section.</i>					
	Mampu membuat diagram benda bebas, diagram normal, geser, momen bending dan momen torsi <i>Able to create free body diagrams, normal diagrams, shear,</i>	Kecakapan dalam membuat diagram benda bebas, diagram normal, geser, momen bending dan momen torsi <i>Skill in making free body diagrams,</i>	Oral Post-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic</i>	<i>Lecture</i> [TM: 3x50''] <i>Contextual Teaching and Learning (CTL)</i> ` Belajar Terstruktur [TM: 3x60''] Kuasai pembuatan diagram (benda bebas, normal,		Kontrak kuliah (<i>Study contract</i>) Review: - Diagram benda bebas - Diagram normal, geser, momen bending dan momen torsi	-



8	<i>bending moments and torsion moments</i> • Mampu menjelaskan sifat mekanik material dan fungsi angka keamanan dalam perancangan <i>Able to explain the mechanical properties of materials and the function of safety factors in design</i>	<i>normal diagrams, shear, bending moments and torsion moments</i> • Kecakapan dalam menjelaskan sifat mekanik material dan fungsi angka keamanan <i>Ability to explain the mechanical properties of materials and the function of safety factors</i>	<i>and comprehensive description</i>	geser, momen bending dan torsi) yang baik Kuasai sifat mekanik material dan angka keamanan <i>Structured Learning [TM: 3x60"] Master the creation of good diagrams (free body, normal, shear, bending moment and torque)</i> <i>Master the mechanical properties of materials and safety factors</i> Belajar Mandiri [TM: 3x60"] Persiapkan oral-pretest untuk kuliah ke-2 mengenai analisis tegangan akibat beban tunggal Pelajari hubungan beban dan tegangan <i>Independent Study [TM: 3x60"] Prepare oral-pretest for the 2nd lecture on stress analysis due to single load. Learn</i>	<i>-Free body diagrams</i> <i>- Normal, shear, bending moment and torsion moment diagrams</i> Sifat mekanik material: Hooke's law, poisson rasio, mod. elastisitas dan mod. Geser <i>Mechanical properties of materials: Hooke's law, Poisson's ratio, mod. of elasticity and mod. of shear.</i> Angka keamanan (<i>Safety factor</i>) [1]: Bab (<i>Ch.</i>) 1 – 3 [2]: Handout in myITS Classroom	



				<i>the relationship between load and stress.</i>			
9	- Mampu menganalisis kasus tegangan akibat beban tunggal (beban aksial, termal, lintang, bending dan puntir) <i>Able to analyze stress cases due to single loads (axial, thermal, transverse, bending and torsional loads)</i>	- Kecakapan dalam analisis tegangan akibat beban tunggal <i>Proficiency in stress analysis due to single loads</i>	Oral Pre-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten) <i>Independent Assignment: Timeliness of submission Completeness (format and content)</i>	<i>Lecture</i> [TM: 3x50"] Contextual Teaching and Learning (CTL) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning</i> [TM: 3x60"] <i>Complete the assigned tasks, according to the sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Kuasai analisis tegangan akibat beban kombinasi Kuasai penyusunan elemen tegangan Persiapkan Kuis 1 pada minggu ke-3, mencakup sub-CPMK minggu 1-3		Review: Analisis tegangan dan deformasi akibat beban tunggal (aksial, bending, puntir dan lintang) <i>Analysis of stress and deformation due to single loads (axial, bending, torsion and transverse)</i> Analisis tegangan-regangan 2D3D: Plane stress, Plane strain <i>2D-3D stresses-strains analysis: Plane stress, Plane strain</i> [1]: Bab(Ch.) 4 – 7 [2]: Handout di myITS Classroom	-



				<i>Independent Learning [TM: 3x60"] Master the analysis of stress due to combination loads Master the arrangement of stress elements Prepare for Quiz 1 in week 3, covering sub-CPMK weeks 1-3</i>			
10	• Mampu menganalisis kasus tegangan akibat beban kombinasi <i>Able to analyze stress cases due to combination loads</i> • Mampu menyusun elemen tegangan (state of stress) dari beban kombinasi <i>Able to compose stress elements (state of stress) from combination loads</i>	• Kecakapan dalam analisis tegangan dari beban kombinasi • Kecakapan dalam menyusun elemen tegangan dari beban kombinasi • <i>Proficiency in stress analysis of combined loads</i> • <i>Proficiency in composing stress elements of combined loads</i>	Kuis: 2 soal 100 mnt Model matematik, kalkulasi <i>Quiz: 2 questions 100 min Mathematical models, calculations</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Kuis 1 (asesmen CPMK 1) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Complete the assigned tasks, according to the sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Pelajari transformasi tegangan 2D-3D secara grafis		Analisis tegangan-regangan 2D-3D: Plane stress, Plane strain Lingkaran Mohr 2D <i>2D-3D stress-strain analysis: Plane stress, Plane strain 2D Mohr circle</i> [1]: Bab (Ch.) 8 [2]: Handout di myITS Classroom	3/15



				Persiapkan oral-pretest untuk kuliah ke-4 mengenai lingkaran Mohr <i>Self-Study [TM: 3x60"]</i> <i>Learn 2D-3D stress transformation graphically Prepare for oral-pretest for the 4th lecture on Mohr's circle</i>			
11	• Mampu melakukan transformasi tegangan secara grafis (lingkaran Mohr) • <i>Able to perform stress transformation graphically (Mohr circle)</i> • Mampu melakukan transformasi regangan secara grafis (lingkaran Mohr) • <i>Able to perform strain transformation graphically (Mohr's circle)</i>	• Kecakapan dalam melakukan transformasi tegangan-regangan 2D secara grafis • <i>Ability to perform 2D stress-strain transformations graphically</i>	Oral Pre-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten) <i>Independent Assignment:</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Complete the assigned tasks, according to the sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Pelajari		Transformasi tegangan-regangan 2D-3D: Lingkaran Mohr <i>2D-3D stress-strain transformation: Mohr's circle</i> [1]: Bab (<i>Ch.</i>) 9 dan 10 [2]: Handout di myITS Classroom	-



			<i>Timeliness of submission</i> <i>Completeness (format and content)</i>	transformasi tegangan secara analitis Persiapkan oral-pretest untuk kuliah ke-5 mengenai plane stress – plane strain <i>Independent Study [TM: 3x60"] Study stress transformation analytically Prepare oral-pretest for the 5th lecture on plane stress – plane strain</i>			
12	• Mampu melakukan transformasi tegangan-regangan 2D secara analitis (plane stress - plane strain) • <i>Capable of performing 2D stress-strain transformation analytically (plane stress - plane strain)</i> • Mampu melakukan transformasi tegangan -	• Ketepatan dalam menerapkan asumsi plane stress – plane strain dalam analisis tegangan • <i>Accuracy in applying the plane stress – plane strain assumption in stress analysis</i> • Kecakapan dalam melakukan transformasi	Oral Pre-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK Kuasai transformasi tegangan 2D-3D <i>Structured Learning [TM: 3x60"] Complete the</i>		Plane stress – Plane strain Transformasi tegangan-regangan 3D: metode analitik <i>Plane stress – Plane strain 3D stress-strain transformation: analytical method</i> [1]: Bab (Ch.) 9 dan 10	-



	regangan 3D secara analitis • <i>Capable of performing 3D stress-strain transformation analytically</i>	tegangan-regangan 3D secara analitis <i>Proficiency in performing 3D stress-strain transformation analytically</i>	Kelengkapan (format dan konten) <i>Independent Assignment: Timeliness of submission Completeness (format and content</i>	<i>assigned tasks, according to sub-CPMK Master 2D-3D stress transformation</i> Belajar Mandiri [TM: 3x60"] Kuasai transformasi tegangan 2D-3D secara analitis Persiapkan Kuis 2 pada minggu ke-6, mencakup sub-CPMK minggu 4-6 <i>Self-Study [TM: 3x60"] Master 2D-3D stress transformation analytically Prepare for Quiz 2 in week 6, covering sub-CPMK weeks 4-6</i>		[2]: Handout di myITS Classroom	
13	• Mampu menganalisis tegangan2 ekstrem dari transformasi tegangan akibat beban kombinasi <i>Able to analyze extreme stresses from stress</i>	• Ketepatan dalam mendapatkan tegangan prinsipal dan tegangan geser maksimum dari transformasi tegangan tegangan2	Kuis: 2 soal 100 mnt Model matematik, kalkulasi <i>Quiz: 2 questions 100 min Mathematical models, calculations</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Kuis 2 (asesmen CPMK 2) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas		Tegangan2 ekstrem: tegangan prinsipal, tegangan geser maksimum, tegangan ekuivalen Strain gages Strain Rosette	3/15



	<i>transformation due to combination loads.</i>	ekstrem dari transformasi tegangan <i>Accuracy in obtaining principal stress and maximum shear stress from stress transformation</i>		yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Complete the assigned tasks, according to the sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Pelajari teori2 kegagalan statik dan implementasinya <i>Self-Study [TM: 3x60"] Learn static failure theories and their implementations</i>		<i>Extreme stresses: principal stress, maximum shear stress, equivalent stress Strain gages Strain Rosette</i> [1]: Bab (Ch.) 9 dan 10 [2]: Handout di myITS Classroom	
14	- Mampu menjelaskan teori kegagalan statik <i>• Able to explain static failure theories</i> - Mampu menerapkan teori kegagalan statik dalam perancangan material	- Kecakapan dalam menjelaskan teori2 kegagalan static <i>Ability to explain static failure theories</i> - Ketepatan dalam menerapkan teori	Oral Pre-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK		Kegagalan material: statik, fatik dan creep Teori kegagalan statik: Rankin, Guest Tresca dan von Mises <i>Material failure: static, fatigue and creep Static failure theories: Rankin,</i>	-



	• <i>Able to apply static failure theories in material design</i>	kegagalan statik dalam perancangan <i>Accuracy in applying static failure theory in design</i>	Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten) <i>Independent Assignment: Timeliness of submission Completeness (format and content</i>	<i>Structured Learning [TM: 3x60"] Complete the assigned tasks, according to sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Kuasai implementasi teori2 kegagalan statik Persiapkan Kuis 3 pada minggu ke-8, mencakup sub-CPMK minggu 7-8 <i>Independent Learning [TM: 3x60"] Master the implementation of static failure theories Prepare for Quiz 3 in week 8, covering sub-CPMK weeks 7-8</i>		<i>Guest Tresca and von Mises</i> [1]: Bab (<i>Ch.</i>) 3.8 dan 10.7 [2]: Handout di myITS Classroom	
	• Mampu memilih teori kegagalan statik yang sesuai dengan jenis material • <i>Able to select the appropriate static</i>	• Ketepatan dalam pemilihan teori kegagalan statik yang sesuai dengan jenis material yg digunakan.	Kuis: 1 soal 50 mnt Model matematik, kalkulasi <i>Quiz: 1 questions 50 min Mathematical models, calculations</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Kuis 3 (asesmen CPMK 3)		Teori kegagalan statik: Rankin, Guest Tresca dan von Mises	2/15



15	<i>failure theory for the type of material</i>	<i>Accuracy in selecting the appropriate static failure theory for the type of material used</i>		Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Do the given assignments, according to the sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Persiapkan oral-pretest untuk kuliah ke-9 mengenai analisis defleksi pada balok <i>Independent Learning [TM: 3x60"] Prepare an oral pretest for the 9th lecture on deflection analysis of beams</i>		<i>Static failure theory: Rankin, Guest Tresca and von Mises</i> [2]: Handout di myITS Classroom	
16	Evaluasi Tengah Semester / Ujian Tengan Semester						
	Mampu menyelesaikan kasus defleksi balok statis tertentu dengan metode	Kecakapan dalam menyelesaikan kasus defleksi balok statis tertentu dengan	Oral Post-Test (acak): Sistematis dan komprehensivitas deskripsi	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Pengumuman hasil		Analisis beam untuk poros Klasifikasi metode analisis defleksi balok	



17-18	integrasi ganda dan diskontinu • <i>Able to solve determinated static beam deflection with integration and discontinuous methods.</i>	metode integrasi ganda dan diskontinyu <i>Proficiency in solving certain static beam deflection cases using multiple and discontinuous integration methods.</i>	<i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten) <i>Independent Assignment: Timeliness of submission Completeness (format and content</i>	evaluasi tengah semester (CPMK 1-3) <i>Announcement of mid-semester evaluation results (CPMK 1-3)</i> Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Do the assigned tasks, according to sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Persiapkan oral-pretest untuk kuliah ke-10 Pelajari analisis defleksi balok dengan metode luasan bidang momen dan Castigliano <i>Independent Learning [TM: 3x60"] Prepare oral-pretest for the 10th</i>	<i>Beam analysis for shafts Classification of beam deflection analysis methods</i> Analisis defleksi balok statis tertentu: metode integral ganda, diskontinu <i>Statistically determinate beam deflection analysis: double integral method, discontinuous</i> [1]: Bab (<i>Ch.</i>) 12 [2]: Handout di myITS Classroom	



				<i>lecture Learn beam deflection analysis using the moment area and Castigliano methods</i>			
19-20	- Mampu menyelesaikan kasus defleksi balok statis tertentu dengan metode luasan bidang momen dan Castigliano <i>Able to solve certain static beam deflection cases using the moment plane area and Castigliano methods.</i>	- Kecakapan dalam menyelesaikan kasus defleksi balok statis tertentu dengan metode luasan bidang momen dan superposisi <i>Skill in solving certain static beam deflection cases using the moment area and superposition method</i>	Oral Pre-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten) <i>Independent Assignment: Timeliness of submission Completeness (format and content</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Complete the assigned tasks, according to sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Persiapkan oral-pretest untuk kuliah ke-11 Kuasai analisis defleksi balok metode luasan bidang momen dan Castigliano		Analisis defleksi balok statis tertentu: luasan bidang momen dan Castigliano <i>Deflection analysis of statically determinate beams: moment plane area and Castigliano</i> [1]: Bab (Ch.) 12 [2]: Handout di myITS Classroom	-



				Independent Learning [TM: 3x60"] Prepare for oral pretest for the 11th lecture Master the analysis of beam deflection using the area, moment and Castigliano methods			
21-22	- Mampu menyelesaikan kasus defleksi balok statis tak tentu dengan metode luasan bidang momen atau superposisi <i>Able to solve cases of statically indeterminate beam deflection using the moment area or superposition method</i>	- Kecakapan dalam menyelesaikan kasus defleksi balok statis tak tentu dengan metode luasan bidang momen atau superposisi <i>Ability to solve statically indeterminate beam deflection cases using the moment area or superposition method</i>	Oral Pre-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten) <i>Independent Assignment: Timeliness of submission</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Complete the assigned tasks, according to sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Kuasai analisis defleksi balok		Analisis defleksi balok statis tak tentu: metode superposisi atau luasab bidang momen <i>Static indeterminate beam deflection analysis: superposition method or moment plane area</i> [1]: Bab (Ch.) 12 [2]: Handout di myITS Classroom	-



			<i>Completeness (format and content)</i>	determinateindeterminate dengan metode yang tepat Persiapkan Kuis 4 pada minggu ke-12, mencakup sub-CPMK minggu 9-12 <i>Independent Learning [TM: 3x60"] Master the analysis of determinate indeterminate beam deflection with the right method Prepare for Quiz 4 in week 12, covering sub-CPMK weeks 9-12</i>			
23-24	• Mampu menganalisis kasus defleksi balok dengan metode yang tepat • <i>Able to analyze beam deflection cases with the right method</i>	• Ketepatan dalam menggunakan metode analisis balok dalam menyelesaikan kasus defleksi (statik tertentu/statik tak tentu) • <i>Accuracy in using beam analysis methods in solving deflection cases (static</i>	Kuis: 1 soal 50 mnt Model matematik, kalkulasi <i>Quiz: 1 questions 50 min Mathematical models, calculations</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Kuis 4 (asesmen CPMK 4) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK <i>Structured Learning [TM: 3x60"] Do the given</i>		Strategi analisis defleksi balok statis tertentu dan tak tentu: <i>Definite and indeterminate static beam deflection analysis strategies:</i> [1]: Bab (Ch.) 12	4/15



		<i>determinate/static indeterminate)</i>		<i>tasks, according to the sub-CPMK</i> Belajar Mandiri [TM: 3x60"] Perajari buckling pada kolom dan metode analisisnya <i>Independent Learning [TM: 3x60"] Learn about buckling in columns and its analysis methods</i>		[2]: Handout di myITS Classroom	
25-26	• Mampu menganalisis kasus buckling beban konsentrik, baik pada kolom pendek atau Panjang • <i>Able to analyze concentric load buckling cases, both on short and long columns.</i>	• Kecakapan dalam analisis buckling untuk beban konsentrik • <i>Proficiency in buckling analysis for concentric loads</i>	Oral Post-Test (acak): Sistematika dan komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten)	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK Kuasai analisis buckling pada kolom panjang akibat beban konsentrik <i>Structured Learning [TM: 3x60"] Do the given assignments, according to</i>		Analisis buckling: kasus beban konsentrik dan eksentrik <i>Buckling analysis: concentric and eccentric load cases</i> [1]: Bab (<i>Ch.</i>) 13 [2]: Handout di myITS Classroom	-



			<i>Independent Assignment: Timeliness of submission Completeness (format and content</i>	<i>sub-CPMK Master the buckling analysis on long columns due to concentric loads</i> Belajar Mandiri [TM: 3x60"] Pelajari analisis buckling pada kolom panjang akibat beban eksentrik Pelajari analisis buckling pada kolom pendek akibat beban konsentrik-eksentrik <i>Independent Learning [TM: 3x60"] Learn the buckling analysis on long columns due to eccentric loads Learn the buckling analysis on short columns due to concentric-eccentric loads</i>			
	• Mampu menganalisis kasus buckling beban eksentrik, baik pada	• Kecakapan dalam analisis buckling	Oral Pre-Test (acak): Sistematika dan	Lecture[TM: 3x50"] Contextual Teaching and Learning (CTL)		Analisis buckling: kasus beban konsentrik dan eksentrik	-



27-28	kolom pendek atau Panjang <i>Able to analyze eccentric load buckling cases, both on short and long columns.</i>	untuk beban eksentrik <i>Proficiency in buckling analysis for eccentric loads</i>	komprehensivitas deskripsi <i>Oral Post-Test (random): Systematic and comprehensive description</i> Tugas Mandiri: Ketepatan waktu penyerahan Kelengkapan (format dan konten) <i>Independent Assignment: Timeliness of submission Completeness (format and content</i>	Belajar Terstruktur [TM: 3x60"] Kerjakan tugas yang diberikan, sesuai sub-CPMK Kuasai analisis buckling pada kolom pendek akibat beban konsentrik-eksentrik <i>Structured Learning [TM: 3x60"] Complete the assigned tasks, according to sub-CPMK Master the buckling analysis on short columns due to concentric-eccentric loads</i> Belajar Mandiri [TM: 3x60"] Persiapkan Kuis 5 pada minggu ke-15, mencakup sub-CPMK minggu 13-15 <i>Independent Learning [TM: 3x60"] Prepare for</i>		<i>Buckling analysis: concentric and eccentric load cases</i> [1]: Bab (Ch.) 13 [2]: Handout di myITS Classroom	



				Quiz 5 in week 15, covering sub-CPMK weeks 13-15			
29-30	• Mampu menerapkan metode energi regangan dalam analisis defleksi pada struktur • <i>Able to apply the strain energy method in deflection analysis of structures</i>	• Kecakapan dalam menerapkan metode energi regangan dalam analisis defleksi pada struktur • <i>Proficiency in applying strain energy methods in deflection analysis of structures</i>	Kuis: 1 soal 50 mnt Model matematik, kalkulasi <i>Quiz: 1 questions 50 min Mathematical models, calculations</i>	Lecture [TM: 3x50"] Contextual Teaching and Learning (CTL) Kuis 5 (asesmen CPMK 5-6) Belajar Terstruktur [TM: 3x60"] Kuasai analisis defleksi struktur dengan metode energi regangan <i>Structured Learning [TM: 3x60"] Master the analysis of structural deflection using the strain energy method</i> Belajar Mandiri [TM: 3x60"] Kuasai materi yang berkaitan dengan sub-CPMK yang belum lulus		Analisis dengan metode energi: metode kerja virtual dan metode Castigliano <i>Analysis by energy methods: virtual work method and Castigliano method</i> [1]: Bab (Ch.) 14 [2]: Handout di myITS Classroom	3/15



				<i>Independent Learning [TM: 3x60"] Master the material related to the sub-CPMK that has not been passed</i>			
31	• Mampu menguasai CPMK/sub CPMK yang dipersyaratkan • <i>Able to master the required CPMK/sub CPMK</i>	• Kemampuan menguasai CPMK/sub CPMK yang dipersyaratkan • <i>Ability to master the required CPMK/sub CPMK</i>	Ujian Remedi: 4 soal 200 mnt Model matematik, kalkulasi <i>Remedial Exam: 4 questions 200 min Mathematical models, calculations</i>	Lecture[TM: 3x50"] Evaluasi menyeluruh semua CPMK Ujian remedi dilaksanakan secara luring (dalam kelas) atau daring (myITS Classroom) <i>Comprehensive evaluation of all CPMK Remedial exams are conducted offline (in class) or online (myITS Classroom)</i> Belajar Terstruktur [TM: 3x60"] Persiapkan diri mengikuti ujian remedi akhir, bagi yang tidak lulus CPMK 1-6		Sesuai CPMK/sub CPMK yang diujikan <i>According to the CPMK/sub CPMK being tested</i>	*



				<i>Structured Learning [TM: 3x60"] Prepare yourself to take the final remedial exam, for those who did not pass CPMK 1-6</i> Belajar Mandiri [TM: 3x60"] Persiapkan diri mengikuti ujian remedi akhir, bagi yang tidak lulus CPMK 1-6 <i>Independent Learning [TM: 3x60"] Prepare yourself to take the final remedial exam, for those who did not pass CPMK 1-6</i>			
32	Evaluasi Akhir Semester / Ujian Akhir Semester <i>(Final Semester Evaluation / Final Semester Exam)</i>						

Catatan (Notes):

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

Graduate Learning Outcomes of PRODI (CPL-PRODI) are the abilities possessed by each PRODI graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program which are obtained through the learning process.



2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.

The CPL charged to a course is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills, specific skills and knowledge.

3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

Course CP (CPMK) is the ability that is specifically described from the CPL that is assigned to the course, and is specific to the study material or learning material of the course.

4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

Sub-CP Course (Sub-CPMK) is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.

5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

Assessment indicators for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or abilities accompanied by evidence.



6. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

Assessment Criteria are benchmarks used as a measure or benchmark for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.

7. **Bentuk penilaian:** tes dan non-tes.

Forms of assessment: test and non-test.

8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.

Form of learning: Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning

9. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.

Learning Methods: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.

10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.

Learning materials are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.

11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.

The assessment weight is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.



12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.
TM=Face to Face, PT=Structured assignment, BM=Independent learning.



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
	RENCANA PEMBELAJARAN SEMESTER					
	MATA KULIAH (MK) (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)
METODE MATRIKS ANALISA STRUKTUR STRUCTURE ANALYSIS MATRIX METHOD	TM234708	Mekanika Benda Padat Solid State Mechanics	T=3	P=0	7 / Pilihan	November 2023
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Undergraduate Program)	
	Julendra Bambang Ariatedja		Alief Wikarta, PhD			
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan				



		<i>Ability to design mechanical components, systems and/or processes to meet expected needs using an analytical engineering approach based on cutting-edge science & technology and taking into account technical standards, performance aspects, reliability and ease of use.</i>				
CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply modern engineering methods, skills and tools necessary for the practice of mechanical systems.</i>					
CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze and solve engineering problems</i>					
CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, complete and evaluate tasks based on the results of information and data analysis.</i>					
Capaian Pembelajaran Mata Kuliah (CPMK)						
CPMK-1	Mampu merencanakan, menyelesaikan dan mengevaluasi tugas pada Metode Matriks dan Metode Elemen Hingga. Mampu mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan pada Plane Bar dan Spring. <i>Able to plan, complete and evaluate tasks on Matrix Method and Finite Element Method.</i> <i>Able to identify, formulate, analyze and solve problems on Plane Bar and Spring.</i>					
CPMK-2	Mampu menerapkan Metode Matriks untuk struktur planar dengan program komputasi/MatLab. <i>Able to apply Matrix Method for planar structures with computational programs/MatLab.</i>					
CPMK-3	Mampu mendesain struktur dari kasus struktur planar dan 3D dengan ANSYS. <i>Able to design structures from planar and 3D structure cases with ANSYS.</i>					
		Matrik CPL – CPMK				
		CPMK	CPL-5	CPL-7	CPL-8	CPL-10
		CPMK-1 (Matriks & MEH)			V	V
		CPMK-2 (MATLAB)		V		
		CPMK-3 (ANSYS)	V			



Deskripsi Singkat MK <i>(Short Description of Course)</i>	Mahasiswa mampu memahami model, gambaran besar dan prosedur dari Metode Matriks dan Metode Elemen Hingga untuk Analisa Struktur dalam menggunakan elemen bar dan beam untuk menyelesaikan kasus plane truss dan frame, serta menyusun kode program MatLab dan menggunakan ANSYS dalam mendesain dan menganalisa kasus struktur planar baik kerja secara individu maupun bersama-sama dalam sebuah tim. <i>Students are able to understand the models, big picture and procedures of Matrix Method and Finite Element Method for Structural Analysis in using bar and beam elements to solve plane truss and frame cases, as well as compile MatLab program codes and use ANSYS in designing and analyzing planar structure cases both individually and together in a team.</i>
Bahan Kajian: Materi Pembelajaran <i>(Course Materials)</i>	<i>Tuliskan materi / bahan kajian MK, secara rinci, dengan penulisan secara berurut</i> 1. Pengenalan: Sejarah, Perbedaan, Klasifikasi, Dasar Analisa Struktur (Metode Matriks, Elemen Hingga), Metode Numerik, Diferensial Parsial 2. Kaji ulang Analisa Struktur Klasikal, Metode Matriks pada Elemen Pegas, Inversi Matriks (Metode Determinant dan Gauss-Jordan). 3. Metode Matriks pada Plane Bar; Matriks Kekakuan dengan pendekatan Formal dan Weighted Residual Method; Shape Function: Polynomial vs Lagrange Interpolation 4. Hourglassing dan efek Gauss Quadrature Points; Beban terdistribusi pada Plane Bar; matriks transformasi, perakitan matriks struktur, penyelesaian untuk derajat kebebasan aktif pada Plane Truss dan Spring 5. Penerapan Program Komputasi MATLAB untuk analisa struktur planar 6. Analisa Plane Truss, Beam, dan Frame dengan menggunakan ANSYS: desain pemodelan, strategi Meshing, Cleaning, Defeaturing, dan Element Quality. 7. Pengetahuan Lanjut: Large Deformation, Plasticity, Shape Function, dan kasus-kasus material dan komponen khusus <i>Write down the MK study materials/materials, in detail, by writing sequentially</i> 1. Introduction : History, Differences, Classification, Basics of Structural Analysis (Matrix Method, Finite Element), Numerical Methods, Partial Differentials



	2. Review of Classical Structural Analysis , Matrix Methods on Spring Elements , Matrix Inversion (Determinant and Gauss-Jordan Methods). 3. Matrix Method on Plane Bar ; Stiffness Matrix with Formal Approach and Weighted Residual Method ; Shape Function : Polynomial vs Lagrange Interpolation 4. Hourglassing and Gauss Quadrature Points effect ; Distributed loads on Plane Bar; transformation matrix , assembly of structural matrix , solution for active degrees of freedom in Plane Truss and Spring 5. Application of MATLAB Computational Program for planar structure analysis 6. Plane Truss, Beam, and Frame Analysis using ANSYS: modeling design, Meshing strategy, Cleaning, Defeaturing , and Element Quality . Advanced Knowledge: Large Deformation, Plasticity, Shape Function , and special cases of materials and components	
Pustaka (References)	Utama :	
	(Main)	
	1. M. Asghar Bhatti, <i>Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations</i> 2. Aslam Kassimali, <i>Matrix Analysis of Structures</i> 3. Xiaolin Chen, <i>Finite Element Modeling and Simulation with ANSYS Workbench</i>	
	Pendukung :	
	(Supplementary)	
	1. Srinivasan Chandrasekaran, <i>Advanced Structural Analysis with MATLAB</i> 2. Pramote Dechaumphai, <i>Finite Element Analysis with ANSYS Workbench</i> 3. Huei-Huang Lee, <i>Finite Element Simulations with ANSYS Workbench 2023, Theory, Applications, Case Studies</i>	
Dosen Pengampu (Lecturers)	Julendra Bambang Ariatedja	
Mata kuliah syarat (Prerequisites)	Mekanika Kekuatan Material, Analisa Numerik, Algoritma Komputasi Mechanics of Materials Strength, Analysis Numerical, Computational Algorithms	



Mg Ke (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>(Final Ability of Each Learning Stage (LLO))</i>	Penilaian <i>(Assesment)</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>(Learning Model; Learning Method; Student Assignment)</i>		Materi Pembelajaran <i>(Learning Materials)</i>	Bobot Penilaian (%) <i>(Assesment Credit (%))</i>
		Indikator <i>(Indicator)</i>	Kriteria & Bentuk <i>(Criteria & Model)</i>	Luring (offline) <i>(Offline)</i>	Daring (online) <i>(Online)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)
1, 2, 3, 4	Mampu merencanakan, menyelesaikan dan mengevaluasi tugas pada Metode Matriks dan Metode Elemen Hingga. Mampu mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan pada Bar dan Truss.	Membuat matriks K dengan metode langsung Merumuskan Governing Equation untuk Bar Menjabarkan matriks K dengan metode Weighted Reduced Method	Kecakapan menjabarkan dan menerapkan model dan prosedur MMAS dan FEM pada Bar dan Truss <i>Ability to describe and apply MMAS and FEM models and procedures to Bars and Trusses</i>	Ceramah[4x 2x50"] Diskusi contoh kasus (Small Group Discussion) [2x 1x50"] Presentasi individual (Collaborative Learning) [2x 1x50"] Tugas Mandiri (Self-Directed Learning): - Matriks K - Governing Equation - Shape Function Pada Bar / Truss <i>Lecture</i> [4x 2x50"] <i>Case study discussion (Small Group Discussion) [2x 1x50"]</i> <i>Individual presentation (Collaborative Learning) [2x 1x50"]</i>		Review metode numerik Overview Metode Matriks Analisa Struktur Matriks K dengan metode langsung (Spring Element dan Bar Element) Governing Equation untuk Bar Matriks K bar element dengan metode Weighted Reduced Method (Strong Form, Weak Form, Approximation, Discretisation)	



	<i>Able to plan, complete and evaluate tasks on Matrix Method and Finite Element Method.</i> <i>Able to identify, formulate, analyze and solve problems in Bar and Truss.</i>	Mendapatkan Shape Funtion Menggunakan Hourglass, Gauss Quadrature integration dalam convergen mesh) Creating K matrix by direct method Formulate Governing Equation for Bar Describe the K matrix using the Weighted Reduced Method Get Shape Function		<i>Self-Directed Learning:</i> - K Matrix - Governing Equation - Shape Function <i>On Bar / Truss</i>	Shape Funtion dengan metode Polynomial, Lagrange, Isoparametrik. (baik linear, quadratic, cubic) - Hourglass, Gauss Quadrature integration (sebagai evaluasi jumlah mesh untuk convergen mesh) [Kassimali] - Review of numerical methods - Overview of Matrix Method of Structural Analysis - K Matrix with direct method (Spring Element and Bar Element) - Governing Equation for Bar - K bar element matrix with the Weighted Reduced Method (Strong Form, Weak	



		<i>Using Hourglass, Gauss Quadrature integration in convergent mesh)</i>			<i>Form, Approximation, Discretisation) Shape Function with Polynomial, Lagrange, Isoparametric methods. (either linear, quadratic, cubic) Hourglass, Gauss Quadrature integration (as an evaluation of the number of meshes for convergent mesh) [Kassimala]</i>	
5	Quiz 1		Evaluasi 1 [3x50"] <i>Evaluation 1 [3x50"]</i>			40%
6, 7 8 9	Mampu menerapkan Metode Matriks untuk struktur planar dengan program komputasi/MatLab. <i>Able to apply Matrix Method for planar structures</i>	Pengembangan kode program MatLab untuk kasus Planar Bar, Truss. Penyelesaian kasus Planar (Bar, Truss) dengan Metode Matriks	Keberhasilan kode program MatLab menyelesaikan kasus Planar (Bar, Truss) <i>The success of MatLab program code in solving Planar (Bar, Truss) cases</i>	Ceramah[4x 1x50"] Diskusi dan presentasi pemrograman dalam kelompok (Project Based Learning) [4x 2x50"] Case Study & Project Based Learning (Discovery Learning): - Bar & Truss <i>Lecture[4x 1x50"]</i>	Penerapan Program Komputasi MATLAB untuk analisa struktur planar [Bhatti] <i>Application of MATLAB Computational Program for planar structure analysis</i>	



	<i>with computational programs/MatLab.</i>	<i>MatLab program code development for Planar Bar, Truss cases. Planar Case Solution (Bar, Truss) with Matrix Method</i>		<i>Programming discussion and presentation in groups (Project Based Learning) [4 x 2x50"]</i> <i>Case Study & Project Based Learning (Discovery Learning): Bar & Truss</i>	<i>[Bhatti]</i>	
10	Quiz 2		Evaluasi 2 [3x50"] Evaluation 2 [3x50"]			30%
11, 12, 13 14	Mampu mendesain struktur dari kasus struktur planar (Bar, Truss) dan 3-D sederhana dengan ANSYS. <i>Able to design structures from simple planar (Bar, Truss) and 3-D structure cases with ANSYS.</i>	Desain dan analisa dengan ANSYS pada kasus planar (Bar, Truss) dan 3-D sederhana dengan ANSYS. <i>Design and analysis with ANSYS on simple planar (Bar, Truss) and 3-D</i>	Kefektifan desain dan analisa melalui ANSYS dalam menyelesaikan kasus planar (Bar, Truss) dan 3-D sederhana <i>The effectiveness of design and analysis through ANSYS in solving simple planar (Bar, Truss) and 3-D cases</i>	<i>Ceramah (online) [4x 1x50"]</i> Choaching, diskusi dan presentasi desain dan analisa dalam kelompok (Project Based Learning) [4x 2x50"] Case Study Bar & Truss Project Based Learning (Discovery Learning): 3-D sederhana <i>Lecture (online) [4x 1x50"]</i>	Analisa Plane Truss, Beam, dan Frame dengan menggunakan ANSYS: desain pemodelan, strategi Meshing, Cleaning, Defeaturing, dan Element Quality - Pengetahuan Lanjut: Large Deformation, Platicity, Shape Function, dan kasus-kasus material dan komponen khusus	



		cases with ANSYS.		Coaching, discussion and presentation of design and analysis in groups (Project Based Learning) [4x 2x50"] Case Study Bar & Truss Project Based Learning (Discovery Learning): Simple 3-D	[Chen][Dechaumphai][Lee] Plane Truss, Beam, and Frame Analysis using ANSYS: modeling design, Meshing strategy, Cleaning, Defeaturing, and Element Quality Advanced Knowledge: Large Deformation, Plasticity, Shape Function, and special cases of materials and components [Chen][Dechaumphai][Lee]	
15	Quiz 3		Evaluasi 3 [3x50"] Evaluation 3 [3x50"]			30%
16	Evaluasi Akhir Semester / Ujian Akhir Semester Final Semester Evaluation / Final Semester Exam					



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
	RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)					
	MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)
Tribologi dan Teori Gesek Pada Permesinan (Tribology and Friction Theories on Machinery)	TM 234714	Mata Kuliah Pilihan (Elective Courses)	T= 3	P= 0	1	10 Mei 2025
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)	
	Yusuf Kaelani	Yusuf Kaelani			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan				



		kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>(Able to demonstrate attitudes and characters that reflect: devotion to God Almighty, ethics and integrity, virtuousness, sensitivity and care for social and environmental problems, respect for cultural differences and pluralism, uphold law enforcement, prioritizing the interests of the nation and the wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potentials possessed to achieve maximum results)</i>
	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>(Able to study and utilize science and technology in order to apply them to the field of mechanical engineering, and able to make appropriate decisions based on individual or group work in the form of final project reports or other forms of learning activities whose output is equivalent to the final project through logical, critical, systematic, and innovative thinking)</i>
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi. <i>(Able to manage one's own learning and develop oneself as a lifelong learner to compete at the national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability and understanding technology-based entrepreneurship)</i>
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>(Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)</i>
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja,



		keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>(Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources)</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>(Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>(Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>(Ability to identify, formulate, analyze, and solve technical problems)</i>
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi <i>(Ability to effectively communicate both oral and written and apply technology-based entrepreneurship)</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>(Ability to plan, solve and evaluate the task based on the analysis of data and information)</i>
	CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika <i>(Ability to be responsible to society and obey professional ethics in solving the problem of mechanical systems)</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)	



	CPMK-1	Mahasiswa mampu memahami konsep dasar gesekan permukaan																													
	CPMK-2	Mahasiswa mampu menganalisa aspek teknik dan efek gesekan positif dan negatif gesekan serta mampu menganalisa pemanfaatan gesekan dan penanggulangan gesekan																													
	CPMK-3	Mahasiswa mampu melakukan perancangan komponen mesin.																													
	CPMK-4	Mahasiswa mampu melakukan pengujian keausan																													
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-8</td><td>CPL-9</td><td>CPL-10</td><td>CPL-11</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-2</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-4</td><td></td><td>V</td><td>V</td><td>V</td></tr></table>					CPMK	CPL-8	CPL-9	CPL-10	CPL-11	CPMK-1	V	V	V		CPMK-2	V	V	V	V	CPMK-3	V	V	V	V	CPMK-4		V	V	V
CPMK	CPL-8	CPL-9	CPL-10	CPL-11																											
CPMK-1	V	V	V																												
CPMK-2	V	V	V	V																											
CPMK-3	V	V	V	V																											
CPMK-4		V	V	V																											
Deskripsi Singkat MK <i>(Short Description of Course)</i>	Mata kuliah ini membahas fenomena gesekan, mekanisme keausan akibat gesekan, pelumas dan sistem pelumasan, karakteristik pelumas, tekanan hydrodynamics, persamaan Reynold dan penggunaan pada lapisan tipis pelumas, perancangan thrust bearing dan journal bearing dan pengujian keausan secara praktik.																														
Bahan Kajian: Materi Pembelajaran <i>(Course Materials)</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: 1. Konsep Dasar Tribologi 2. Surface Tecture 3. Wear dan Mekanisme Wear 4. Lubricant and Lubrication 5. Persamaan Renold 6. Perancangan Thrust Bearing dan Journal Bearing 7. Praktikum Pengujian Keausan																														
Pustaka <i>(References)C</i>	Utama : <i>(Main)</i>																														



		Batan, I Made Londen, Desain Produk Edisi 1, Guna Widya, 2012, Surabaya Pendukung : (Supplementary) Michael M. Khonsari and, E. Richard Booser : Applied Tribology: Bearing Design and Lubrication (Tribology in Practice Series) 3rd Edition, Willey, 2017 Bharat Bhushan : Introduction to Tribology, second Edition, Willey, 2002 T.A. Stolarsky : Tribology in Machine Design, Butterworth-Heinemann. 2000 M. J. NEALE: THE TRIBOLOGY HANDBOOK, Second edition, Butterworth-Heinemann, 1995					
Dosen Pengampu (Lecturers)		Yusuf Kaelani					
Matakuliah syarat (Prerequisites)		Tidak ada mata kuliah prasyarat					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami konsep dasar tribology dan fenomena-fenomena pada gesekan permukaan.	Mampu dan memahami fenomena kontak dua permukaan seperti: proses gesekan, keausan, dan	Mahasiswa dapat memberikan berbagai contoh permasalahan gesekan	Luring. Perkuliahan [TM: 3x50"] Kuliah Pengantar & Brainstorming Penugasan Terstruktur [PT: 3x60"]		- Kontrak Kuliah - Pengenalan terminologi - Introduksi tribologi	5



		kehilangan energi		Belajar Mandiri [BM: 3x60"]		[1]: Bab 1 [2]: Supplement (publikasi)	
2 & 3	Mahasiswa mampu memahami karakter lubricant dan sistem lubrication	Mahasiswa mampu menjelaskan dan memahami karakteristik pelumas, kandungan pelumas dan perilaku pelumas dalam permesinan	Diskusi dan tanya jawab berbagai jenis pelumas hidrocarbon dan sintetis	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1]: Bab 2 [2]: Supplement	
4	Mahasiswa mampu memahami kekasaran permukaan dan surface texture	Mampu dan memahami surface roughness. Metode – metode menghitung kekasaran permukaan	Diskusi problema kekasaran permukaan hasil manufaktur Tugas 1	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1]: Bab 3	10
5	Mahasiswa mampu dan memahami mekanisme keausan dan mampu menghitung volume	Mahasiswa Dapat menghitung volume aus dan	Diskusi Problema waer berbagai material dan fenomena koefisien	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"]		[1]: Bab 3 [3]: Bab 2	5



	keausan dan memprediksi umur komponen mesin	membedakan mekanisme aus	gesek terhadap keausan	Belajar Mandiri [BM: 3x60"]			
6	Mahasiswa mampu dan faham mengklasifikasi wear failure	Mahasiswa mampu dan faham mekanisme keausan dan mampu mengklasifikasi wear failure	Diskusi dan Tugas 2	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1] Bab 3 :Hal 123-128 [1] Bab 4	5
7	Mahasiswa memahami persamaan Petroff	Mahasiswa mampu dan menggunakan persamaan Petroff	Diskusi dan tanya jawab tentang pengujian Viscosimeter	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1] Bab 5	5
8	Evaluasi Tengah Semester (Midterm Exam)						10
9 & 10	Mahasiswa mampu menurunkan persamaan Reynold	Mahasiswa mampu dan menggunakan persamaan Reynold	Diskusi dan contoh perhitungan hidrodynamic pressure distribution	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"]		[1] Bab 6	10



				Belajar Mandiri [BM: 3x60"]			
11	Mahasiswa mampu Menganalisis Thrust Bearing	Mahasiswa dapat merancang thrust bearing dan mengevaluasi Load Carrying Capacity	Diskusi dan contoh perancangan, simulasi iterasi hingga proses konvergensi	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1] Bab 7	10
12	Mahasiswa mampu menganalisa dan merancang journal bearing	Mahasiswa mampu menganalisa dan merancang atau memilih journal bearing yang sesuai dengan kebutuhan	Tugas 3 Diskusi kelas	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1] Bab 8	5
13	Mahasiswa mampu menganalisa stability pada journal bearing	Mahasiswa mampu dan faham problema stabilitas journal bearing dari fenomena Whirling	Diskusi kelas	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1] Bab 8	5



14 & 15	Mahasiswa mampu mengukur dan menguji keausan dalam skala laboratorium	Mahasiswa melakukan praktikum Keausan untuk material PE dan menganalisa wear volume, contact surface dan wear mechanism	Pelaporan hasil praktikum dan Presentasi	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		Kelompok Praktikum 1 kelompok 3 personel. 15 menit Presentasi dan 15 menit diskusi tanya jawab.	10
16	Evaluasi Akhir Semester (Final Exam)						20



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN <i>Faculty of Industrial Technology and Systems Engineering</i> <i>Undergraduate Program of Mechanical Engineering Department</i>					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
PROSES MANUFAKTUR II (Manufacturing Processes II)	TM 234506	PROSES MANUFAKTUR Manufacturing Processes	T= 3	P= 0	1	10 November 2022
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)	
	Prof. Suhardjono, Sampurno, Ari Kurniawan, Diny Harnani, M. Khoirul Effendi.	Prof. Suhardjono			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)				



	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>(Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)</i>																				
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>(Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)</i>																				
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>(Ability to identify, formulate, analyze, and solve technical problems)</i>																				
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)																					
	CPMK-1	Mampu memahami proses-proses pembuatan produk yang umum dipakai di industri manufaktur, penentuan dan pemilihan parameter proses manufaktur sehingga mampu menganalisa dan merancang proses pembuatan produk. (CPL-4, 6, 8) <i>Able to understand the product manufacturing processes commonly used in the manufacturing industry, determining and selecting manufacturing process parameters so as to be able to analyze and design of the manufacturing process of a product.</i> (CPL-4, 6, 8)																				
	CPMK-2	Mahasiswa mampu melakukan praktikum dan menganalisis hasilnya. (CPL-6, 7) <i>Students are able to conduct practical work and analyze the results.</i>																				
	CPMK-3	Mempunyai kemampuan bertanya, dapat memberi komentar, menjawab pertanyaan dan kerjasama. (CPL-4, 6, 7, 8) <i>Have the ability to ask questions, be able to give comments, answer questions and collaborate</i>																				
	CPMK-4																					
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-5</td><td>CPL-6</td><td>CPL-7</td><td>CPL-8</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-2</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td>V</td><td>V</td></tr></table>	CPMK	CPL-5	CPL-6	CPL-7	CPL-8	CPMK-1	V	V	V		CPMK-2	V	V	V	V	CPMK-3	V	V	V	V
CPMK	CPL-5	CPL-6	CPL-7	CPL-8																		
CPMK-1	V	V	V																			
CPMK-2	V	V	V	V																		
CPMK-3	V	V	V	V																		



		CPMK-4		V	V	V	
Deskripsi Singkat MK (Short Description of Course)	Mempelajari proses-proses pemesinan non-konvensional , <i>welding, polymer processing</i> dan <i>casting</i> . <i>Studying non-conventional machining processes, welding, polymer processing and casting.</i>						
Bahan Kajian: Materi Pembelajaran (Course Materials)	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: 1. Proses pemesinan non-konvensional (<i>non-conventional machining processes</i>): <i>abrasif jet machining and water jet machining (AJM and WJM), electric discharge machining (EDM), electrochemical machining (ECM), electrochemical grinding (ECG), chemical machining (CHM), dan rapid prototyping.</i> 2. Proses pengelasan (<i>Welding processes</i>): <i>shield metal arc welding (SMAW), acetylene gas welding (AGW), spot and seam resistance welding (RW), brazing and soldering (B&S), metal inert gas (MIG), tungsten inert gas (TIG), submerge arc welding (SAW), plasma arc welding (PAW).</i> 3. Material Polimer beserta proses pembuatannya. Jenis-jenis material polimer dan karakteristiknya serta metode pemrosesan seperti: <i>Polymer Materials and their manufacturing processes. Types of polymer materials and their characteristics and processing methods such as: injection-, compression-, transfer-, blow-, rotational-, and foam- molding, extrusion, thermoforming and processing of elastomer.</i> 4. Proses pengecoran, prinsip kerja, perhitungan dan perancangan sistem gating serta karakteristik masing-masing jenis proses pengecoran, seperti: <i>Casting process, working principles, calculations and design of gating systems and the characteristics of each type of casting process, such as: sand-, slush-, permanent mold-, centrifugal-, semi centrifugal-, shell mold-, evaporative-, plaster mold-, ceramic mold-, investment-, die-, and continuous-casting as well as centrifuging.</i>						
Pustaka (References)	Utama : (Main)	1. Kalpakjian, Serope and Schmid, Steven R., <i>Manufacturing Processes for Engineering Materials</i> , 5th Edition, Prentice Hall, 2007					



		2. Pandey, P. C, <u>Modern Machining Processes</u> , Tata McGraw-Hill Publishing Company Limited, New Delhi, 1980. 3. Suhardjono, Proses Pemesinan ECM dan EDM (<i>ECM and EDM machining process</i>), ITS Press, 2023.					
		Pendukung : <i>(Supplementary)</i>					
		4. Schey, John A., <u>Introduction to Manufacturing Processes</u> , 3rd Edition, Mc Graw-Hill, 1999 5. Groover, Mikell P, <u>Fundamental of Modern Manufacturing</u> , 4th Edition, John Wiley & Sons, Inc, 2010 6. McGeough, J.A., <u>Advanced Methods of Machining</u> , Chapman and Hall, 1988 7. Kalpakjian, Serope and Schmid, Steven R., <u>Manufacturing Engineering & Technology</u> , 7th Edition, Prentice Hall, 2013 8. De Garmo, Paul E., <u>Material and Processes in Manufacturing</u> , 7th Edition, Mc Millan Publishing Co, New York, 1988					
Dosen Pengampu <i>(Lecturers)</i>		Prof. Suhardjono, Sampurno, Ari Kurniawan, Dinny Harnani, M. Khoirul Effendi.					
Assessment		Latihan Soal (<i>Exercises</i>) Pekerjaan rumah untuk Studi kasus (<i>Homework for case study</i>) Evaluasi tertulis untuk Kuis, ETS dan EAS (<i>Examination for quiz, midterm dan final exam</i>)					
Matakuliah syarat <i>(Prerequisites)</i>		Tidak ada mata kuliah prasyarat <i>No prerequisites</i>					
Mg Ke- / <i>(Week)</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>(Final Ability of Each Learning Stage (LLO))</i>	Penilaian <i>(Assesment)</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa,		Materi Pembelajaran <i>(Learning Materials)</i>	Bobot Penilaian (%) <i>(Assesment Credit (%))</i>
				<i>(Learning Model; Learning Method; Student Assignment)</i>			
		Indikator / <i>(Indicator)</i>	Kriteria & Bentuk <i>(Criteria & Model)</i>	Luring <i>(Offline)</i>	Daring <i>(Online)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)



1	Mahasiswa mampu mengenal dasar-dasar prinsip kerja proses pemesinan nonkonvensional, karakteristiknya, dasar pemilihan proses serta kemampuannya masing-masing. Kelebihan dan kekurangan dibanding proses pemesinan konvensional. <i>Students are able to recognize the basic principles of non-conventional machining processes, their characteristics, the basis for selecting processes and their respective capabilities. Advantages and disadvantages</i>	Mampu mengenal dengan baik proses pemesinan non konvensional, kelebihan dan kekurangannya dibanding yang konvensional. <i>Able to understand non-conventional machining processes, their advantages and disadvantages compared to conventional ones.</i>	Pekerjaan Rumah <i>Homework</i>	- Kuliah Luring (<i>Offline lecture</i>) - Latihan soal-soal (<i>Exercises</i>) [TM: 1x(3x50'')] Penugasan Terstruktur [PT: 3x60''] <i>Structured Assignment</i> Belajar Mandiri [BM: 3x60''] <i>Self study</i>	- Kontrak Kuliah - Klasifikasi proses pemesinan non-konvensional - Kemampuan proses nonkonvensional - Klasifikasi proses nonkonvensional - Parameter fisik, kemampuan proses, aplikasi material, efek kelengkapan dan peralatan, tinjauan ekonomi 2: Pandey Bab 1 - <i>Lecture Contract</i> - <i>Classification of non-conventional machining processes</i> - <i>Capabilities of non-conventional processes</i> - <i>Classification of non-conventional processes</i> - <i>Physical parameters, process capabilities,</i>	5



	<i>compared to conventional machining processes.</i>					<i>material applications, effects of equipment and tools, economic review</i> 2: Pandey Ch. 1	
2	Mahasiswa mampu memahami prinsip kerja dan merancang langkah-langkah pembuatan produk dengan proses AJM dan AWJM [Mahasiswa mampu menganalisa pengaruh parameter proses terhadap kualitas dan produktifitas proses AJM dan AWJM] <i>Students are able to understand the working principles and design the steps for making products with the AJM and AWJM processes</i>	Mampu merancang langkah proses untuk pembuatan produk dengan menggunakan proses AJM dan AWJM <i>Able to design process steps for product manufacturing using the AJM and AWJM processes</i>	Pekerjaan Rumah <i>Homework</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- Proses <i>abrasive jet machining</i> (AJM) dan <i>abrasive water jet machining</i> (AWJM) serta prinsip-prinsip kerjanya - Kemampuan proses AJM dan AWJM - Merancang langkah-langkah proses untuk pembuatan atau pemrosesan produk dengan menggunakan ke dua proses ini. - Menentukan parameter proses dan pengaruhnya terhadap akurasi dan laju pembuangan material (MRR) 2: Pandey Bab 2	10



	<i>[Students are able to analyze the influence of process parameters on the quality and productivity of the AJM and AWJM processes]</i>					<i>Abrasive jet machining (AJM) and abrasive water jet machining (AWJM) processes and their working principles</i> <i>AJM and AWJM process capabilities</i> <i>Designing process steps for manufacturing or processing products using these two processes.</i> <i>- Determining process parameters and their effects on accuracy and Material Removal Rate (MRR)</i> 2: Pandey Ch. 2	
3	Mahasiswa mampu memahami prinsip	Mampu merancang	Pekerjaan Rumah	Luring. Perkuliahan [TM: 3x50"]		- Proses pemesinan elektro kimia dan	5



	kerja dan merancang langkah-langkah pembuatan produk dengan proses ECM, ECG, ECD, ECH, CHM. [Mahasiswa mampu menganalisa pengaruh parameter proses terhadap kualitas dan produktifitas proses ECM, ECG, ECD, ECH, CHM] <i>Students are able to understand the working principles and design steps for making products with ECM, ECG, ECD, ECH, CHM processes. [Students are able to analyze the influence of process parameters on the quality and productivity of ECM,</i>	langkah proses untuk pembuatan produk dengan menggunakan proses ECM, ECG, ECD, ECH dan CHM <i>Able to design process steps for product manufacturing using ECM, ECG, ECD, ECH and CHM processes</i>	<i>Homework</i>	Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		kimia yang terdiri dari proses-proses <i>electrochemical machining</i> (ECM), <i>electrochemical grinding</i> (ECG), <i>electrochemical deburring</i> (ECD), <i>electrochemical honing</i> (ECH) dan <i>chemical machining</i> (CHM) - Kemampuan proses-proses ECM, ECG, ECD, ECH dan CHM - Merancang langkah-langkah proses untuk pembuatan atau pemrosesan produk dengan menggunakan proses-proses ECM, ECG, ECD, ECH dan CHM. 2: Pandey Bab 3 3: Suhardjono bab 1& 2 4: Schey Bab 17	



	<i>ECG, ECD, ECH, CHM processes</i>					- <i>Electrochemical and chemical machining processes consisting of electrochemical machining (ECM), electrochemical grinding (ECG), electrochemical deburring (ECD), electrochemical honing (ECH) and chemical machining (CHM) processes</i> - <i>Capabilities of ECM, ECG, ECD, ECH and CHM processes</i> - <i>Designing process steps for manufacturing or processing products using ECM, ECG, ECD, ECH and CHM processes.</i> 2: Pandey Ch. 3 3: Suhardjono Ch. 1& 2 4: Schey Ch. 17	



4	Mahasiswa mampu memahami prinsip kerja dan merancang langkah-langkah pembuatan produk dengan proses EDM <i>sinking</i> dan WEDM. [Mahasiswa mampu menganalisa pengaruh parameter proses terhadap kualitas dan produktivitas proses EDM <i>sinking</i> dan WEDM] <i>Students are able to understand the working principles and design the steps of making products with the EDM sinking and WEDM processes. [Students are able to analyze the influence of process parameters on the quality and</i>	Mampu merancang langkah proses untuk pembuatan produk dengan menggunakan proses EDM <i>sinking</i> dan WEDM <i>Able to design process steps for product manufacturing using EDM sinking and WEDM processes</i>	Quiz 1	Luring. Perkuliahan [TM: 3x50"]		- Proses pemesian elektro kimia dan kimia yang terdiri dari proses-proses <i>electrochemical machining</i> (ECM), <i>electrochemical grinding</i> (ECG), <i>electrochemical deburring</i> (ECD), <i>electrochemical honing</i> (ECH) dan <i>chemical machining</i> (CHM) - Kemampuan proses-proses ECM, ECG, ECD, ECH dan CHM - Merancang langkah-langkah proses untuk pembuatan atau pemrosesan produk dengan menggunakan proses-proses ECM, ECG, ECD, ECH dan CHM.	5



	productivity of the EDM sinking and WEDM processes]					2: Pandey Bab 3 3: Suhardjono bab 3 4: Schey Bab 17 - Electrochemical and chemical machining processes consisting of electrochemical machining (ECM), electrochemical grinding (ECG), electrochemical deburring (ECD), electrochemical honing (ECH) and chemical machining (CHM) processes - Capabilities of ECM, ECG, ECD, ECH and CHM processes - Designing process steps for manufacturing or processing products using ECM, ECG, ECD, ECH and CHM processes. 2: Pandey Ch. 3 3: Suhardjono Ch. 3	



						4: Schey Ch. 17	
5	Mahasiswa mampu memahami prinsip kerja dan merancang langkah-langkah penyambungan produk secara umum dengan proses SMAW dan AGW <i>Students are able to understand the working principles and design general product joining steps using SMAW and AGW processes.</i>	Mampu merancang penyambungan logam dengan proses SMAW dan OAW. <i>Able to design metal joining using SMAW and OAW processes</i>	Pekerjaan Rumah <i>Homework</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- Klasifikasi proses penyambungan logam seperti <i>brazing</i>, <i>soldering</i> dan <i>welding</i> - Proses <i>shield metal arc welding</i> (SMAW) dan <i>oxy acetylene gas welding</i> (OAW). - Kemampuan proses <i>brazing</i>, <i>soldering</i>, las SMAW dan OAW. - Merancang langkah proses penyambungan dengan menggunakan proses-proses <i>brazing</i>, <i>soldering</i> dan las SMAW- OAW 3: Schey Bab 18 7: De Garmo Bab 8 - <i>Classification of metal joining processes such as brazing, soldering and welding</i>	10



						- Shield metal arc welding (SMAW) and oxy acetylene gas welding (OAW) processes. - Brazing, soldering, SMAW and OAW welding process capabilities. - Designing the joining process steps using SMAW-OAW brazing, soldering and welding processes 3: Schey Ch. 18 7: De Garmo Ch. 8	
6	Mahasiswa mampu mengoperasikan, mempraktekkan serta menganalisa proses penyambungan <i>Students are able to operate, practice and analyze the component joining process.</i>	- Praktikum las oxy acetylene welding (OAW), las SMAW dan spot welding - Oxy acetylene welding (OAW) welding, SMAW welding and	Praktikum dan laporan <i>Practicum and report</i>	Luring. Pretest 1x60" Praktikum [TM: 1x(3x60")] Post-test 1x60" Laporan [BM: 3x60"]		Praktikum dan laporan <i>Practicum and report</i>	5



		<i>spot welding practicum.</i>					
7	Mahasiswa mampu mengoperasikan serta menganalisa proses pemotongan menggunakan mesin WEDM <i>Students are able to operate and analyze the cutting process using a WEDM machine.</i>	- Praktikum WEDM - <i>WEDM Practicum</i>	Praktikum dan laporan <i>Practicum and report</i>	Luring. Pretest 1x60" Praktikum [TM: 1x(3x60")] Post-test 1x60" Laporan [BM: 3x60"]		Praktikum dan laporan <i>Practicum and report</i>	5
8	Evaluasi Tengah Semester (Midterm Exam)						10
9	Mahasiswa mampu memahami prinsip kerja dan merancang langkah-langkah penyambungan produk dengan proses TIG, PAW, RW, dan SAW <i>Students are able to understand the</i>	Mampu merancang penyambungan logam dengan proses TIG, RW dan SAW <i>Able to design metal connections using TIG, RW</i>	Pekerjaan Rumah <i>Homework</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i>		- Proses las: <i>tungsten inert gas</i> (TIG), Metal inert, RW dan SAW. - Kemampuan proses las TIG, PAW, RW dan SAW, serta merancang langkah proses penyambungan dengan menggunakan	5



	<i>working principles and design steps for connecting products using the TIG, PAW, RW and SAW processes</i>	<i>and SAW processes</i>		[SA: 3x60"] <i>Self study</i> [SS: 3x60"]		proses-proses las TIG, RW dan SAW 1: Kalpakjian Bab 12 3: Schey Bab 18 - <i>Welding processes: tungsten inert gas (TIG), Metal inert, RW and SAW.</i> - <i>TIG, PAW, RW and SAW welding process capabilities, and designing the process steps of joining using TIG, RW and SAW welding processes</i> 1: Kalpakjian Ch. 12 3: Schey Ch. 18	
10	Mahasiswa mampu mengidentifikasi jenis-jenis polimer serta menganalisa sifat dan perilakunya <i>Students are able to identify types of polymers and analyze their</i>	Mampu mengidentifikasi dan menganalisa jenis polimer serta karakteristiknya <i>Able to identify and analyze</i>	Kerja sama tim untuk presentasi (student center learning, SCL) dan diskusi. <i>Teamwork for presentations (student center learning, SCL) and discussion.</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"]		- Struktur dari polimer - Sifat dan perilaku termoplastik dan termoset - Klasifikasi umum dan penggunaan thermoplastic & Thermosetting	10



	<i>properties and behavior.</i>	<i>types of polymers and their characteristics</i>		<i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- Klasifikasi umum dan penggunaan termoset - Polimer temperatur tinggi, polimer penghantar listrik, dan plastik <i>biodegradable</i> - Klasifikasi umum dan penggunaan <i>elastomer</i> (karet) - Plastik <i>Reinforced</i> 1: Kalpakjian Bab 10 3: Schey Bab 7 - <i>Structure of polymers</i> - <i>Properties and behavior of thermoplastics and thermosets</i> - <i>General classification and use of thermoplastics & Thermosettings</i> - <i>General classification and use of thermosets</i> - <i>High temperature polymers, electrically conductive polymers,</i>	



						and biodegradable plastics - General classification and use of elastomers (rubbers) - Reinforced Plastics 1:Kalpakjian Ch. 10 3: Schey Ch. 7	
11	Mahasiswa mampu menganalisa sifat, perilaku polimer, penggunaan dan metode pembuatannya <i>Students are able to analyze the properties, behavior of polymers, their use and manufacturing methods.</i>	Mampu mengidentifikasi jenis polimer yang digunakan pada produk-produk yang umum digunakan beserta alasan pemilihannya <i>Able to identify the types of polymers used in commonly used products and the reasons for their selection.</i>	Kerja sama tim untuk presentasi (<i>student center learning, SCL</i>) dan diskusi. <i>Teamwork for presentations (student center learning, SCL) and discussion.</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- Polymer processing - Injection molding - Blow molding - Extrusion 1: Kalpakjian Bab 10 3: Schey Bab 7	5



12	Mahasiswa mampu merancang langkah-langkah pembuatan produk plastik <i>Students are able to design the steps for making plastic products.</i>	Mampu merancang langkah proses untuk pembuatan produk dengan material plastic. <i>Able to design process steps for manufacturing products with plastic materials</i>	Quiz 2	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- <i>Rotational molding</i> - <i>Transfer molding</i> - <i>Compression molding</i> - <i>Casting</i> - <i>Thermo-foaming</i> - <i>Thermoplastic processing</i> - <i>Processing polymer with reinforced plastic matrix.</i> - Aspek desain dan ekonomi pemrosesan plastic (- <i>Design and economic aspects of plastic processing</i>) 1: Kalpakjian Ch. 10 3: Schey Ch. 7	5
13	Mahasiswa mampu mengidentifikasi dan menentukan parameter proses pengecoran logam <i>Students are able to identify and determine metal casting process parameters.</i>	Mampu merancang parameter proses pengecoran logam. <i>Able to design metal casting process parameters</i>	Pekerjaan Rumah Homework	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"]		- Klasifikasi proses pengecoran - Teknologi proses pengecoran - Pemanasan dan penuangan logam cair - Solidification process 1: Kalpakjian Bab 5 3: Schey Bab 7 4: Groover Bab 10	10



				<i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- Classification of casting processes - Casting process technology - Heating and pouring of molten metal - Solidification process 1: Kalpakjian Ch. 5 3: Schey Ch. 7 4: Groover Ch. 10	
14	Mahasiswa mampu merancang langkah pembuatan produk dengan menggunakan proses pengecoran <i>Students are able to design product manufacturing steps using the casting process.</i>	Mampu merancang langkah pembuatan produk dengan menggunakan proses pengecoran <i>Able to design product manufacturing steps using the casting process</i>	Tugas studi kasus <i>Case study assignment</i>	Luring. Perkuliahan [TM: 3x50"] Kuliah Pengantar QFD Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- Sand Casting - Proses pengecoran dengan cetakan sekali pakai - Proses pengecoran dengan cetakan permanen - Macam-macam cacat pada pengecoran - Perencanaan cetakan dan perhitungan waktu tuang 1: Kalpakjian Bab 5 3: Schey Bab 7 4: Groover Bab 11 - Sand Casting	5



						- Casting process with disposable molds - Casting process with permanent molds - Types of casting defects - Mold planning and pouring time calculation 1: Kalpakjian Ch. 5 3: Schey Ch. 7 4: Groover Ch. 11	
15	Mahasiswa mampu memilih logam serta proses pengecorannya dan menganalisa produk hasil pengecoran <i>Students are able to select metals and casting processes and analyze casting products.</i>	Mampu menganalisa produk hasil pengecoran. <i>Able to analyze casting products</i>	Tugas studi kasus <i>Case study assignment</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline lecture</i> [OL: 3x50"] <i>Structured Assignment</i> [SA: 3x60"] <i>Self study</i> [SS: 3x60"]		- Kualitas pengecoran - Logam yang digunakan untuk pengecoran - Aspek desain dan ekonomi dalam pengecoran logam - Loss foam - Investment casting - Permanent casting - Die casting - Centrifugal casting - Slush casting 1: Kalpakjian Bab 5 3: Schey Bab 7 4: Groover Bab 11 - Casting quality	5



						- Metal used for casting - Design and economic aspects in metal casting - Loss foam - Investment casting - Permanent casting - Die casting - Centrifugal casting - Slush casting 1: Kalpakjian Ch. 5 3: Schey Ch. 7 4: Groover Ch. 11	
16	Evaluasi Akhir Semester (Final Exam)						20



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen Document Code
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (SUBJECTS)	KODE (CODE)	Rumpun MK (Course Cluster)	BOBOT (credits)		SEMESTER	Tgl Penyusunan (date of preparation)
PROSES MANUFAKTUR I (MANUFACTURING PROCESS I)	TM234401	REKAYASA PRODUKSI (PRODUCTION ENGINEERING)	T=3	P=0	1	25 November 2023 (November 25 th 2023)
OTORISASI (AUTHORIZATION)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of the Undergraduate Program)	
	P. Sampurno, Prof. Suhardjono, P. Ari Kurniawan, B. Dinny Harnany, P. M. Khoirul Effendi.		Prof. Suhardjono		Atok Setiyawan	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to the Course)					
	CPL-2 (PLO-2)	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif.				



		<i>Able to study and utilize science and technology in order to apply it in the field of mechanical engineering, and able to make appropriate decisions from the results of individual or group work in the form of a final project report or other learning activities with outcomes equivalent to the final project through logical, critical, systematic, and innovative thinking.</i>
CPL-4 (PLO-4)	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika	<i>The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.</i>
CPL-6 (PLO-6)	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik.	<i>The ability to conduct laboratory and/or field experiments and to analyze and interpret data to strengthen engineering assessments.</i>
CPL-8 (PLO-8)	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik.	<i>The ability to identify, formulate, analyze, and solve engineering problems.</i>
CPL-10 (PLO-10)	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data	<i>The ability to plan, complete, and evaluate tasks based on the analysis of information and data</i>
Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)		
CPMK-1 (CLO-1)	Mampu memahami prinsip kerja dan merancang urutan proses pembuatan produk secara umum dengan memilih jenis poses pemesinan konvensional yang paling baik.	<i>Able to understand the working principles and design the sequence of the product manufacturing process in general by selecting the best type of conventional machining process.</i>
CPMK-2 (CLO-2)	Mampu menghitung laju pengerjaan logam, waktu pemesinan, torsi yang terjadi, gaya potong dan daya potong pada macam-macam proses pemesinan konvensional.	



		Able to calculate the metal removal rate, machining time, occurring torque, cutting force, and cutting power in various conventional machining processes.					
	CPMK-3 (CLO-3)	Mampu memahami prinsip kerja dan merancang urutan proses pembuatan produk dengan bermacam-macam proses pembentukan logam, baik pada proses pengerjaan panas maupun proses pengerjaan dingin.					
		Able to understand the working principles and design the sequence of the product manufacturing process with various metal forming processes, both in hot working and cold working processes.					
	CPMK-4 (CLO-4)	Mampu menghitung dan menganalisa macam-macam proses pembentukan logam untuk menentukan gaya potong dan daya potong yang dibutuhkan.					
		Able to calculate and analyze various metal forming processes to determine the required cutting force and cutting power.					
		Matrik CPL – CPMK (Matrix of PLO – CLO)					
		CPMK (CLO)	CPL-2 (PLO-2)	CPL-4 (PLO-4)	CPL-6 (PLO-6)	CPL-8 (PLO-8)	CPL-10 (PLO-10)
		CPMK-1 (CLO-1)			V	V	
		CPMK-2 (CLO-2)	V		V		V
		CPMK-3 (CLO-3)				V	V
		CPMK-4 (CLO-4)	V	V			V
Deskripsi Singkat MK (Short Description of Course)	kuliah Proses Manufaktur I mempelajari tentang proses pemesinan konvensional, metal forming, powder metallurgy. Proses pemesinan konvensional yang meliputi proses-proses bubut, gurdi, freis dan gerinda. Proses pembentukan logam yang meliputi proses-proses pengerolan, tempa, ekstrusi, drawing, pembentukan lembaran plat dan powder metallurgy.						
	The Manufacturing Process I course studies conventional machining processes, metal forming, and powder metallurgy. Conventional machining processes include turning, drilling, milling, and grinding. Metal forming processes include rolling, forging, extrusion, drawing, sheet metal forming, and powder metallurgy.						



Bahan Kajian: Materi Pembelajaran (Course Material)	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: <i>In this course, the following main topics will be studied:</i> - Proses Pemesinan Konvensional (Proses bubut, gurdi, freis, dan gerinda) / <i>conventional machining processes (Turning, Drilling, Milling, and Grinding)</i> - Metal Forming - Powder Metallurgy - Proses pembentukan logam (Proses pengerolan, tempa, ekstrusi, drawing, pembentukan lembaran plat, powder metallurgy) / <i>Metal Forming Processes (Rolling, forging, extrusion, drawing, sheet metal forming, powder metallurgy)</i>								
Pustaka (Reference)	<table border="1"> <tr> <td data-bbox="293 668 535 751">Utama : <i>(Main)</i></td><td data-bbox="535 668 2031 751"></td></tr> <tr> <td data-bbox="293 751 535 791">[1].</td><td data-bbox="535 751 2031 791"></td></tr> <tr> <td data-bbox="293 791 535 874">Pendukung : <i>(Supporting)</i></td><td data-bbox="535 791 2031 874"></td></tr> <tr> <td data-bbox="293 874 535 927">[2].</td><td data-bbox="535 874 2031 927"></td></tr> </table>	Utama : <i>(Main)</i>		[1].		Pendukung : <i>(Supporting)</i>		[2].	
Utama : <i>(Main)</i>									
[1].									
Pendukung : <i>(Supporting)</i>									
[2].									
Dosen Pengampu (Lecturers)	P. Sampurno, Prof. Suhardjono, P. Ari Kurniawan, B. Dinny Harnany, P. M. Khoirul Effendi.								
Matakuliah syarat (Prerequisite course)	Tuliskan mata kuliah prasyarat, jika ada <i>Prerequisite courses, if any</i>								



Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assesment</i>		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>(Form of Learning; Learning Method; Student Assignment)</i>		Materi Pembelajaran <i>Learning Material</i>	Bobot Penilaian (%) <i>Assesment Load (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria & Model</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	- Mahasiswa mampu memahami proses pemesinan konvensional <i>(Student must be able to understand conventional machining process)</i>	Pengantar proses pemesinan konvensional dan proses bubut <i>(Introduction to Conventional Machining Processes and Turning)</i>	Oral Post-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		2%
2	- Mahasiswa mampu memahami parameter proses, waktu	Menentukan parameter proses, waktu potong dan kecepatan	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit	Materi slide PPT di myITSClassroom		4%



	potong, dan kecepatan pembuangan pada proses bubut <i>(Students are able to understand process parameters, cutting time, and removal speed in the turning process.)</i>	pembuangan geram & gaya potong pada bubut <i>(Determining process parameters, cutting time, chip removal speed, and cutting force in turning)</i>		<i>(Face to face sessions 3x50 minutes)</i>	<i>PPT slide materials on myITSClassroom</i>		
3	- Mahasiswa mampu memahami prinsip kerja mesin gurdi <i>(Students are able to understand the working principles of</i>	Mesin gurdi dan prinsip kerjanya, kemampuan, dan langkah pembuatan produk di mesin gurdi <i>(Drilling machines and their working</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		3%



	<i>drilling machines)</i>	<i>principles, capabilities, and steps for product manufacturing on drilling machines)</i>					
4	- Mahasiswa mampu memahami prinsip kerja mesin freis <i>Students are able to understand the working principles of milling machines</i>	Prinsip kerja, kemampuan, macam-macam, proses pembuatan, menentukan parameter proses di mesin freis <i>Working principles, capabilities, types, manufacturing processes, and determining process parameters on milling machines)</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		4%



5	- Mahasiswa mampu memahami prinsip kerja mesin gerinda <i>Students are able to understand the working principle of grinding machines</i>	Prinsip kerja, kemampuan, proses pembuatan, menentukan parameter proses di mesin gerinda <i>Working principles, capabilities, manufacturing processes, and determining process parameters on grinding machines.</i>	Kuis: 3 soal 15 mnt <i>Quiz: 3 questions in 15 minutes</i>	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		5%
6	- Mahasiswa mampu memahami pembuatan produk pada mesin bubut <i>Students are able to</i>	Praktikum pembuatan produk silindris dan pembuatan ulir luar pada mesin bubut <i>Practical work</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		3%



	<i>understand product manufacturing on a lathe machine</i>	<i>on cylindrical product manufacturing and external thread cutting on a lathe machine</i>					
7	- Mahasiswa mampu memahami pembuatan produk menggunakan mesin freis <i>Students are able to understand product manufacturing using a milling machine</i>	Praktikum pembuatan produk dengan menggunakan mesin freis, gurdi, dan tap ulir dalam <i>Practical work on product manufacturing using milling machines, drilling machines, and internal thread tapping</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		4%
8	Evaluasi Tengah Semester / Ujian Tengan Semester Mid Semester Evaluation / Mid Semester Exam						25%



9	- Mahasiswa mampu memahami analisis deformasi plastis <i>Students are able to understand the analysis of plastic deformation</i>	Klasifikasi proses pembentukan, temperatur dan tujuan deformasi plastis, analisa deformasi plastis <i>Classification of forming processes, temperature and purpose of plastic deformation, analysis of plastic deformation</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		2%
10	- Mahasiswa mampu memahami proses pengerolan	Proses, jenis-jenis proses, gaya dan daya, kemampuan	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit	Materi slide PPT di myITSClassroom		3%



	<i>Students are able to understand the rolling process</i>	proses dan aspek desain dalam proses pengerolan <i>Process, types of processes, forces and power, process capabilities, and design aspects in rolling</i>		<i>(Face to face sessions 3x50 minutes)</i>	<i>PPT slide materials on myITSClassroom</i>		
11	Mahasiswa mampu memahami proses tempa <i>Students are able to understand the forging process</i>	Proses, jenis-jenis, kemampuan proses dan aspek desain dalam proses tempa <i>Process, types, process capabilities, and design aspects in forging</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		4%



12	Mahasiswa mampu memahami proses ekstrusi dan drawing <i>Students are able to understand the extrusion and drawing processes</i>	Proses, jenis-jenis, kemampuan proses dan aspek desain dalam proses ekstrusi dan drawing <i>Process, types, process capabilities, and design aspects in extrusion and drawing</i>	Kuis: 3 soal 15 mnt <i>Quiz: 3 questions in 15 minutes</i>	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		5%
13	Mahasiswa mampu memahami klasifikasi pembentukan lembaran plat, proses shearing, piercing, blanking, dan bending <i>Students are</i>	Klasifikasi pembentukan lembaran plat, proses shearing, piercing, blanking, dan bending <i>Classification of sheet metal forming,</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		3%



	<i>able to understand the classification of sheet metal forming, shearing, piercing, blanking, and bending process</i>	<i>shearing process, piercing, blanking, and bending</i>					
14	Mahasiswa mampu memahami proses deep drawing, LDR, penentuan parameter dan perhitungan gaya drawing <i>Students are able to understand the deep drawing process, LDR, parameter determination, and drawing force calculation</i>	Proses deep drawing, LDR, penentuan parameter dan perhitungan gaya drawing <i>Deep drawing process, LDR, parameter determination, and drawing force calculation</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		4%



15	Mahasiswa mampu memahami proses, produk, dan aspek desain <i>Students are able to understand processes, products, and design aspects</i>	Proses, produk-produk, powder metallurgy, proses cold compaction dan injection moulding, sintering dan finishing, serta kemampuan proses dan aspek desain <i>Processes, products, powder metallurgy, cold compaction and injection moulding processes, sintering and finishing, as well as process capabilities</i>	Oral Pre-Test (random): Homework	Tatap muka 3x50 menit <i>(Face to face sessions 3x50 minutes)</i>	Materi slide PPT di myITSClassroom <i>PPT slide materials on myITSClassroom</i>		4%



		and design aspects.					
16	Evaluasi Akhir Semester / Ujian Akhir Semester Final Semester Evaluation / Final Semester Exam						25 %

Catatan :

2. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
3. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
4. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
5. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
6. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
7. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
8. **Bentuk penilaian:** tes dan non-tes.



9. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
10. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
11. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
12. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
13. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

Notes:

1. **Program Learning Outcomes (PLO)** are the abilities possessed by each graduate of the program, which are the internalization of attitudes, mastery of knowledge, and skills according to their program level obtained through the learning process.
2. **PLO assigned to courses** are several program learning outcomes used for the formation/development of a course, consisting of aspects of attitude, general skills, specific skills, and knowledge.
3. **Course Learning Outcomes (CLO)** are abilities specifically derived from the PLO assigned to the course and are specific to the study material or learning content of the course.
4. **Sub-Course Learning Outcomes (Sub-CLO)** are abilities specifically derived from the CLO that can be measured or observed and are the final abilities planned at each stage of learning, specific to the learning content of the course.
5. **Assessment indicators** are specific and measurable statements that identify the abilities or performance of student learning outcomes accompanied by evidence.
6. **Assessment criteria** are benchmarks used as measures or standards for achieving learning in assessments based on predetermined indicators. Assessment criteria serve as guidelines for assessors to ensure consistent and unbiased assessments. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** tests and non-tests.



8. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalents, Practicums, Studio Practices, Workshop Practices, Field Practices, Research, Community Service, and/or other equivalent forms of learning.
9. **Learning methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-topics.
11. **Assessment weight** is the percentage of assessment for each achievement of Sub-CLO, proportional to the difficulty level of achieving the Sub-CLO, totaling 100%.
12. **TM = Face-to-Face, PT = Structured Assignment, BM = Independent Study.**



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM				Kode Dokumen Document Code		
		RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (SUBJECTS)		KODE (CODE)	Rumpun MK (Course Cluster)		BOBOT (credits)	SEMESTER	Tgl Penyusunan (date of preparation)	
STATISTIK DAN PERENCANAAN EKSPERIMEN (STATISTIC AND EXPERIMENTAL DESIGN)		TM234404	REKAYASA PRODUKSI (PRODUCTION ENGINEERING)		T=4	P=0	4	21 Nopember 2023
OTORISASI (AUTHORIZATION)		Pengembang RPS (Developer Lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)	Ketua PRODI (Head of the Undergraduate Program)			
		Arif Wahjudi		Arif Wahjudi	Atok Setiawan			
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to the Course)							
	CPL-4 (PLO-4)	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.						



CPL-6 (PLO-6)	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik <i>The ability to conduct laboratory and/or field experiments and to analyze and interpret data to strengthen technical assessments.</i>
CPL-8 (PLO-8)	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>The ability to identify, formulate, analyze, and solve technical problems.</i>
CPL-10 (PLO-10)	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>The ability to plan, complete, and evaluate tasks based on the analysis of information and data</i>
Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)	
CPMK-1 (CLO-1)	Mahasiswa mampu menampilkan data secara deskriptif dan menginterpretasikannya <i>Students are able to present data descriptively and interpret it.</i>
CPMK-2 (CLO-2)	Mahasiswa mampu mengidentifikasi dan menghitung peluang kejadian berdasarkan distribusi khusus baik diskrit dan kontinyu <i>Students are able to identify and calculate the probability of events based on specific distributions, both discrete and continuous.</i>
CPMK-3 (CLO-3)	Mahasiswa mampu menguji rata-rata, varians dan proporsi satu dan 2 populasi <i>Students are able to test the mean, variance, and proportion of one and two populations.</i>
CPMK-4 (CLO-4)	Mahasiswa mampu membuat model hubungan 2 variabel kuantitatif <i>Students are able to model the relationship between two quantitative variables</i>



	CPMK-5 (CLO-5)	Mahasiswa mampu merancang percobaan yang sesuai dengan kebutuhan <i>Students are able to design experiments according to needs</i>				
	CPMK-6 (CLO-6)	Mahasiswa menganalisa berdasarkan metoda statistik serta mempunyai kemampuan bertanya, dapat memberi komentar, menjawab pertanyaan dan Kerjasama <i>Students analyze based on statistical methods and have the ability to ask questions, provide comments, answer questions, and collaborate</i>				
		Matrik CPL – CPMK Matrix of PLO – CLO)				
		CPMK (CLO)	CPL-1 (PLO-1)	CPL-2 (PLO-2)	CPL-3 (PLO-3)	CPL-4 (PLO-4)
		CPMK-1 (CLO-1)	V		V	
		CPMK-2 (CLO-2)	V		V	
		CPMK-3 (CLO-3)	V		V	
		CPMK-4 (CLO-4)	V		V	
		CPMK-5 (CLO-5)	V	V	V	V
		CPMK-6 (CLO-6)	V	V	V	V
Deskripsi Singkat MK	Mata kuliah ini memberikan pengetahuan dan pemahaman tentang statistic dan dapat mengaplikasikannya pada perancangan dan Analisa eksperimen.					
(Short Description of Course)	<i>This course provides knowledge and understanding of statistics and can apply it to the design and analysis of experiments.</i>					
Bahan Kajian:	Bahan Kajian (<i>Study Materials</i>): • Statistika (<i>statistic</i>)					



Materi Pembelajaran	- Perancangan Eksperimen (<i>Experimental Design</i>) Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: <i>In this course, the following topics will be covered:</i> - Teori probabilitas dan distribusi Uji hipotesis (<i>Probability theory and distribution hypothesis testing</i>) - Analisa Varian (<i>Analysis of Variance</i>) – ANOVA - Regresi (<i>Regression</i>)	
Pustaka (Reference)	Utama: (Main)	
		[1]. Blank, L., "Statistical Procedures for Engineering, Management, and Science", McGraw-Hill, 1980 [2]. Bhattacharya, G.K., Johnson, R.A., "Statistical Concepts and Methods", John Wiley, 1977 [3]. Montgomery, D.C., "Design and Analysis of Experiments", John Wiley, 1991
	Pendukung: (Supporting)	
		[1]. Kuehl, R. O., "Design of experiments : statistical principles of research design and analysis", Pacific Grove: Duxbury, 2000
Dosen Pengampu (Lecturer)	Prof. Abdulah Shahab Arif Wahjudi, Ph.D Dinny Harnany, M.Sc	
Matakuliah syarat (Prerequisite course)	Tidak ada prasyarat	



Mg Ke Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assessment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>(Form of Learning; Learning Method; Student Assignment)</i>		Materi Pembelajaran <i>Learning Material</i>	Bobot Penilaian (%) <i>Assessment Load (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria & Model</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami konsep probability dan distribusi <i>Students are able to understand the concepts of probability and distribution</i>	Mampu memahami dan menjelaskan tentang probability, probability density function, dan cumulative density function <i>Able to understand and explain probability, probability density function, and cumulative density function.</i>	Oral Post-Test (random): Perkuliahan (<i>Lectures</i>) [TM: 3x50"] Kuliah Pengantar & Brainstorming (<i>Introductory Lecture & Brainstorming</i>) Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Latihan soal (<i>Practice</i>) Belajar Mandiri (<i>Independent Learning</i>) [TM: 3x60"]	V		- Kontrak Kuliah (<i>course contract</i>) - Probability - Probability density function - Cumulative density function [1]: Chapter 1, 3 dan 5 [2]: Handout di myITS Classroom (<i>Handout in myITS Classroom</i>)	
2	Mahasiswa mampu memahami	Mampu memahami, menjelaskan, menyelesaikan kasus	Oral Post-Test (random): Perkuliahan (<i>Lectures</i>) [TM: 3x50"]	V		- Distribusi Hipergeometrik (<i>Hipergeometrik Distribution</i>)	



	distribusi hipergeometrik <i>Students are able to understand hypergeometric distribution</i>	yang harus diselesaikan dengan distribusi hipergeometrik <i>Able to understand, explain, and solve cases that need to be addressed with hypergeometric distribution.</i>		Kuliah Pengantar & Brainstorming (Introductory Lecture & Brainstorming) Belajar Terstruktur (Structured Learning) [TM: 3x60"] Latihan soal (Practice) Belajar Mandiri Independent Learning [TM: 3x60"]			[1]: Chapter 8 [2]: Handout di myITS Calssroom (Handout in myITS Classroom)	
3	Mahasiswa mampu memahami distribusi binomial <i>Students are able to understand binomial distribution.</i>	Mampu memahami, menjelaskan, menyelesaikan kasus yang harus diselesaikan dengan distribusi binomial <i>Able to understand, explain, and solve cases that need to be addressed with binomial distribution.</i>	Oral Post-Test (random):	Perkuliahan (Lectures) [TM: 3x50"] Kuliah Pengantar & Brainstorming (Introductory Lecture & Brainstorming) Belajar Terstruktur (Structured Learning) [TM: 3x60"] Latihan soal (Practice)	V		- Distribusi binomial (<i>binomial distribution</i>) 1]: Chapter 8 [2]: Handout di myITS Calssroom (Handout in myITS Classroom)	



				Belajar Mandiri <i>Independent Learning</i> [TM: 3x60"]				
4	Mahasiswa mampu memahami distribusi poisson <i>Students are able to understand Poisson distribution.</i>	Mampu memahami, menjelaskan, menyelesaikan kasus yang harus diselesaikan dengan distribusi poisson <i>Able to understand, explain, and solve cases that need to be addressed with Poisson distribution.</i>	Tugas Mandiri (<i>Independent assignment</i>): Tugas distribusi hipergometrik, binomial, poisson <i>Assignment on hypergeometric, binomial, and Poisson distributions</i>	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] Kuliah Pengantar & Brainstorming (<i>Introductory Lecture & Brainstorming</i>) Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Latihan soal (<i>Practice</i>) Belajar Mandiri <i>Independent Learning</i> [TM: 3x60"]	V		- Distribusi poisson (<i>Poisson distribution</i>) [1]: Chapter 8 [2]: Handout di myITS Calssroom (<i>Handout in myITS Classroom</i>)	25%
5	Mahasiswa mampu memahami distribusi normal dan teori central limit <i>Students are able to understand</i>	Mampu memahami, menjelaskan, menyelesaikan kasus yang harus diselesaikan dengan distribusi normal dan teori central limit <i>Able to understand, explain, and solve</i>	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] Kuliah Pengantar & Brainstorming (<i>Introductory Lecture & Brainstorming</i>)	V		- Distribusi normal (<i>normal distribution</i>) - Teori central limit (<i>central limit theory</i>) [1]: Chapter 9 [2]: Handout di myITS Calssroom (<i>Handout in myITS Classroom</i>)	



	<i>normal distribution and central limit theorem.</i>	<i>cases that need to be addressed with normal distribution and central limit theorem</i>		Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Latihan soal (<i>Practice</i>) Belajar Mandiri (<i>Independent Learning</i>) [TM: 3x60"]				
6	Mahasiswa mampu memahami distribusi chi-square <i>Students are able to understand chi-square distribution.</i>	Mampu memahami, menjelaskan, menyelesaikan kasus yang harus diselesaikan dengan chi-square <i>Able to understand, explain, and solve cases that need to be addressed with chi-square distribution.</i>	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] Kuliah Pengantar & Brainstorming (<i>Introductory Lecture & Brainstorming</i>) Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Latihan soal (<i>Practice</i>) Belajar Mandiri (<i>Independent Learning</i>) [TM: 3x60"]	V		- Distribusi chi-square (<i>chi-square distribution</i>) 1]: Chapter 9 [2]: Handout di myITS Calsroom (<i>Handout in myITS Classroom</i>)	
7	Mahasiswa mampu memahami	Mampu memahami, menjelaskan, menyelesaikan kasus	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"]	V		- Distribusi t (<i>t distribution</i>) - Distribusi F (<i>F distribution</i>)	



	distribusi t dan F <i>Students are able to understand t and F distributions</i>	yang harus diselesaikan dengan t dan F <i>Able to understand, explain, and solve cases that need to be addressed with t and F distributions.</i>		Kuliah Pengantar & Brainstorming (<i>Introductory Lecture & Brainstorming</i>) Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Latihan soal (<i>Practice</i>) Belajar Mandiri <i>Independent Learning</i> [TM: 3x60"]			[1]: Chapter 9 [2]: Handout di myITS Calssroom (<i>Handout in myITS Classroom</i>)	
8	EVALUASI TENGAH SEMESTER (ETS) <i>Mid Semester Evaluation (MSE)</i>		Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Belajar Mandiri <i>Independent Learning</i> [TM: 3x60"]	V		- Review: [1]: Chapter 3, 5, and 6 [2]: Handout di myITS Calssroom (<i>handout in myITS Classroom</i>)	25%
9	Mahasiswa mampu menganalisa dan mempraktekkan uji hipotesa <i>Students are</i>	Mampu menganalisa kasus-kasus perbandingan 1 dan 2 sample <i>Able to analyze</i>	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] <i>Experiment</i>	V		- Uji Hipotesa (<i>hypothesis testing</i>): - Test on means (1 dan 2 sample) - Test on variances (1 dan 2 sample)	



	<i>able to analyze and practice hypothesis testing.</i>	<i>comparison cases of 1 and 2 samples.</i>		Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Belajar Mandiri <i>Independent Learning</i> [TM: 3x60"]			[1]: Chapter 5 dan 7 [2]: Handout di myITS Calssroom (<i>handout in myITS Classroom</i>)	
10	Mahasiswa mampu menganalisa dan mempraktekkan uji hipotesa <i>Students are able to analyze and practice hypothesis testing</i>	Mampu menganalisa kasus-kasus perbandingan 1 dan 2 sample <i>Able to analyze comparison cases of 1 and 2 samples.</i>	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] <i>Experiment</i> Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Belajar Mandiri <i>Independent Learning</i> [TM: 3x60"]	V		- Uji Hipotesa (<i>hypothesis testing</i>): - Test on means (1 dan 2 sample) - Test on variances (1 dan 2 sample) [1]: Chapter 6 dan 7 [2]: Handout di myITS Calssroom (<i>handout in myITS Classroom</i>)	
11	Mahasiswa mampu menganalisa dan mempraktekkan ANOVA single factor, block design, multi factor <i>Students are able to analyze and practice single-factor ANOVA, block</i>	Mampu menganalisa kasus-kasus perbandingan 1 dan multi factor <i>Able to analyze comparison cases of 1 and multiple factors</i>	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] <i>Experiment</i> Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Belajar Mandiri <i>Independent Learning</i> [TM: 3x60"]	V		- ANOVA: - Single factor - Block design - Multi factor [1]: Chapter 7 [2]: Handout di myITS Calssroom (<i>handout in myITS Classroom</i>)	



	<i>design, and multi-factor ANOVA.</i>							
12	Mahasiswa mampu menganalisa dan mempraktekkan ANOVA single factor, block design, multi factor <i>Students are able to analyze and practice single-factor ANOVA, block design, and multi-factor ANOVA.</i>	Mampu menganalisa kasus-kasus perbandingan 1 dan multi actor <i>Able to analyze comparison cases of 1 and multiple factors</i>	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] <i>Experiment</i> Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Belajar Mandiri (<i>Independent Learning</i>) [TM: 3x60"]	V		ANOVA: - Single factor - Block design - Multi factor [1]: Chapter 16 [2]: Handout di myITS Calsroom (<i>handout in myITS Classroom</i>)	
13	Mahasiswa mampu menganalisa dan mempraktekkan ANOVA single factor, block design, multi factor <i>Students are able to analyze and practice single-factor</i>	Mampu menganalisa kasus-kasus perbandingan 1 dan multi factor <i>Able to analyze comparison cases of 1 and multiple factors</i>	Oral Post-Test (random):	Perkuliahan (<i>Lectures</i>) [TM: 3x50"] <i>Experiment</i> Belajar Terstruktur (<i>Structured Learning</i>) [TM: 3x60"] Belajar Mandiri (<i>Independent Learning</i>) [TM: 3x60"]	V		ANOVA: - Single factor - Block design - Multi factor [1]: Chapter 16 [2]: Handout di myITS Calsroom (<i>handout in myITS Classroom</i>)	



	ANOVA, block design, and multi-factor ANOVA.							
14	Mahasiswa mampu menganalisa dan mempraktekkan regresi <i>Students are able to analyze and practice regression</i>	Mampu menganalisa kasus-kasus menentukan persamaan yang sesuai dengan data <i>Able to analyze cases to determine the appropriate equation for the data</i>	Oral Post-Test (random):	Perkuliahan (Lectures) [TM: 3x50"] <i>Experiment</i> Belajar Terstruktur (Structured Learning) [TM: 3x60"] Belajar Mandiri Independent Learning [TM: 3x60"]	V		- Regresion [1]: Chapter 10 [2]: Handout di myITS Calsroom <i>(handout in myITS Classroom)</i>	25%
15	Mahasiswa mampu menganalisa dan mempraktekkan regresi <i>Students are able to analyze and practice regression.</i>	Mampu menganalisa kasus-kasus menentukan persamaan yang sesuai dengan data <i>Able to analyze cases to determine the appropriate equation for the data</i>	Oral Post-Test (acak): Presentasi (Presentation)	Perkuliahan (Lectures) [TM: 3x50"] <i>Experiment</i> Belajar Terstruktur (Structured Learning) [TM: 3x60"] Belajar Mandiri Independent Learning [TM: 3x60"]	V		- Regresion [1]: Chapter 10 [2]: Handout di myITS Calsroom <i>(handout in myITS Classroom)</i>	25%
16	EVALUASI AKHIR SEMESTER (EAS) FINAL		Ujian Remedi: 4 soal 200 mnt <i>Remedial Exam: 4</i>	Perkuliahan [TM: 3x50"] Belajar Terstruktur [TM: 3x60"]	V		Sesuai CPMK/sub CPMK yang diujikan <i>According to the CLO/LLO being tested</i>	25%



	SEMESTER EVALUATION (FSE)		questions, 200 minutes	Belajar Mandiri [TM: 3x60"]				

Catatan :

3. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
4. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
5. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
6. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
7. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
8. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
9. **Bentuk penilaian:** tes dan non-tes.
10. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
11. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.



12. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
13. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
14. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

Notes:

13. **Program Learning Outcomes (PLO)** are the abilities possessed by each graduate of the program, which are the internalization of attitudes, mastery of knowledge, and skills according to their program level obtained through the learning process.
14. **PLO assigned to courses** are several program learning outcomes used for the formation/development of a course, consisting of aspects of attitude, general skills, specific skills, and knowledge.
15. **Course Learning Outcomes (CLO)** are abilities specifically derived from the PLO assigned to the course and are specific to the study material or learning content of the course.
16. **Sub-Course Learning Outcomes (Sub-CLO)** are abilities specifically derived from the CLO that can be measured or observed and are the final abilities planned at each stage of learning, specific to the learning content of the course.
17. **Assessment indicators** are specific and measurable statements that identify the abilities or performance of student learning outcomes accompanied by evidence.
18. **Assessment criteria** are benchmarks used as measures or standards for achieving learning in assessments based on predetermined indicators. Assessment criteria serve as guidelines for assessors to ensure consistent and unbiased assessments. Criteria can be quantitative or qualitative.
19. **Forms of assessment:** tests and non-tests.
20. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalents, Practicums, Studio Practices, Workshop Practices, Field Practices, Research, Community Service, and/or other equivalent forms of learning.
21. **Learning methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.



22. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-topics.
23. **Assessment weight** is the percentage of assessment for each achievement of Sub-CLO, proportional to the difficulty level of achieving the Sub-CLO, totaling 100%.
24. **TM = Face-to-Face, PT = Structured Assignment, BM = Independent Study.**



		INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department				Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (MK) Subject	KODE (Code)	Rumpun MK (Course cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan Preperation Date
Computer Aided Design and Manufacturing	TM234625	Perancangan dan Pengembangan Produk (Design and Product Development)	T=3	P=0	7	20 November 2023
OTORISASI Authorazation	Pengembang RPS (Developer lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		KaPRODI (Head of Undergraduate Program)	
	I Made Londen Batan		Arif Wahjudi		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan				



Learning Outcomes		standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>	
	CPMK-1	Mahasiswa mampu memahami spesifikasi geometri produk <i>Students are able to understand product geometry specifications</i>
	CPMK-2	Mahasiswa mampu mewujudkan sebuah produk dengan piranti lunak dalam bentuk gambar teknik (2D dan 3D) <i>Students are able to realize a product with software in the form of technical drawings (2D and 3D)</i>
	CPMK-3	Mahasiswa mampu merancang proses manufaktur (CAM) <i>Students are able to design manufacturing processes (CAM)</i>
	CPMK-4	Mahasiswa mampu memahami pembuatan G-code dan mengaplikasikan pada proses pembuatan produk dalam proses pemotongan <i>Students are able to understand how to make G-code and apply it to the product manufacturing process in the cutting process</i>
		Matrik CPL – CPMK



		CPMK	CPL-5	CPL-7	CPL-8	CPL-10
		CPMK-1	V	V	V	V
		CPMK-2	V	V	V	V
		CPMK-3	V	V	V	V
		CPMK-4	V	V	V	V
Deskripsi Singkat MK <i>Short Description of Course</i>	Pada mata kuliah ini akan dipelajari spesifikasi geometri sebuah komponen, fitur-fitur perangkat lunak baik untuk perancangan (desain), maupun untuk pembuatan (manufaktur), khususnya pada proses pemotongan logam <i>In this course, you will learn the geometric specifications of a component, software features for both design and manufacturing, especially in the metal cutting process.</i>					
Bahan Kajian: Materi Pembelajaran <i>Course Materials</i>	Pokok-pokok bahasan dalam mata kuliah ini adalah sebagai berikut: 1. Teori dan aplikasi toleransi linier dan geometrik pada gambar komponen 2. Fitur-fitur piranti lunak dalam perancangan dan proses manufaktur 3. Penyusunan program pembuatan piranti lunak 4. Pengoperasian CAD dasar dan lanjut 5. Pengoperasian CAM 2 dan 3 Axis <i>The main topics of this course are as follows:</i> 1. Theory and application of linear and geometric tolerances in component drawings 2. Software features in design and manufacturing processes 3. Compiling software creation programs 4. Basic and advanced CAD operations 5. 2 and 3 Axis CAM operations					



Pustaka <i>(References)</i>	Utama: <i>(Main)</i>						
	Software CAD, CAM, dan software Mold serta aplikasinya <i>CAD, CAM, and Mold software and their applications</i>						
	Pendukung : <i>(Supplementary)</i>						
	Software Solidworks <i>(Solidworks Software)</i>						
Dosen Pengampu <i>Lecturers</i>	I Made Londen Batan						
Matakuliah syarat <i>Prerequisites</i>	Menggambar Mesin, Proses Manufaktur 1 dan 2 <i>(Technical Drawing, Manufacturing Process 1 and 2)</i>						
Mg Ke- <i>(Week)</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>(Final Ability of Each Learning Stage (LLO))</i>	Penilaian <i>(Assessment)</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>(Learning Model; Learning Method; Student Assignment)</i>		Materi Pembelajaran (Learning Materilas)	Bobot Penilaian (%) <i>(Assesment Credit (%))</i>
		Indikator <i>Indicators</i>	Kriteria & Bentuk <i>Criteria & Model</i>	Luring <i>(offline)</i>	Daring <i>(online)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menganalisa fungsi	Mengerti fungsi toleransi linier dan geometrik	Tanya jawab di kelas Tugas Individu / Kelompok	Perkuliahan Luring: 3x50"		Introduksi perancangan permasalahan spesifikasi geometri	5



	komponen, bagian benda kerja dan produk <i>Students are able to analyze the function of components, parts of work objects and products.</i>	serta kekasaran permukaan secara umum <i>Understand the functions of linear and geometric tolerances and surface roughness in general.</i>	<i>Class Q&A Individual / Group Assignments</i>	Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		pada tahapan proses desain <i>Introduction to designing geometric specification problems at the design process stage</i>	
2	Mahasiswa mampu menganalisa kebutuhan toleransi untuk komponen <i>Students are able to analyze tolerance requirements</i>	Mampu dan terampil menyelesaikan permasalahan kebutuhan akan toleransi linier, geometrik, dan suaian <i>Able and skilled in solving problems</i>	Tanya jawab di kelas Tugas Individu / Kelompok <i>Class Q&A Individual / Group Assignments</i>	Perkuliahan Luring : 3x50" Penugasan Terstruktur : 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i>		Pengertian poros dan lubang, standarisasi dan jenis toleransi linier, prinsip toleransi dan suaian <i>Understanding shafts and holes, standardization and types of linear tolerances, principles of tolerance and fit</i>	5



	<i>for components.</i>	<i>regarding the need for linear, geometric and conformal tolerances</i>		<i>Independent Learning: 3x60"</i>			
3	Mahasiswa mampu memilih toleransi linier sesuai dengan kebutuhan berdasarkan aspek fungsi, manufaktur dan pengukuran <i>Students are able to select linear tolerances according to needs based on functional, manufacturing and</i>	Mampu memilih jenis sistem suaian, jenis toleransi linier dan geometric <i>Able to choose the type of custom system, linear and geometric tolerance types</i>	Tanya jawab di kelas Tugas Individu / Kelompok <i>Class Q&A Individual / Group Assignments</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Sistem dan jenis suaian, perhitungan besarnya toleransi linier dan penetapan pasangan toleransi pada komponen <i>Systems and types of adjustments, calculation of linear tolerance values and determination of tolerance pairs on components</i>	5



	<i>measurement aspects.</i>						
4	EVALUASI 1/1st Evaluation						10
5-6	Mahasiswa mampu menjalankan sistem operasi software CAD untuk desain dan drafting benda sederhana <i>Students are able to run CAD software operating systems for designing and drafting simple objects.</i>	Mampu menjalankan sistem operasi software CAD Mampu membuat model 3D yang sederhana beserta gambar teknik <i>Able to run CAD software operating system</i> <i>Able to create simple 3D models along with engineering drawings</i>	Praktek menggunakan software CAD <i>Practice using CAD software</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Latihan praktek membuat benda sederhana dengan sketsa dan latihan software CAD <i>Practical exercises to make simple objects with sketches and CAD software exercises</i>	5



7	Mahasiswa mampu menjalankan sistem operasi software CAD membuat benda assembly <i>Students are able to run CAD software operating systems to create assembly objects</i>	Mampu menjalankan sistem operasi software CAD Mampu membuat gambar susunan (assembly) <i>Able to run CAD software operating system</i> <i>Able to create assembly drawings</i>	Praktek menggunakan software CAD <i>Practice using CAD software</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Merangkai (assembly) benda sederhana yang telah dibuat minggu sebelumnya menjadi satu kesatuan sistem <i>Assembling simple objects that were made the previous week into a single system unit</i>	5
8	EVALUASI 2 / <i>Evaluation 2</i>						10
9	Mahasiswa mampu menjalankan sistem operasi software CAD untuk desain dan drafting	Mampu menjalankan sistem operasi software CAD Mampu membuat	Praktek menggunakan software CAD <i>Practical using CAD software</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60"		Latihan praktek membuat benda dengan tingkat kesukaran lebih tinggi (Crankshaft, piston, dll)	5



	benda kompleks <i>Students are able to run CAD software operating systems for designing and drafting complex objects.</i>	model 3D yang komplek beserta gambar teknik <i>Able to run CAD software operating systems</i> <i>Able to create complex 3D models along with technical drawings</i>		Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>Practice making objects with a higher level of difficulty (crankshaft, piston, etc.)</i>	
10-11	Mahasiswa mampu menjalankan sistem operasi software CAD untuk desain dan drafting benda surface <i>Students are able to run CAD software operating</i>	Mampu menjalankan sistem operasi software CAD Mampu membuat model 3D menggunakan metode surface <i>Able to run CAD software</i>	Praktek menggunakan software CAD <i>Practical using CAD software</i>	. Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri : 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i>		Latihan praktek membuat benda dari metode surface (botol, teko, dll) <i>Practical exercises for making objects using surface methods (bottles, teapots, etc.)</i>	10



	systems for designing and drafting surface objects	operating system Able to create 3D models using the surface method		Independent Learning: 3x60"			
12	EVALUASI 3/Evaluation 3						10
13	Mahasiswa mampu memahami arti kode G-Code <i>Students are able to understand the meaning of G-Code</i>	Mampu mengartikan kode G-Code <i>Able to interpret G-Code</i>	Praktek menggunakan software CAD dan CAM <i>Practice using CAD and CAM software</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		G-Code proses Manufaktur <i>G-Code Manufacturing process</i>	5
14	Mahasiswa mampu	Mampu generate	Praktek menggunakan	Perkuliahan Luring: 3x50"		Praktek langsung pada software CAD	5



	mengeluarkan kode G-Code dari software CAD untuk proses manufaktur <i>Students are able to output G-Code from CAD software for manufacturing processes.</i>	kode G-Code dari software CAD untuk proses manufaktur benda yang dibuat <i>Able to generate G-Code from CAD software for the manufacturing process of manufactured objects</i>	software CAD dan CAM <i>Practical using CAD and CAM software</i>	Penugasan Terstruktur: 3x60" Belajar Mandiri : 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		CAM <i>Practice CAD CAM software</i>	
15	Mahasiswa mampu membuat animasi proses manufaktur dari software CAD CAM <i>Students are able to create manufacturing</i>	Mampu membuat animasi proses manufaktur dari software CAD CAM	Praktek menggunakan software CAD dan CAM <i>Practice using CAD and CAM software</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>		Praktek langsung pada software CAD CAM <i>Practice CAD CAM software</i>	5



	process animations from CAD CAM software.	Able to create manufacturing process animations from CAD CAM software		Structured Assignments: 3x60" Independent Learning: 3x60"			
16	EVALUASI 4 / <i>Evaluation 4</i>						15



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
	RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)					
	MATA KULIAH (MK) Subject	KODE (Code)	Rumpun MK (Course cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)
Mold Design	TM234723	Perancangan dan Pengembangan Produk (Design and Product Development)	T3	P=0	PILIHAN	20 November 2023
OTORISASI Authorazation	Pengembang RPS (Developer lecturer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		KaPRODI (Head of Undergraduate Program)	
	I Made Londen Batan		I Made Londen Batan		KaPRODI (Head of Undergraduate Program)	
	CPL-PRODI yang dibebankan pada MK					



Capaian Pembelajaran (CP) <i>Learning outcome</i>	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>
	Capaian Pembelajaran Mata Kuliah (CPMK)	
	CPM K-1	Mahasiswa mampu memahami perbedaan berbagai thermoplastik <i>Students are able to understand the differences between various thermoplastics</i>
	CPM K-2	Mahasiswa mampu memahami cara kerja mesin dan menentukan parameter proses injeksi <i>Students are able to understand how the machine works and determine the parameters of the injection process</i>
	CPM K-3	Mahasiswa mampu merancang cetakan untuk produk plastik dan mensimulasikan parameter proses injeksi <i>Students are able to design molds for plastic products and simulate injection process parameters</i>
	CPM K-4	Mahasiswa mampu memahami cara kerja mesin dan menentukan parameter proses injeksi, serta mengetahui proses cetakan tiup <i>Students are able to understand how the machine works and determine the parameters of the injection process, as well as knowing the blow molding process</i>
	Matrik CPL – CPMK	



		CPMK	CPL-5	CPL-7	CPL-8	CPL-10	
		CPMK-1	V	V	V	V	
		CPMK-2	V	V	V	V	
		CPMK-3	V	V	V	V	
		CPMK-4	V	V	V	V	
Deskripsi Singkat MK <i>Short Description of Course</i>	Pada mata kuliah ini akan dipelajari macam-macam thermoplastik, proses cetakan injeksi untuk material plastik, memilih parameter proses injeksi, mensimulasikan proses injeksi dengan berbagai input desain, analisis cacat atau hasil proses pencetakan serta merancang cetakan tiup <i>In this course, you will learn about various types of thermoplastics, injection molding processes for plastic materials, selecting injection process parameters, simulating injection processes with various design inputs, analyzing defects or molding process results, and designing blow molds.</i>						
Bahan Kajian: Materi Pembelajaran <i>Course Materials</i>	Pokok-pokok bahasan dalam mata kuliah ini adalah sebagai berikut: 1. Jenis thermoplastik 2. Proses cetakan injeksi untuk material plastik 3. Perhitungan Cavity dan beban kerja mesin 4. Desain cetakan dan simulasi proses cetakan injeksi 5. Percobaan cetakan injeksi 6. Analisis hasil proses cetakan injeksi untuk material plastik 7. Perancangan cetakan tiup <i>The main topics of this course are as follows:</i> 1. <i>Types of thermoplastics</i> 2. <i>Injection molding process for plastic materials</i> 3. <i>Cavity calculation and machine workload</i> 4. <i>Mold design and injection molding process simulation</i>						



	5. Injection molding experiments 6. Analysis of injection molding process results for plastic materials 7. Blow mold design				
Pustaka Reference	Utama : <i>(Main)</i>				
	1. Menges, Georg & Mohren; How to Make Injection Molds , Hanser Publisher, Munschen, Vienna, New York. 1986 2. Jerry M. Fischer (2003), Handbook of Molded Part Shrinkage and Warpege . Plastics design Libray, Williem Andrew Inc. 3. Herbert, Rees. (1995), Mold Engineering , Hanser Publishers, New York.				
	Pendukung/: <i>Supplementary</i>				
	1. User manual operation mesin injeksi merk Heitien 2. User Manual Moldflow Autodesk for Simulation atau software lainnya 3. Handout Perancangan Cetakan Injeksi dan Tiup <i>1. User manual operation of injection machine</i> <i>2. User Manual Moldflow Autodesk for Simulation or other software</i> <i>3. Handout for Injection and Blow Mold Design</i>				
Dosen Pengampu Lecturer	I Made Londen Batan dan Bambang Pramujati				
Matakuliah syarat Required courses	Tidak ada mata kuliah prasyarat <i>There are no prerequisite courses</i>				
Mg Ke-	Kemampuan akhir tiap	Penilaian <i>(Assessment)</i>	Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa,	Materi Pembelajaran	Bobot Penilaian (%)



(Week -)	tahap belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))			(Learning Model; Learning Method; Student Assignment)		(Learning Materilas)	(Assesment Credit (%))
		Indikator Indicators	Kriteria & Bentuk Criteria & Model	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami perbedaan berbagai thermoplastik <i>Students are able to understand the differences between various thermoplastics.</i>	Mampu memahami sifat-sifat fisik dan mekanik thermoplastik <i>Able to understand the physical and mechanical properties of thermoplastics</i>	Mahasiswa bisa menjawab arti material thermoplastik dengan benar saat tanya jawab (diskusi kelas - non tes) Keaktifan di kelas <i>Students can answer the meaning of thermoplastic materials correctly during Q&A (class discussion - non-test)</i> <i>Activity in class</i>	Luring. Perkuliahan: [TM 3x50"] Penugasan Terstruktur: [PT 3x60"] Belajar Mandiri:[BM 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		- Kontrak Kuliah - Pengertian dan Macam-macam thermoplastics - Implementasi plastik dalam kehidupan <i>- Lecture Contract</i> <i>- Definition and Types of Thermoplastics</i> <i>- Implementation of Plastic in Life</i>	5



2	Mahasiswa mampu memahami cara kerja mesin dan menentukan parameter proses injeksi <i>Students are able to understand how the machine works and determine the parameters of the injection process</i>	Mahasiswa mengetahui berbagai komponen utama mesin injeksi Mahasiswa memahami fungsi komponen utama mesin injeksi <i>Students know the various main components of the injection machine</i> <i>Students understand the function of the main</i>	Mahasiswa bisa menjawab fungsi utama mesin injeksi dan komponennya dengan benar saat tanya jawab (diskusi kelas - non test) <i>Students can answer the main functions of the injection machine and its components correctly during Q&A (class discussion - non-test)</i>	Luring. Perkuliahah: [TM 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Jenis-jenis mesin cetakan injeksi Double atau Triple plate mold Mesin Cetakan injeksi dengan saluran panas dan dingin Tugas perancangan cetakan injeksi – Tugas Mandiri <i>Types of injection molding machines</i> <i>Double or Triple plate mold</i> <i>Injection molding machine with hot and cold channels</i> <i>Injection mold design assignment –</i>	5



		<i>components of the injection machine</i>				<i>Independent Assignment</i>	
3	Mahasiswa mampu merancang jumlah cavity dan gaya cekam cetakan <i>Students are able to design the number of cavities and the mould clamping force</i>	Mahasiswa mampu menghitung jumlah cavity dan besarnya gaya cekam cetakan <i>Students are able to calculate the number of cavities and the magnitude of the mould clamping force</i>	Mahasiswa dapat menunjukkan hasil perhitungan jumlah cavity dan gaya cekam cetakan – diskusi non test <i>Students can show the results of calculating the number of cavities and the mould clamping force – non-test discussion</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Tahapan perancangan cetakan injeksi <i>Injection mould design stages</i>	5
4	Mahasiswa mampu merancang	Mahasiswa dapat	Oral Post-Test (acak):	Luring. Perkuliahan [TM: 3x50"]		Perhitungan jumlah cavity, gaya pencekaman, dan	5



	cetakan untuk produk plastik <i>Students are able to design moulds for plastic products</i>	menunjukkan dimensi cetakan dan perancangan rongga cetakan yang memenuhi syarat <i>Students are able to show mould dimensions and mould cavity designs that meet the requirements</i>	Diskusi hasil perancangan tugas mandiri mahasiswa <i>Oral Post-Test (random):</i> <i>Discussion of the results of students' independent task design</i>	Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		waktu siklus proses cetakan injeksi <i>Calculation of the number of cavities, clamping force, and cycle time of the injection moulding process</i>	
5	Mahasiswa mampu memahami waktu siklus dan sistem pendinginan cetakan injeksi	Mahasiswa bisa memperkirakan waktu siklus yang tepat dan menghitung panas yang timbul saat	Oral Post-Test (acak): Diskusi hasil perhitungan waktu siklus dan kalor yang harus dipindahkan pada cetakan injeksi	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"]		Perpindahan panas pada cetakan injeksi Macam dan jenis pendinginan cetakan	5



	<i>Students are able to understand the cycle time and cooling system of injection moulding</i>	proses pencetakan <i>Students are able to estimate the correct cycle time and calculate the heat generated during the moulding process</i>	dari tugas mandiri mahasiswa – non test <i>Oral Post-Test (random): Discussion of the results of calculating cycle time and heat that must be transferred in the injection mould from students' independent assignments - non-test</i>	Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Perancangan pendinginan cetakan injeksi <i>Heat transfer in injection moulding</i> <i>Types and kinds of mould cooling</i> <i>Injection mold cooling design</i>	
6	Mahasiswa mampu merancang cetakan untuk produk plastik dan mensimulasikan parameter proses injeksi	Mahasiswa menunjukkan hasil perancangan secara manual	Diskusi perancangan secara manual cetakan injeksi dari tugas mandiri mahasiswa – non test <i>Discussion of manual design of</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		Jenis cacat-cacat pada proses pencetakan produk plastik dan penyebabnya	5



	<i>Students are able to design moulds for plastic products and simulate injection process parameters</i>	<i>Students show the results of manual design</i>	<i>injection mould from students' independent assignments – non-test</i>	<i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>Types of defects in the plastic product printing process and their causes</i>	
7	Mahasiswa mampu menganalisis hasil simulasi <i>Students are able to analyze simulation results</i>	Mahasiswa dapat menunjukkan hasil simulasi yang baik dan cacat <i>Students can show good and defective simulation results</i>	Diskusi hasil simulasi dari tugas mandiri mahasiswa – non test <i>Discussion of simulation results from students' independent assignments - non-test</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i>		Proses injeksi, cacat fisik dan mekanik hasil simulasi, dan penyebabnya <i>Injection process, physical and mechanical defects resulting from simulation, and their causes</i>	5



				<i>Independent Learning:</i> 3x60"			
8	Evaluasi Tengah Semester / Ujian Tengah Semester - Presentasi 1 Tugas Mandiri <i>Project Presentation</i>						10
9	Mahasiswa mampu membandingkan hasil perancangan secara manual dan hasil simulasi <i>Students are able to compare manual design results and simulation results.</i>	Mahasiswa dapat menunjukkan perbedaan hasil perencanaan dan simulasi secara berkelanjutan <i>Students are able to show differences in planning and simulation results on an ongoing basis.</i>	Diskusi awal hasil perencanaan dan simulasi cetakan dari tugas mandiri mahasiswa – non test <i>Initial discussion of the results of planning and simulation of printing from students' independent assignments - non-test</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures:</i> 3x50" <i>Structured Assignments:</i> 3x60" <i>Independent Learning:</i> 3x60"		Parameter proses injeksi dan efeknya terhadap hasil cetakan <i>Injection process parameters and their effects on moulding results</i>	10



10	Masiswa mampu menyelesaikan perancangan cetakan injeksi secara menyeluruh <i>Students are able to complete the injection mould design in its entirety</i>	Mahasiswa dapat membuat laporan tugas mandiri yang memuat perancangan cetakan dan hasil simulasi serta analisisnya <i>Students are able to create independent assignment reports that include mould design and simulation results and their analysis</i>	Diskusi akhir hasil perencanaan dan simulasi cetakan dari tugas mandiri mahasiswa – non test <i>Final discussion of the results of planning and simulation of printing from students' independent assignments - non-test</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Laporan Akhir Perancangan Cetakan Injeksi – Tugas mandiri mahasiswa <i>Final report on Injection Mold Design – Student independent assignment</i>	5
11	Mahasiswa memahami proses cetakan tiup (blow moulding)	Mahasiswa mengetahui berbagai komponen utama mesin cetakan tiup dan fungsinya	Diskusi kelas – non test <i>Class discussion – non-test</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"]		Konstruksi mesin cetakan tiup dan proses pencetakannya <i>Construction of</i>	5



	<i>Students understand the blow moulding process.</i>	masing-masing <i>Students know the various main components of a blow moulding machine and their respective functions.</i>		Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>blow moulding machine and its moulding process</i>	
12	Mahasiswa memahami inside dan outside parison <i>Students understand inside and outside parison</i>	Mahasiswa mengetahui ada berbagai macam parison dan cara merancang nya <i>Students know that there are various types of parison and how to design them</i>	Diskusi kelas – non test <i>Class discussion – non-test</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i>		Perencanaan inside dan outside parison <i>Inside and outside parison planning</i>	5



				<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>			
13	Mahasiswa mampu merancang dimensi pin dan die untuk membentuk parison <i>Students are able to design the dimensions of pins and dies to form parisons</i>	Mahasiswa bisa menghitung diameter /dimensi pin dan die sebagai dasar perancangan parison <i>Students are able to calculate the diameter/dimensions of pins and dies as the basis for designing parisons</i>	Diskusi kelas – non test <i>Class discussion – non-test</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i>		Perhitungan dimensi pin dan die untuk membuat outside parison pada berbagai bentuk produk berongga, baik simetris maupun non- simetris <i>Calculation of pin and die dimensions for making outside parisons on various hollow product shapes, both symmetrical and non-symmetrical.</i>	5



14	Mahasiswa mampu menyelesaikan perancangan cetakan tiup <i>Students are able to complete the design of a blow mold</i>	Mahasiswa bisa menunjukkan dimensi pin dan die serta bentuk cetakan tiup sebuah produk berongga <i>Students are able to show the dimensions of the pin and die and the shape of the blow mold of a hollow product</i>	Diskusi kelas – non test <i>Class discussion – non-test</i>	Luring. Perkuliahan [TM: 3x50"] Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"] <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Tugas perancangan cetakan tiup produk berongga, seperti jerigen, botol, tempat penyimpanan cairan, dll <i>The task of designing blow moulds for hollow products, such as jerry cans, bottles, liquid storage containers, etc.</i>	5
15	Mahasiswa mampu memahami perbedaan dasar proses cetakan injeksi dan cetakan tiup	Mahasiswa mengetahui perancangan cetakan tiup dari berbagai bentuk produk berongga	Presentasi tugas perancangan cetakan tiup <i>Blow mould design assignment presentation</i>	Presentasi tugas secara offline Penugasan Terstruktur [PT: 3x60"]		Tugas Mandiri Mahasiswa – Perancangan Cetakan Tiup <i>Student Independent Assignment – Blow Mold Design</i>	10



	<i>Students are able to understand the basic differences between injection molding and blow molding processes</i>	<i>Students know the design of blow molds for various hollow product shapes</i>		Belajar Mandiri [BM: 3x60"] <i>Assignment Offline Presentation</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>			
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Exam</i>						10



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen <i>(Document Code)</i>	
	RENCANA PEMBELAJARAN SEMESTER						
	<i>(Semester Learning Plan)</i>						
MATA KULIAH (MK) <i>Subject</i>	KODE <i>(Code)</i>	Rumpun MK <i>(Course cluster)</i>	BOBOT (sks) <i>(Credit)</i>		SEMESTER <i>(Semester)</i>	Tgl Penyusunan <i>Preperation Date</i>	
Perancangan dan Pengembangan Produk <i>Design and Product Development</i>	TM234614	Perancangan dan Pengembangan Produk <i>Design and Product Development</i>	T=3	P=0	PILIHAN	20 November 2023	
OTORISASI <i>Authorazation</i>	Pengembang RPS <i>(Developer lecturer of Semester Learning Plan)</i>		Koordinator RMK <i>(Course Cluster Coordinator)</i>		KaPRODI <i>(Head of Undergraduate Program)</i>		
	I Made Londen Batan		Arif Wahjudi		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.		



Capaian Pembelajaran (CP) <i>Learning outcome</i>	CPL-PRODI yang dibebankan pada MK <i>(PLO Program Charged to The Course)</i>	
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data. <i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>
	Capaian Pembelajaran Mata Kuliah (CPMK)	
	CPM K-1	Mahasiswa mampu memahami proses perancangan dan mampu mengembangkan produk, baik dari aspek desain, ergonomi, manufaktur dan perakitan [5, 7, 8, 10] <i>Students are able to understand the design process and are able to develop products, both from the aspects of design, ergonomics, manufacturing and assembly</i>
	CPM K-2	Mahasiswa mampu menyusun rencana pengembangan produk dan menganalisa gaya-gaya, dan tegangan-tegangan yang terjadi pada produk saat digunakan [5, 7, 8, 10] <i>Students are able to prepare product development plans and analyze the forces and stresses that occur in the product</i>
	CPM K-3	Mahasiswa mampu merencanakan proses manufaktur, memilih mesin/peralatan yang diperlukan, proses dan metode perakitan produk [8, 10] <i>Students are able to plan the manufacturing process, select the necessary machines/equipment, processes and assembly methods</i>



	CPM K-4	Mahasiswa mampu mengembangkan sebuah produk dengan atas kebutuhan konsumen [7,8, 10] <i>Students are able to develop a product based on consumer needs</i>																												
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-5</td><td>CPL-7</td><td>CPL-8</td><td>CPL-10</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-2</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-3</td><td></td><td></td><td>V</td><td>V</td></tr><tr><td>CPMK-4</td><td></td><td>V</td><td>V</td><td>V</td></tr></table>				CPMK	CPL-5	CPL-7	CPL-8	CPL-10	CPMK-1	V	V	V	V	CPMK-2	V	V	V	V	CPMK-3			V	V	CPMK-4		V	V	V
CPMK	CPL-5	CPL-7	CPL-8	CPL-10																										
CPMK-1	V	V	V	V																										
CPMK-2	V	V	V	V																										
CPMK-3			V	V																										
CPMK-4		V	V	V																										
Deskripsi Singkat MK <i>Short Description of Course</i>	Mata kuliah ini membahas tentang metode perancangan produk, baik dari aspek desain, ergonomi, manufaktur, dan perakitan serta membahas pengembangan produk berdasarkan kebutuhan konsumen melalui metode Quality Function Deployment (QFD). <i>This course discusses product design methods, both from the aspects of design, ergonomics, manufacturing, and assembly and discusses product development based on consumer needs through the Quality Function Deployment (QFD) method.</i>																													
Bahan Kajian: Materi Pembelajaran <i>Coure material</i>	Pokok-pokok bahasan dalam mata kuliah ini adalah sebagai berikut: - Proses desain: proses desain kognitif, persuatif, deduktif - Fungsi produk: struktur fungsi, fungsi utama, fungsi tambahan sebuah produk - Pengembangan konsep : daftar kebutuhan, pembuatan dan pemilihan konsep - Perancangan komponen: perwujudan desain, perancangan komponen yang ekonomis, perancangan untuk manufaktur dan perakitan - Ergonomi Produk: metode RULA, manfaat dan aplikasinya dalam perancangan dan pengembangan produk																													



	- Pengembangan produk: konsep pengembangan berbasis fungsi produk, dan analisis kebutuhan dengan quality function deployment <i>The main topics of this course are as follows:</i> - <i>Design process: cognitive, persuasive, deductive design process</i> - <i>Product function: function structure, main function, additional function of a product</i> - <i>Concept development: list of needs, concept creation and selection</i> - <i>Component design: design realization, economical component design, design for manufacturing and assembly</i> - <i>Product Ergonomics: RULA method, benefits and applications in product design and development</i> - <i>Product development: product function-based development concept, and needs analysis with quality function deployment</i>	
Pustaka <i>References</i>	Utama : <i>Main</i>	
	Batan, I Made Londen, Desain Produk Edisi 1, Guna Widya, 2012, Surabaya	
	Pendukung : <i>Supplementary</i>	
	[1].Bralla, James G., Design for Manufacturability Handbook, Mc Graw-Hill, 1999. [2].Mc-Atamney, Lynn and Corlett, E Nigel; RULA: a survey method for investigation of work-related upper limb disorders, Institute for Occupational Ergonomics, University of Nottingham. [3].Otto, Kevin N. and Wood, Kristin L., Product Design – Techniques in Reverse Engineering and New Product Development, Printice Hall, 2000. [4].Ulrich, Karl T.; Eppinger, Steven D., Product Design and Development. Mc Graw-Hill, Inc., 2000. [5].Boothroyd, Geoffrey; Peter, Dewhurst and Winston, Knight, Product Design For Manufacture and Assembly, 2nd ed, 2002.	
Dosen Pengampu <i>Lecturer</i>	I Made Londen Batan, Arif Wahyudi, dan Dinny Harnany	



Matakuliah h syarat <i>Prerequisites</i>		Tidak ada mata kuliah prasyarat <i>There are no prerequisite courses</i>					
Mg Ke- (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assessment)		Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materilas)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator (Indicators)	Kriteria & Bentuk (Criteria & Model)	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami permasalahan dalam perancangan dan pengembangan produk <i>Students are able to understand problems in product design</i>	Mampu merumuskan permasalahan umum dalam pembuatan produk <i>Able to formulate general problems in product manufacturing</i>	Latihan perumusan masalah dalam perancangan produk <i>Practice problem formulation in product design</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i>		- Kontrak Kuliah - Masalah pada perancangan produk - Introduksi Proses desain [1]: Bab 1 [2]: Handout <i>Lecture Contract</i> - Problems in product design - Introduction to the design process	5



	<i>and development.</i>			<i>Independent Learning: 3x60</i>		[1]: Chapter 1 [2]: Handout	
2	Mahasiswa mampu memahami proses desain <i>Students are able to understand the design process</i>	Mampu dan memahami dasar-dasar dan metode proses desain <i>Able and understand the basics and methods of the design process</i>	Diskusi metode yang umum digunakan dalam proses desain <i>Discussion of methods commonly used in the design process</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		- Introduksi Proses desain, metode dan aplikasinya dalam pembuatan produk manufaktur [1]: Bab 2 dan 3 [2]: Handout <i>- Introduction to design processes, methods and their applications in manufacturing products</i> <i>[1]: Chapters 2 and 3</i> <i>[2]: Handout</i>	5
3	Mahasiswa mampu menyusun dan menganalisa fungsi produk <i>Students are able to compile and analyze product functions</i>	Mampu dan terampil menyusun tahapan fungsi produk, komponen, dan elemen <i>Able and skilled at compiling</i>	Pembagian tugas Pengembangan produk <i>Product Development Task Division</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>		- Struktur fungsi - Output proses desain [1]: Bab 4 - [2]: Handout di myITS Classroom	5



		<i>product function stages, components and elements</i>		<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		<i>- Introduction to design processes, methods and their applications in manufacturing products</i> <i>[1]: Chapters 2 and 3</i> <i>[2]: Handout</i>	
4	Mahasiswa mampu menyusun kebutuhan akan produk, yang didapat dari berbagai sumber termasuk ide desainer sendiri <i>Students are able to compile product needs, which are obtained from various sources including the designer's own ideas</i>	Mampu dan terampil menyusun daftar kebutuhan sebuah produk <i>Able and skilled in compiling a list of product requirements</i>	Latihan menyusun kebutuhan akan produk <i>Exercise to formulate product needs</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		- Metode pencarian kebutuhan akan produk - Studi perbandingan/kajian produk [1]: Bab 5 - [2]: Handout di myITS Classroom <i>- Methods for finding product needs</i> <i>- Comparative study/product review</i> <i>[1]: Chapter 5</i> <i>- [2]: Handout in myITS Classroom</i>	5
5	Mahasiswa mampu membuat	Mampu menyusun beberapa konsep	Pembuatan sketsa alat dan Presentasi awal	Perkuliahan Luring: 3x50"	Tentatif daring	- Dasar-dasar pembuatan	5



	konsep desain sebuah produk <i>Students are able to create a product design concept</i>	sebuah produk <i>Able to compile several concepts for a product</i>	tugas <i>Sketch making of tools and Initial presentation of assignments</i>	Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		konsep sebuah produk - Contoh umum dalam pengembangan konsep [1]: Bab 6 - [2]: Handout di myITS Classroom <i>- The basics of creating a product concept</i> <i>- Common examples in concept development</i> [1]: Chapter 6 - [2]: Handout in myITS Classroom	
6	Mahasiswa mampu memilih konsep desain sebuah produk <i>Students are able to select a product design concept</i>	Mampu menyusun beberapa konsep sebuah produk dan memilih konsep terbaik <i>Able to compile several product concepts and choose the best concept</i>	Oral Pre-Test (acak): Geometri, fungsi dan analisis faktor yang berpengaruh pada produk <i>Oral Pre-Test (random): Geometry, function and analysis of factors that influence the product</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>		- Kriteria pemilihan konsep - Metode Pemilihan konsep [1]: Bab 6 - [2]: Handout di myITS Classroom	5



				<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		- Concept selection criteria - Concept selection method [1]: Chapter 6 - [2]: Handout in myITS Classroom	
7	Mahasiswa mampu merancang komponen sebuah produk dengan menganalisis kekuatan material <i>Students are able to design product components by analyzing the material strength.</i>	Mampu dan terampil merancang komponen serta memilih komponen standar <i>Able and skilled in designing components and selecting standard components</i>	Membuat laporan tugas dan presentasi tugas lanjutan <i>Make assignment reports and advanced assignment presentations</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>	Tentatif daring	- Perwujudan desain - Perancangan komponen yang ekonomis - Analisis Perancangan dari aspek kekuatan material [1]: Bab 6 dan 7 [2]: Handout di myITS Classroom <i>Design realization</i> - Economical component design - Design analysis from material strength aspect [1]: Chapter 6 and 7 [2]: Handout in myITS Classroom	5



8	Evaluasi Tengah Semester / Ujian Tengah Semester <i>Project Presentation</i>						10
9	Mahasiswa mampu menganalisis aspek ergonomi sebuah produk <i>Students are able to analyze the ergonomic aspects of product</i>	Mampu menganalisis ergonomi sebuah produk dengan menghitung nilai risiko cedera tubuh <i>Able to analyze the ergonomics of a product by calculating the risk value of bodily injury</i>	Oral Pre-Test (acak): Kriteria ergonomis sebuah produk dan menghitung nilai RULA sebuah aktivitas <i>Ergonomics criteria of a product and calculating the RULA value of an activity</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		- Metode RULA - Nilai risiko cedera tubuh - nilai risiko cedera tubuh [1]: Bab 8 dan 9 [2]: Handout di myITS Calsroom <i>- RULA method</i> <i>- Assess the risk of bodily injury assess the risk of bodily injury</i> <i>[1]: Chapters 8 and 9</i> <i>[2]: Handout in myITS Classroom</i>	5
10	Mahasiswa mampu menunjukkan produk yang ergonomis <i>Students are able to demonstrate ergonomic products</i>	Mampu menggunakan software untuk menghitung nilai risiko cedera tubuh, memastikan aspek ergonomi pada produk <i>Able to use</i>	Oral Pre-Test (acak): Presentasi tugas RULA <i>Oral Pre-Test (random): Presentation of RULA assignment</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>	Tentatif daring	- Perhitungan RULA sebuah Produk - Simulasi RULA dengan bantuan software CATIA atau software lainnya [1]: Bab 8 dan 9	5



		<i>software to calculate the risk value of bodily injury, ensure ergonomic aspects of the product</i>		<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		[2]: Handout di myITS Classroom <i>RULA Calculation of a Product</i> - RULA Simulation with the help of CATIA software or other software [1]: Chapter 8 and 9 [2]: Handout in myITS Classroom	
11	Mahasiswa mampu menganalisa perancangan untuk manufaktur <i>Students are able to analyze designs for manufacturing</i>	Mampu menghitung dan menganalisa gaya-gaya pembentukan proses piercing & blanking dan menunjukkan tegangan-regangan akibat adanya proses sharing <i>Able to calculate and analyze the forming forces of the piercing and blanking processes and</i>	Penetapan proses manufaktur produk dan menerapkan aspek DFM pada produk manufaktur (sesuai dengan tugas mhs) <i>Determining the product manufacturing process and applying DFM aspects to manufactured products (in accordance with student assignments)</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		- Metode Perancangan untuk manufaktur (design for Manufacture – DFM) - Aplikasi DFM pada berbagai proses pemesinan dan pembentukan [1]: Bab 8 [2]: Handout di myITS Classroom <i>Design for Manufacture (DFM)</i>	5



		<i>show the stresses and strains resulting from the sharing process.</i>				<i>- Application of DFM in various machining and forming processes</i> <i>[1]: Chapter 8</i> <i>[2]: Handout in myITS Classroom</i>	
12	Mahasiswa mampu menganalisa perancangan untuk perakitan <i>Students are able to analyze designs for assembly</i>	Mampu memahami metode dan proses perakitan <i>Able to understand assembly methods and processes</i>	Merancang proses perakitan pada produk manufaktur (sesuai dengan tugas mahasiswa) <i>Determining the product manufacturing process and applying DFM aspects to manufactured products (in accordance with student assignments)</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		- Metode Perancangan untuk manufaktur (design for Manufacture – DFM) - Jenis-jenis sambungan - Perakitan yang ekonomis - Perakitan berbagai material yang berbeda [1]: Bab 8 [2]: Handout di myITS Classroom <i>Design for Manufacture (DFM) Methods</i> <i>- Types of joints</i> <i>- Economical assembly</i>	5



						- Assembly of different materials [1]: Chapter 8 [2]: Handout in myITS Classroom	
13	Mahasiswa mengetahui dan mempunyai pengetahuan umum untuk mengembangkan produk baru. <i>Students know and have technical knowledge to develop new products.</i>	Mampu menganalisa dan menunjukkan kebutuhan baru akan produk <i>Able to analyze and demonstrate new needs for products</i>	Oral Pre-Test (acak): Menyusun daftar kebutuhan akan produk berdasarkan suara konsumen/pengguna <i>Oral Pre-Test (random): Compiling a list of product needs based on consumer/user voices</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		- Perminataan dan kepuasan pelanggan - Metode QFD dan aplikasinya pada pengembangan produk [1]: Bab 10 [2]: Handout di myITS Classroom <i>Customer demand and satisfaction</i> <i>- QFD method and its application to product development</i> [1]: Chapter 10 [2]: Handout in myITS Classroom	10
14	Mahasiswa mampu merancang bagian produk	Mampu menganalisa dan menunjukkan bagian-bagian	Mengembangkan produk baru dari produk sebelumnya	Luring, Perkuliahan [TM: 3x50"] Kuliah		Tugas masing-masing mahasiswa – Tugas Perancangan dan Pengembangan Produk	5



	yang dikembangkan dari seluruh aspek pengembangan produk <i>Students are able to design product parts that are developed from all aspects of product development.</i>	produk baru yang dikembangkan <i>Able to analyze and demonstrate parts of new products developed</i>	<i>Developing new products from previous products</i>	Penugasan Terstruktur [PT: 3x60"] Belajar Mandiri [BM: 3x60"]		[1]: Bab 10 [2]: Handout di myITS Classroom <i>Each student's assignment – Product Design and Development Assignment</i> [1]: Chapter 10 [2]: Handout in myITS Classroom	
15	Mahasiswa mampu menunjukkan hasil perancangan dan pengembangan produk. <i>Students are able to demonstrate the results of product design and development.</i>	Mampu menyampaikan hasil perancangan dan pengembangan produk <i>Able to convey product design and development results</i>	Presentasi akhir tugas, menguasai materi tugas dan menyampaikan dengan baik hasil laporan tugas mata kuliah <i>Final assignment presentation, mastering the assignment material and conveying the results of the course assignment report well</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i>	Tentatif daring	- Presentasi akhir tugas [1]: Bab 10 & 11 [2]: Handout di myITS Classroom <i>- Final assignment presentation</i> [1]: Chapter 10 and 11 [2]: Handout in myITS Classroom	10



				<i>Independent Learning: 3x60</i>			
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Exam</i>						10



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN <i>Faculty of Industrial Technology and Systems Engineering</i> <i>Undergraduate Program of Mechanical Engineering Department</i>					Kode Dokumen <i>(Document Code)</i>
RENCANA PEMBELAJARAN SEMESTER						
MATA KULIAH (MK) <i>Subject</i>	KODE <i>(Code)</i>	Rumpun MK <i>(Course cluster)</i>	BOBOT (sks) <i>(Credit)</i>		SEMESTER <i>(Semester)</i>	Tgl Penyusunan <i>Preperation Date</i>
Perancangan Perkakas Tool Design	TM234726	Perancangan dan Pengembangan Produk <i>(Design and Product Development)</i>	T=3	P=0	7	20 November 2023
OTORISASI <i>Authorazation</i>	Pengembang RPS <i>(Developer lecturer of Semester Learning Plan)</i>		Koordinator RMK <i>(Course Cluster Coordinator)</i>		KaPRODI <i>(Head of Undergraduate Program)</i>	
	I Made Londen Batan		Arif Wahjudi		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
	CPL-PRODI yang dibebankan pada MK					



Capaian Pembelajaran (CP) <i>Learning outcome</i>	CPL -5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL -7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>
	CPL -8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL -10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>
	Capaian Pembelajaran Mata Kuliah (CPMK)	
	CP MK-1	Mahasiswa mampu memahami pergerakan mesin perkakas, pahat, peralatan bantu seperti: pencekam, peletak, pengarah, dan alat bantu lainnya <i>Students are able to understand the movement of machine tools, tools, auxiliary equipment such as: chucks, clamp, guides, and other auxiliary tools</i>
	CP MK-2	Mahasiswa mampu merancang peralatan bantu, baik sebagai pencekam dan peletakan benda kerja, maupun pengarah perkakas <i>Students are able to design auxiliary equipment, both for clamping and object locating, and for guiding tools</i>
	CP MK-3	Mahasiswa mampu memahami proses pembentukan logam lembaran seperti: piercing & blanking, bending dan forming, dan drawing <i>Students are able to understand the process of forming sheet metal such as: piercing & blanking, bending, forming, and drawing</i>



	CP MK-4	Mahasiswa mampu merancang peralatan pembentukan, khususnya punch & die dalam proses pembentukan logam lembaran <i>Students are able to design forming equipment, especially punches & dies in the sheet metal forming process</i>																													
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-5</td><td>CPL-7</td><td>CPL-8</td><td>CPL-10</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-2</td><td>V</td><td>v</td><td>V</td><td>V</td></tr><tr><td>CPMK-3</td><td>v</td><td>V</td><td>V</td><td>v</td></tr><tr><td>CPMK-4</td><td>V</td><td>V</td><td>V</td><td>V</td></tr></table>					CPMK	CPL-5	CPL-7	CPL-8	CPL-10	CPMK-1	V	V	V	V	CPMK-2	V	v	V	V	CPMK-3	v	V	V	v	CPMK-4	V	V	V	V
CPMK	CPL-5	CPL-7	CPL-8	CPL-10																											
CPMK-1	V	V	V	V																											
CPMK-2	V	v	V	V																											
CPMK-3	v	V	V	v																											
CPMK-4	V	V	V	V																											
Deskripsi Singkat MK <i>Short Description of Course</i>	Pada mata kuliah ini akan dipelajari metode peletakan dan pencekaman benda kerja pada proses pemotongan logam, perancangan punch & die untuk proses pembentukan logam lembaran dan peralatan pembentuknya. <i>In this course, you will learn the methods of placing and clamping workpieces in the metal cutting process, designing punches & dies for sheet metal forming processes and forming equipment.</i>																														
Bahan Kajian: Materi Pembelajaran <i>Course materials</i>	Pokok-pokok bahasan dalam mata kuliah ini adalah sebagai berikut: 1. Proses manufaktur: proses pembuatan dengan pemotongan logam dan pembentukan lembar logam 2. Gerakan benda dalam 6 derajat kebebasan : 3 gerakan translasi dan 3 gerakan rotasi, gerakan yang terjadi pada mesin perkakas 3. Prinsip peletakan benda kerja : prinsip 4-2-1 dan prinsip 3-2-1, pencekaman benda kerja; mekanis, hidrolik, dan magnetik 4. Proses pembentukan (pelat tipis (sheet metal): proses piercing dan blanking, bending, forming, dan drawing 5. Perancangan punch & dies: single dies, invers drawing, progressive dies 6. Perancangan punch & dies untuk pembuatan produk																														



	<i>The main topics of this course are as follows:</i> 1. <i>Manufacturing process: manufacturing process by cutting metal and forming metal sheets</i> 2. <i>Movement of objects in 6 degrees of freedom: 3 translational movements and 3 rotational movements, movements that occur in machine tools</i> 3. <i>Principles of workpiece placement: 4-2-1 principle and 3-2-1 principle, workpiece clamping; mechanical, hydraulic, and magnetic</i> 4. <i>Forming process (thin plate (sheet metal): piercing and blanking process, bending, forming, and drawing</i> 5. <i>Punch & dies design: single dies, inverse drawing, progressive dies</i> 6. <i>Punch and dies design for product manufacturing</i>	
Pustaka <i>References</i>	Utama : <i>Main</i>	
	Herman W. Pollack, Tool Design, Prentice Hall, Englewood Cliffs, New Jersey	
	Pendukung : <i>Supplementary</i>	
	1. John G. Nee, Fundamentals of Tool Design, Published by Society of Manufacturing Engineers, 1998, USA 2. Kalpakjian and Schmid, Manufacturing Engineering and Technology, Prentice Hall, 4th Edition	
Dosen Pengampu <i>Lecturer</i>	I Made Londen Batan	
Matakuliah syarat <i>Prerequisites</i>	Menggambar Mesin, Proses Manufaktur <i>Technical Drawing and Manufacturing Process</i>	



Mg Ke- (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assessment)		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materilas)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator Indicators	Kriteria & Bentuk Criteria & Model	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami proses manufaktur, khususnya proses pemotongan logam <i>Students are able to understand the manufacturing process, especially</i>	Mengerti secara detail proses pembuatan produk melalui proses pemotongan <i>Understand in detail the product manufacturing process through the cutting process</i>	Mahasiswa bisa menjawab menguraikan jenis proses pemotongan logam Tanya jawab di kelas <i>Students can answer and describe the types of metal cutting processes</i> <i>Questions and answers in class</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		Introduksi perancangan perkakas - Proses pembuatan/manufaktur - Proses pemotongan logam [1:Polack Bab 1-2] <i>Introduction to tool design</i> - <i>Manufacturing process</i> - <i>Metal cutting process</i>	5



	<i>the metal cutting process.</i>					<i>[1:Polack chapter 1-2]</i>	
2	Mahasiswa mampu merancang urutan proses dan memilih mesin serta perkakas <i>Students are able to design process sequences and select machines and tools.</i>	Perencanaan proses manufaktur, mesin dan perkakas yang dibutuhkan <i>Planning the manufacturing process, machines and tools required</i>	Mahasiswa bisa memilih urutan proses yang efisien dan ekonomis pembuatan benda kerja dengan proses pemotongan logam <i>Students can choose the sequence of efficient and economical processes for making workpieces using metal cutting processes</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Jenis-jenis proses bubut, milling, dan drilling. 1:Polack Bab 1-2] <i>Types of turning, milling, and drilling processes.</i> <i>1:Polack Chapter 1-2]</i>	5
3	Mahasiswa mampu menganalisa 6 derajat kebebasan sebuah gerakan	Ada analisis gerakan dalam 6 (atau kurang dari 6) derajat kebebasan; pada beberapa mesin	Mahasiswa bisa menganalisis gerakan dalam 3-6 derajat kebebasan pada berbagai mesin perkakas <i>Students can analyze</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60"		Macam gerakan dalam 6 derajat kebebasan atau lainnya dari gerakan yang terjadi pada proses bubut, milling, dan drilling.	5



	benda kerja saat diproses manufaktur, khususnya pada proses pemotongan logam <i>Students are able to analyze the 6 degrees of freedom of a workpiece movement during the manufacturing process, especially in the metal cutting process.</i>	perkakas: Bubut, Miling, dan Drilling <i>There is motion analysis in 6 (or less than 6) degrees of freedom; on some machine tools: Lathe, Milling, and Drilling</i>	<i>motion in 3-6 degrees of freedom on various machine tools</i>	Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		1:Polack Bab 2 dan 3] <i>Types of movement in 6 degrees of freedom or others of the movements that occur in the process of turning, milling, and drilling.</i> <i>1: Polack Chapter 2 and 3]</i>	
4	Mahasiswa mampu memahami prinsip peletakan dan	Pemilihan prinsip 3-2-1 dan 4-2-1 Pemilihan metode dan	Mahasiswa bisa menetapkan prinsip peletakan dan sistem pencekaman dalam proses pemotongan logam sebuah benda kerja	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60"		Prinsip peletakan benda kerja. Sistem pencekaman benda kerja selama proses pemotongan pada mesin perkakas	5



	pencekaman benda kerja <i>Students are able to understand the principles of placing and clamping work objects.</i>	komponen utama pencekaman benda kerja <i>Selection of 3-2-1 and 4-2-1 principles</i> <i>Selection of the method and main components of workpiece clamping</i>	<i>Students can determine the principle of placement and clamping system in the metal cutting process of a workpiece</i>	Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		1:Polack Bab 8] <i>Principle of workpiece placement. Workpiece clamping system during cutting process on machine tool</i> <i>1:Polack Chapter 8]</i>	
5	Mahasiswa mampu memilih peralatan bantu pemegang benda kerja berbagai proses pemotongan logam	Merancang komponen utama untuk merancang peralatan bantu proses pemotongan <i>Designing the main components to design auxiliary</i>	Mahasiswa bisa memilih dengan benar komponen utama dari peralatan bantu Pembagian Tugas 1 mahasiswa <i>Students can choose the main components of the</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>		Jig & Fixture pada proses bubut, milling dan drilling [1: Polack Bab 10, 11, dan 12] <i>Jig & Fixture in lathe, milling and drilling process</i>	5



	<i>Students are able to select auxiliary equipment for holding work objects for various metal cutting processes.</i>	<i>equipment for the cutting process</i>	<i>auxiliary equipment correctly</i> <i>Project Assignment</i>	<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		<i>[1: Polack Chapter 10, 11, and 12]</i>	
6	Mahasiswa mampu merancang peletakan benda kerja dan peralatan pemegang benda kerja berbagai proses pemotongan logam <i>Mahasiswa mampu merancang peletakan benda kerja</i>	Merancang peralatan bantu proses pemotongan <i>Designing equipment to assist the cutting process</i>	Mahasiswa bisa melakukan perancangan awal peralatan bantu Diskusi tugas 1mahasiswa <i>Students can do initial design of assistive devices</i> <i>Project Discussion</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		Macam-macam komponen utama peralatan bantu (jig & fixture) Perancangan jig & fixture [1: Polack Bab 10, 11, dan 12] <i>Types of main components of auxiliary equipment (jigs & fixtures)</i> <i>Jig & fixture design</i>	5



	<i>dan peralatan pemegang benda kerja berbagai proses pemotongan logam</i>					<i>[1: Polack Chapters 10, 11, and 12]</i>	
7	Mahasiswa mampu merancang secara detail peralatan bantu proses pemotongan <i>Students are able to design in detail the equipment needed to assist the cutting process.</i>	Rancangan jig & fixture secara utuh, terdiri dari gambar teknik peralatan dan cara kerjanya <i>Complete jig & fixture design, consisting of technical drawings of the equipment and how it works</i>	Mahasiswa bisa menunjukkan perancangan peralatan bantu yang efektif dan sederhana dalam presentasi <i>Students can demonstrate the design of effective and simple assistive devices in presentations</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Tugas Rancangan Mahasiswa Presentasi tugas mahasiswa <i>Student Design Assignment</i> <i>Student assignment presentation</i>	10
8	Evaluasi Tengah Semester / Ujian Tengah Semester <i>Middle Semester Examination</i>						10



9	Mahasiswa mampu memilih proses pembentukan untuk merancang benda kerja logam lembaran <i>Students are able to choose the forming process to design sheet metal workpieces.</i>	Mengetahui berbagai jenis proses pembentukan logam lembaran <i>Understanding the various types of sheet metal forming processes</i>	Tanya jawab di kelas Pembagian Tugas 2 <i>Assignment Project 2</i>	Perkuliah Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Proses pembentukan logam lembaran [1: Polack Bab 15] <i>Sheet metal forming processes</i> <i>[1: Polack Chapter 15]</i>	5
10	Mahasiswa mampu menganalisa gaya-gaya pembentukan dan tegangan-tegangan yang terjadi	Perhitungan gaya-gaya pembentukan proses piercing and blanking <i>Calculation of forming forces</i>	Mahasiswa bisa menunjukkan hasil perhitungan gaya-gaya pembentukan Diskusi di kelas <i>Students can show the results of</i>	Perkuliah Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60"		- Gaya pembentukan pada proses piercing & blanking - Tegangan yang terjadi pada benda kerja dan die [1: Polack Bab 15]	5



	akibat dari proses pembentukan piercing dan blanking <i>Students are able to analyze the forming forces and stresses that occur as a result of the piercing and blanking forming processes.</i>	<i>in the piercing and blanking process</i>	<i>calculating the formation forces</i> <i>Discussion Q&A – non-test</i>	<i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>- Forming forces in the piercing and blanking process</i> <i>- Stresses occurring in the workpiece and die</i> <i>[1:Polack Chapter 15]</i>	
11	Mahasiswa mampu menganalisa gaya-gaya pembentukan dan tegangan-tegangan yang terjadi akibat dari	Perhitungan gaya-gaya pembentukan proses bending dan forming <i>Calculation of the forming forces of the</i>	Mahasiswa mengaplikasikannya toleransi umum pada komponen Tanya jawab <i>Students apply</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60"		- Gaya pembentukan pada proses bending, forming - Material yang dapat dibentuk tanpa pembuangan geram [1: Polack Bab 16]	5



	proses pembentukan bending dan forming <i>Students are able to analyze the forming forces and stresses that occur as a result of the bending and forming processes.</i>	<i>bending and forming process</i>	<i>general tolerance to components</i> Q&A	<i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>- Forming force in bending, forming process</i> <i>- Materials that can be formed without chip removal</i> <i>[1: Polack Chapter 16]</i>	
12	Mahasiswa mengetahui dan mampu memilih jenis-jenis die untuk proses pembentukan berbagai bentuk benda kerja dengan	Mampu merencanakan proses pembentukan <i>Able to plan the formation process</i>	Mahasiswa menyusun tugas 2, perencanaan proses pembentukan <i>Students compile task 2, planning the formation process</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>		Puch & die untuk berbagai proses pembentukan logam lembaran [1: Polack Bab 15, 16, dan 17] <i>Puch & die untuk berbagai proses</i>	5



	bending, forming dan drawing Students know and are able to choose the types of dies for the process of forming various forms of work objects by bending, forming and drawing.			<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		<i>pembentukan logam lembaran</i> <i>[1: Polack Bab 15, 16, dan 17]</i>	
13	Mahasiswa mampu merancang punch & die untuk proses pembentukan <i>Students are able to</i>	Terdapat analisis tegangan dan kekuatan komponen punch & die <i>There is a stress and strength</i>	Mahasiswa merancang punch & die serta aksesoriesnya <i>Students design punch & die and their accessories</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60"		Urutan proses pembentukan Perhitungan gaya- gaya pembentukan Kebutuhan material logam lembaran	5



	<i>design punches & dies for the forming process</i>	<i>analysis of punch & die components.</i>		<i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		<i>Sequence of forming process</i> <i>Calculation of forming forces</i> <i>Sheet metal material requirements</i>	
14	Mahasiswa mampu menuangkan rancangan punch & die dalam gambar teknik <i>Students are able to translate punch & die designs into technical drawings.</i>	Dokumen perancangan punch & die dalam gambar teknik <i>Punch & die design documents in technical drawing</i>	Mahasiswa menggunakan rancangan dalam bentuk gambar teknik Diskusi Tugas <i>Students use designs in the form of technical drawings</i> <i>Project Discussion</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60</i>		Spesifikasi geometri produk, dimensi, toleransi linier dan geometrik suatu produk <i>Product geometry specifications, dimensions, linear and geometric tolerances of a product</i>	5



15	Mahasiswa mampu menunjukkann hasil perancangan proses pembentukann logam untuk berbagai bentuk benda kerja <i>Students are able to demonstrate the results of designing metal forming processes for various forms of work objects.</i>	Dokumen urutan proses pembentukan, jenis punch & die untuk pembuatan benda kerja logam lembaran <i>Document the sequence of forming processes, types of punches and dies for the manufacture of sheet metal workpieces</i>	Mahasiswa melakukan presentasi Tugas 2 <i>Presentation Project 2</i>	Perkuliahann Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Tugas 2 masing-masing mahasiswa <i>Assignment 2 for each student</i>	10
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Exam</i>						10



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen <i>(Document Code)</i>
	RENCANA PEMBELAJARAN SEMESTER					
	<i>(Semester Learning Plan)</i>					
MATA KULIAH (MK) <i>Subject</i>	KODE <i>(Code)</i>	Rumpun MK <i>(Course cluster)</i>	BOBOT (sks) <i>(Credit)</i>		SEMESTER <i>(Semester)</i>	Tgl Penyusunan <i>Preperation Date</i>
Toleransi Geometrik <i>Geometrical Tolerances</i>	TM234616	Perancangan dan Pengembangan Produk <i>(Design and Product Development)</i>	T=3	P=0	6	20 November 2023
OTORISASI <i>Authorazation</i>	Pengembang RPS <i>(Developer lecturer of Semester Learning Plan)</i>		Koordinator RMK <i>(Course Cluster Coordinator)</i>		KaPRODI <i>(Head of Undergraduate Program)</i>	
	I Made Londen Batan		Arif Wahjudi		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
	CPL-PRODI yang dibebankan pada MK <i>(PLO Program Charged to The Course)</i>					



Capaian Pembelajaran (CP) <i>Learning outcome</i>	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfil the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>	
	CPM K-1	Mahasiswa mampu memahami spesifikasi geometri sebuah komponen <i>Students are able to understand the geometric specifications of a component</i>
	CPM K-2	Mahasiswa mampu memahami toleransi linier dan aplikasinya pada produk manufaktur, serta mampu mengukur penyimpangannya <i>Students are able to understand linear tolerances and their application to manufactured products, and are able to measure deviations</i>
	CPM K-3	Mahasiswa mampu memahami toleransi bentuk dan aplikasinya pada produk manufaktur, serta mampu mengukur penyimpangannya <i>Students are able to understand shape tolerances and their application to manufactured products, and are able to measure deviations</i>
	CPM K-4	Mahasiswa mampu memahami toleransi Orientasi, Lokasi, dan Siimpang Putar serta aplikasinya pada produk manufaktur, serta mampu mengukur penyimpangannya



		<i>Students are able to understand Orientation, Location and Deviation tolerances and their application to manufactured products, and are able to measure deviations</i>																													
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-5</td><td>CPL-7</td><td>CPL-8</td><td>CPL-10</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-2</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-4</td><td>V</td><td>V</td><td>V</td><td>V</td></tr></table>					CPMK	CPL-5	CPL-7	CPL-8	CPL-10	CPMK-1	V	V	V	V	CPMK-2	V	V	V	V	CPMK-3	V	V	V	V	CPMK-4	V	V	V	V
CPMK	CPL-5	CPL-7	CPL-8	CPL-10																											
CPMK-1	V	V	V	V																											
CPMK-2	V	V	V	V																											
CPMK-3	V	V	V	V																											
CPMK-4	V	V	V	V																											
Deskripsi Singkat MK <i>Short Description of Course</i>	Pada mata kuliah ini akan dipelajari spesifikasi geometri sebuah komponen, yang meliputi toleransi linier, toleransi bentuk, toleransi orientasi, toleransi lokasi dan toleransi simpang putar, dan metode pemilihan serta implementasinya pada produk manufaktur <i>In this course, you will learn the geometric specifications of a component, which include linear tolerance, shape tolerance, orientation tolerance, location tolerance and rotational deviation tolerance, and the selection methods and their implementation in manufactured products.</i>																														
Bahan Kajian: Materi Pembelajaran <i>Course materials</i>	Pokok-pokok bahasan dalam mata kuliah ini adalah sebagai berikut: 1. Permasalahan pada perancangan komponen 2. Toleransi linier dan geometrik serta aplikasinya, 3. Kekasaran permukaan dan hubungannya dengan toleransi 4. Metode pemilihan dan implementasi toleransi pada produk manufaktur 5. Pengukuran dan pemeriksaan penyimpangan linier dan geometrik 6. Contoh implementasi toleransi geometrik dan kekasaran permukaan pada produk manufaktur <i>The main topics of discussion in this course are as follows:</i>																														



	1. <i>Problems in component design</i> 2. <i>Linear and geometric tolerances and their applications,</i> 3. <i>Surface roughness and its relationship to tolerance</i> 4. <i>Methods for selecting and implementing tolerances in manufactured products</i> 5. <i>Measurement and inspection of linear and geometric deviations</i> 6. <i>Examples of implementation of geometric tolerances and surface roughness in manufactured products</i>						
Pustaka <i>References</i>	Utama : <i>Main:</i>						
	Batan, I Made Londen, Toleransi Geometrik – Teori dan Aplikasinya Pada Produk Manufaktur, ITS Tekno Sains, 2022						
	Pendukung : <i>Supplementary:</i>						
	Henzold, G., Handbook of Geometrical Tolerancing – Design, Manufacturing and Inspection, John Wiley & Sons Ltd.						
Dosen Pengampu <i>Lecturer</i>	I Made Londen Batan						
Matakulia h syarat <i>Prerequisit</i> <i>es</i>	Menggambar Mesin, Instrumentasi Pengukuran dan Metrologi <i>Technical Drawing, Measuring Instrumentation and Metrology</i>						
Mg Ke- <i>(Wee</i> <i>k)</i>	Kemampua n akhir tiap tahapan belajar (Sub- CPMK)	Penilaian <i>(Assessment)</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>(Learning Model; Learning Method; Student</i> <i>Assignment)</i>		Materi Pembelajaran <i>(Learning</i> <i>Materilas)</i>	Bobot Penilaian (%) <i>(Assesment Credit</i> <i>(%))</i>
		Indikator <i>Indicators</i>	Kriteria & Bentuk	Luring <i>(offline)</i>	Daring <i>(online)</i>		



	<i>(Final Ability of Each Learning Stage (LLO))</i>		<i>Criteria & Model</i>				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menganalisa fungsi komponen, bagian benda kerja dan produk <i>Students are able to analyze the function of components, parts of work objects and products.</i>	Mengerti fungsi toleransi linier dan geometrik serta kekasaran permukaan sebuah komponen <i>Understand the function of linear and geometric tolerances and the surface roughness of a component.</i>	Mahasiswa bisa menjawab fungsi toleransi Tanya jawab di kelas <i>Students can answer the function of tolerance</i> <i>Q&A in class</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"0</i>		Introduksi perancangan komponen, permasalahan spesifikasi geometri pada tahapan proses desain <i>Introduction to component design, geometry specification issues at the design process stage</i>	5
2	Mahasiswa mampu menganalisa kebutuhan toleransi	Mampu dan terampil menyelesaikan permasalahan kebutuhan	Mahasiswa bisa merencanakan komponen yang berpasangan serta merencanakan toleransi linier	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60"		Pengertian poros dan lubang, standarisasi dan jenis toleransi linier, prinsip toleransi dan suaian	5



	untuk komponen <i>Students are able to analyze tolerance requirements for components.</i>	akan toleransi linier <i>Able and skilled to solve problems of need for linear tolerance</i>	<i>Students can plan paired components and plan linear tolerances.</i>	Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>Understanding shafts and holes, standardization and types of linear tolerances, principles of tolerance and fit</i>	
3	Mahasiswa mampu memilih toleransi linier sesuai dengan kebutuhan berdasarkan aspek fungsi, manufaktur dan pengukuran <i>Students are able to select linear tolerances</i>	Mampu memilih jenis sistem suaian, jenis toleransi linier <i>Able to choose custom system type, linear tolerance type</i>	Mahasiswa bisa merancang komponen yang berpasangan dan memilih jenis suaian dan toleransi linier yang dibutuhkan Latihan merancang komponen <i>Students can design mating components and select the type of fit and linear tolerance required</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Sistem dan jenis suaian, perhitungan besarnya toleransi linier dan penetapan pasangan toleransi pada komponen <i>Systems and types of adjustments, calculation of linear tolerance values and determination of tolerance pairs on components</i>	5



	<i>according to needs based on functional, manufacturing and measurement aspects.</i>		<i>Component design exercises</i>				
4	Mahasiswa mampu memahami kebutuhan toleransi geometrik <i>Students are able to understand the need for geometric tolerances</i>	Mengetahui berbagai macam bentuk elemen (feature) sebuah komponen dan jenis-jenis toleransi geometrik <i>Understanding the various forms of elements (features) of a component and the types of geometric tolerances</i>	Mahasiswa bisa memilih elemen fungsi pada komponen Tanya jawab di kelas <i>Students can select functional elements in components</i> <i>Q&A in class</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Jenis elemen bentuk pada komponen, hubungan elemen bentuk dan elemen fungsi pada komponen yang berpasangan <i>Types of form elements in components, relationships between form elements and function elements in paired components</i>	5



5	Mahasiswa mampu memahami toleransi bentuk <i>Students are able to understand the form tolerance</i>	Mengetahui jenis-jenis toleransi bentuk dan aplikasinya pada elemen bentuk <i>Understanding the types of shape tolerances and their applications to shape elements</i>	Mahasiswa bisa merancang toleransi bentuk pada komponen Tugas dalam kelas dan diskusi <i>Students can design form tolerances on components</i> <i>In-class assignments and discussions</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Macam-macam toleransi bentuk dan aplikasi serta aturan ringan dalam impelmentasinya pada komponen <i>Various types of form and application tolerances and light rules in their implementation on components</i>	5
6	Mahasiswa mampu memahami toleransi orientasi, lokasi dan simpang putar <i>Students are able to understand</i>	Mengetahui jenis toleransi orientasi, lokasi, dan simpang putar sesuai dengan ISO <i>Know the types of orientation,</i>	Mahasiswa bisa merencanakan pemberian toleransi geometrik secara lengkap <i>Students can plan the provision of complete geometric tolerances</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>		Jenis toleransi orientasi, lokasi dan simpang putar dan pengertian penyimpangannya <i>Types of orientation, location and rotation tolerances and the meaning of their deviations</i>	5



	<i>tolerance of orientation, location and run out</i>	<i>location and rotation tolerances according to ISO</i>		<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>			
7	Mahasiswa mampu memahami aplikasi toleransi orientasi, lokasi dan simpang putar pada komponen <i>Students are able to understand the application of orientation, location and run out tolerances</i>	Mengetahui aplikasi toleransi orientasi, lokasi dan simpang putar sebuah komponen <i>Understanding the application of orientation tolerance, location and rotational deviation of a component</i>	Mahasiswa bisa merencanakan toleransi orientasi, lokasi dan simpang putar sebuah komponen Tugas 1 mahasiswa <i>Students can plan the tolerance of orientation, location and rotation of a component</i> <i>Students project 1</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Jenis toleransi orientasi, lokasi dan simpang putar serta aplikasinya pada komponen <i>Types of orientation, location and rotation tolerances and their application to components</i>	5



	<i>on components.</i>						
8	Evaluasi Tengah Semester / Ujian Tengah Semester <i>Midterm Semester</i>						15
9	Mahasiswa mampu memahami penyimpangan geometri komponen <i>Students are able to understand geometric deviations of components</i>	Mengetahui metode pengukuran penyimpangan geometrik <i>Understanding the method of measuring geometric deviations</i>	Mahasiswa bisa merencanakan pengukuran penyimpangan geometrik sebuah komponen Latihan soal dan diskusi di kelas <i>Students can plan the measurement of geometric deviation of a component</i> <i>Practice questions and discussions in class</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Alat ukur dan metode pengukuran penyimpangan geometrik sebuah komponen <i>Measuring instruments and methods for measuring geometric deviations of a component</i>	5
10	Mahasiswa mampu memahami kekasaran permukaan dan	Mengetahui bentuk permukaan secara mikro dan jenis kekasarannya	Mahasiswa bisa memberikan jenis dan nilai kekasaran permukaan sebuah komponen	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60"		Kekasaran permukaan dan cara pengukurannya <i>Surface roughness</i>	5



	hubungannya dengan toleransi linier dan geometrik <i>Students are able to understand surface roughness and its relationship to linear and geometric tolerances.</i>	serta pengukurannya <i>Understanding the micro surface shape and the type of roughness and measuring it</i>	Tugas 2 mahasiswa <i>Students can provide the type and value of surface roughness of a component</i> <i>Students Project 2 Assignment</i>	Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>and how to measure it</i>	
11	Mahasiswa memahami toleransi umum sesuai dengan standar ISO <i>Students understand general tolerances according to</i>	Mengetahui toleransi umum sesuai standar ISO <i>Understanding the general tolerances according to ISO standards</i>	Mahasiswa bisa mengaplikasikannya toleransi umum pada komponen <i>Students can apply general tolerances to components.</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i>		Jenis toleransi umum, pengertian dan aplikasinya pada komponen manufaktur <i>Common tolerance types, their meaning and application in manufacturing components</i>	5



	<i>ISO standards</i>			<i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>			
12	Mahasiswa mampu menunjukkan kesalahan gambar teknik, khususnya aplikasi toleransi linier dan geometrik <i>Students are able to show engineering drawing errors, especially the application of linear and</i>	Mampu membaca gambar teknik dan mengevaluasi ya <i>Able to read technical drawings and evaluate them</i>	Mahasiswa bisa menyampaikan perbedaan sebuah gambar teknik yang lengkap dan tidak lengkap <i>Students can convey the difference between a complete and incomplete engineering drawing</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Aturan penerapan spesifikasi geometri dan metode aplikasinya pada produk manufaktur <i>Rules for applying geometric specifications and their application methods to manufactured products</i>	10



	<i>geometric tolerances.</i>						
13	Mahasiswa mampu merancang sebuah komponen yang berpasangan secara lengkap <i>Students are able to design a component that is completely paired.</i>	Mampu menggambar komponen dan produk manufaktur dengan spesifikasi yang lengkap <i>Able to draw components and manufactured products with complete specifications</i>	Mahasiswa merancang komponen dalam bentuk gambar teknik dilengkapi dengan spesifikasi geometri <i>Students design components in the form of technical drawings complete with geometric specifications.</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		Metode pemeriksaan gambar teknik dari aspek fungsi, manufaktur dan perakitan <i>Methods of checking engineering drawings from the functional, manufacturing and assembly aspects</i>	5
14	Mahasiswa mampu memilih proses manufaktur yang sesuai dengan spesifikasi	Mampu merencanakan proses manufaktur secara umum <i>Able to plan general</i>	Tugas 3 mahasiswa dalam bentuk gambar Teknik dilengkapi dgn rencana proses manufakturnya <i>Student assignment</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60"		Jenis proses manufaktur dalam pembuatan produk/komponen <i>Types of manufacturing</i>	5



	geometri komponen <i>Students are able to select manufacturing processes that are appropriate to the component geometry specifications.</i>	<i>manufacturing processes</i>	<i>3 in the form of engineering drawings complete with manufacturing process plans</i>	Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i> <i>Independent Learning: 3x60"</i>		<i>processes in making products/components</i>	
15	Mahasiswa mampu memilih proses pengukuran komponen yang sesuai dengan spesifikasi geometrinya <i>Students are able to choose the</i>	Mampu merencanakan pengukuran komponen dan penyimpangan geometrinya <i>Able to plan component measurements and their</i>	Tanya jawab dan diskusi di kelas Mahasiswa menyampaikan rencana metode dan proses pengukuran komponen <i>Q&A and discussion in class</i> <i>Students convey the planned method</i>	Perkuliahan Luring: 3x50" Penugasan Terstruktur: 3x60" Belajar Mandiri: 3x60" <i>Offline Lectures: 3x50"</i> <i>Structured Assignments: 3x60"</i>		Metode pengukuran penyimpangan komponen dan geometrinya <i>Method of measuring component deviations and their geometry</i>	5



	<i>component measurement process that is appropriate to its geometric specifications.</i>	<i>geometric deviations</i>	<i>and process of measuring components</i>	<i>Independent Learning: 3x60"</i>			
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Exam</i>						10



		INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)							
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)	
Rekayasa Kualitas (Quality Engineering)	TM234727	Rekayasa Produksi	T= 3	P= 0	1	26 Nopember 2023	
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)		
	M. Khoirul Effendi, Ph.D & Arif Wahjudi, Ph.D	Arif Wahjudi			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.		
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)		Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global.				
	CPL-5						



		(Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources)																							
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. (Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)																							
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. (Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)																							
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)																								
	CPMK-1	Mahasiswa mampu memahami proses perancangan dan pengembangan produk																							
	CPMK-2	Mahasiswa mampu menganalisa aspek teknik produk seperti fungsi, kekuatan, keamanan, keergonomisan, mampu manufaktur dan perakitan																							
	CPMK-3	Mahasiswa mampu mengembangkan produk dari aspek desain, ergonomis, manufaktur dan perakitan																							
	CPMK-4	Mahasiswa mampu pengembangan produk berdasarkan kebutuhan konsumen																							
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-5</td><td>CPL-6</td><td>CPL-7</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-2</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-4</td><td>V</td><td>V</td><td></td></tr></table>				CPMK	CPL-5	CPL-6	CPL-7	CPMK-1	V	V	V	CPMK-2	V	V	V	CPMK-3	V	V		CPMK-4	V	V	
CPMK	CPL-5	CPL-6	CPL-7																						
CPMK-1	V	V	V																						
CPMK-2	V	V	V																						
CPMK-3	V	V																							
CPMK-4	V	V																							



Deskripsi Singkat MK <i>(Short Description of Course)</i>	Mata kuliah ini memberikan dasar-dasar optimasi menggunakan metode Taguchi dan metaheuristic untuk melakukan optimasi yang berkaitan dengan keilmuan yang diajarkan di teknik mesin ITS misal untuk optimasi desain, optimasi proses manufaktur, optimasi parameter PID dalam proses control dll. <i>This course provides the basics of optimization using Taguchi and metaheuristic methods to perform optimization related to the science taught in ITS mechanical engineering, such as design optimization, manufacturing process optimization, PID parameter optimization in process control, etc.</i>						
Bahan Kajian: Materi Pembelajaran <i>(Course Materials)</i>	Dasar-dasar penggunaan software Matlab, Neural network, metode optimasi metaheuristic (<i>genetic algoritma</i> dan <i>particle swarm optimization</i>) dan penggunaan graphical user interface untuk komparasi hasil optimasi <i>We also discuss the basics of using Matlab software, Neural networks, metaheuristic optimization methods (genetic algorithms and particle swarm optimization), and graphical user interfaces for comparing optimization results.</i>						
Pustaka <i>(References)</i>	<table border="1"> <tr> <td data-bbox="347 753 584 817"> Utama : <i>(Main)</i> </td><td data-bbox="584 753 2080 817"></td></tr> <tr> <td data-bbox="347 817 584 1182"> Pendukung : <i>(Supplementary)</i> </td><td data-bbox="584 817 2080 1182"> Martin T. Hagan, dkk., “Neural network Design 2nd Edition”, Hagan and Demuth, 2014. Mark Hudson Beale, dkk., “Neural Network Toolbox User’s Guide R2017a” The Matworks, Inc., 2017. S.R. Otto and J.P Denier, ”An introduction to Programming and Numerical Methods in MATLAB”, Springer, 2005. Andrew Chipperfield, dkk., “Genetic Algorithm Toolbox for Use with MATLAB” Mark A. Abramson, “Genetic Algoritm and Direct Search Toolbox”, The Mathwork, 2004. Xin-She Yang, “Nature-Inspired Optimization Algorithm”, Elsevier, 2014. Ross, P. J., “Taguchi Techniques for Qiality Engineering” </td></tr> <tr> <td data-bbox="347 1182 584 1259"></td><td data-bbox="584 1182 2080 1259"> Chehourri, A. Dkk, ”A Constraint-Handling Technique for Genetic Algorithms using a Violation Factor” Journal of computer science, 2016, 12 (7) </td></tr> </table>	Utama : <i>(Main)</i>		Pendukung : <i>(Supplementary)</i>	Martin T. Hagan, dkk., “Neural network Design 2nd Edition”, Hagan and Demuth, 2014. Mark Hudson Beale, dkk., “Neural Network Toolbox User’s Guide R2017a” The Matworks, Inc., 2017. S.R. Otto and J.P Denier, ”An introduction to Programming and Numerical Methods in MATLAB”, Springer, 2005. Andrew Chipperfield, dkk., “Genetic Algorithm Toolbox for Use with MATLAB” Mark A. Abramson, “Genetic Algoritm and Direct Search Toolbox”, The Mathwork, 2004. Xin-She Yang, “Nature-Inspired Optimization Algorithm”, Elsevier, 2014. Ross, P. J., “Taguchi Techniques for Qiality Engineering”		Chehourri, A. Dkk, ”A Constraint-Handling Technique for Genetic Algorithms using a Violation Factor” Journal of computer science, 2016, 12 (7)
Utama : <i>(Main)</i>							
Pendukung : <i>(Supplementary)</i>	Martin T. Hagan, dkk., “Neural network Design 2nd Edition”, Hagan and Demuth, 2014. Mark Hudson Beale, dkk., “Neural Network Toolbox User’s Guide R2017a” The Matworks, Inc., 2017. S.R. Otto and J.P Denier, ”An introduction to Programming and Numerical Methods in MATLAB”, Springer, 2005. Andrew Chipperfield, dkk., “Genetic Algorithm Toolbox for Use with MATLAB” Mark A. Abramson, “Genetic Algoritm and Direct Search Toolbox”, The Mathwork, 2004. Xin-She Yang, “Nature-Inspired Optimization Algorithm”, Elsevier, 2014. Ross, P. J., “Taguchi Techniques for Qiality Engineering”						
	Chehourri, A. Dkk, ”A Constraint-Handling Technique for Genetic Algorithms using a Violation Factor” Journal of computer science, 2016, 12 (7)						
Dosen Pengampu <i>(Lecturers)</i>	M. Khoirul Effendi, Ph.D & Arif Wahjudi, Ph.D						



Matakuliah syarat (Prerequisites)		Tidak ada mata kuliah prasyarat					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Review anova, orthogonal array dan Taguchi dalam sebuah proses optimasi <i>Review of ANOVA, orthogonal array, and Taguchi in an optimization process</i>	Bisa menjelaskan prinsip-prinsip dasar anova, orthogonal, dan taguchi dalam sebuah proses optimasi	Tugas mencari dan mempresentasikan implementasi anova, orthogonal array dan Taguchi dalam sebuah proses optimasi	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		[7: Ross, P. J., – BAB I]	1%
2	Parameters design dalam sebuah proses optimasi	Bisa menjelaskan parameter design dalam	Tugas mencari dan mempresentasikan parameter design dalam sebuah proses optimasi	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		[7: Ross, P. J., – BAB I]	1%



	<i>Parameters design in an optimization process</i>	sebuah proses optimasi					
3	Experimental konfirmasi hasil optimasi <i>Experimental confirmation of optimization results</i>	Bisa menjelaskan dasar-dasar eksperimental konfirmasi hasil optimasi	Tugas mencari dan mempresentasikan contoh experimental konfirmasi dalam sebuah proses optimasi	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		[7: Ross, P. J., – BAB]	1%
4	Papers review <i>Papers review</i>	Bisa menjelaskan implementasi anova, orthogonal array dan taguchi pada sebuah paper.	Tugas mencari dan mempresentasikan implementasi anova, orthogonal array dan taguchi pada sebuah paper pada sebuah paper dengan topik optimasi	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		[7: Ross, P. J., – BAB]	1%
5	Project						25%
6	Mahasiswa mampu memahami implementasi AI dan optimasi dalam	Bisa menjelaskan contoh-contoh implementasi AI+Optimasi di	Tugas mencari dan mempresentasikan implementasi AI+Optimasi di	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Kontrak kuliah Kuliah Pengantar & Brainstorming - Intro AI dan optimasi metaheuristik	6



	bidang teknik mesin <i>Students are able to understand the implementation of AI and optimization in the field of mechanical engineering.</i>	bidang Teknik mesin Mechanical Engineering	bidang Teknik mesin			- Implementasi AI dan optimasi metaheuristic dalam bidang Teknik mesin [1: Martin T. Hagan – BAB 1]	
7	Mahasiswa mampu memahami dasar-dasar mengoperasikan Matlab <i>Students are able to understand the basics of operating Matlab</i>	Mahasiswa mampu mengoperasikan tool-tool pada Matlab termasuk Graphical User interface (GUI) untuk menyelesaikan kasus optimasi sederhana	Tugas mempresentasikan penggunaan fitur matlab serta Graphical User interface (GUI) untuk menyelesaikan kasus sederhana	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Retooling dasar-dasar Matlab - Graphical User interface with Matlab [2: S.R. Otto and J.P Denier – BAB 2&3]	7
8	Mahasiswa mampu memahami prinsip dasar	Mahasiswa mengerti dan bisa mengimpleme	Tugas: mempresentasikan penggunaan coding single perceptron	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Single perceptron dan implementasinya untuk kasus clustering	8



	single perceptron dan multi layer perceptron serta implementasinya untuk kasus clustering <i>Students are able to understand the basic principles of single perceptron and multi-layer perceptron and their implementation for clustering cases.</i>	ntasikan single perceptron dan multi layer perceptron untuk kasus clustering 2 buah data sederhana	dan multi layer perceptron untuk kasus clustering dan menjawab beberapa pertanyaan berikut: a) Berapa epoch sampai berhenti b) Pengaruh fungsi aktivasi terhadap konvergensi. Perubahan nilai weight dan bias untuk 3x epoch pertama			[1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 1]	
9	Mahasiswa mampu mendefinisikan data input-output dalam sebuah NN, serta memilih topology, fungsi aktivasi sehingga didapatkan NN dengan Mean	Mahasiswa mampu mendefinisikan a. input-output b. jumlah hidden layer dan node c. fungsi aktivasi dan learning algorithm	Tugas : Mempresentasikan penggunaan NN Matlab toolbox untuk memngenerate fungsi $Y = f(\sin x)$	Perkuliahahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Diskusi dan implementasi NN matlab toolbox untuk kasus yang akan dipresentasikan dalam project 1 [1: Martin T. Hagan – BAB 4] - [2: Mark Hudson Beale – BAB 3]	9



	Squared Error (MSE) yang terkecil <i>Students can define input-output data in a Neural Network, choose its topology, and activate functions to obtain a Neural Network with the smallest Mean Squared Error (MSE).</i>	sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil	Dengan variasi jumlah hidden layer, jumlah node, fungsi aktivasi dan learning algorithm				
10	QUIZ 1						10
11	Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Genetic Algoritma (GA) <i>Students can define optimization objectives and</i>	Mahasiswa mampu memahami Langkah-langkah optimasi menggunakan GA - mengenerate populasi - menentukan nilai fitness - filtering (roulette)	Tugas: mempresentasikan bagaimana: - mengenerate populasi - menentukan nilai fitness - filtering (roulette wheel dan tournament) - proses seleksi crossover dan mutasi	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Overview GA Proses seleksi, cross-over dan mutase pada GA [4: Andrew Chipperfield – 1-1 s/d 1-18]	11



	<i>understand the steps for finding optimization values using Genetic Algorithms (GA).</i>	wheel dan tournament) d. proses seleksi crossover dan mutasi	pada coding yang telah diberikan				
12	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB mulai dari kasus yang sederhana sampai kasus multiobjective optimization <i>Students can operate the Genetic Algorithm toolbox in MATLAB, starting from simple cases to multiobjective optimization cases.</i>	Simulasi penggunaan toolbox Genetic Algorithm untuk beberapa kasus 1. Single input single output (SISO) 2. Single input multi output (SIMO) 3. Multi input single output (MISO) Multi input multi output (MIMO)	Tugas: mempresentasikan bagaimana mencari nilai optimum pada fungsi $Y = f(\sin x)$ Pada constraint sudut tertentu $0 < x < 90$	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Membuat fitness function Menentukan setting parameter Menampilkan dan membaca hasil optimasi [5: Mark A. Abramson – Bab 4]	12



13	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB untuk tuning parameter serta pemecahan kasus yang memerlukan constraint handling <i>Students are able to operate the Genetic Algorithm toolbox in MATLAB to tune parameters and solve cases that require constraint handling.</i>	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB dengan constraint handling: penalty tipe static, dynamic dan adaptive	Tugas: mempresentasikan bagaimana mencari nilai optimum menggunakan GA pada fungsi $Y = f(a, b, c, d)$ Dengan constrain yang berbeda	Perkuliahahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Membuat fitness function Menentukan setting parameter Menentukan constraint handling Menampilkan dan membaca hasil optimasi [7. Chehouri, A. Dkk]	13
14	Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Particle Swarm	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi dengan Particle Swarm	Tugas: mempresentasikan setiap baris coding PSO serta bisa menjelaskan fungsi dari coding tersebut pada PSO	Perkuliahahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Overview PSO Proses penentuan posisi, kecepatan, Pbest dan GBest pada PSO [6: Xin She Yang – Bab 7]	14



	Optimization (PSO) <i>Students can define optimization objectives and understand the steps for finding optimization values with Particle Swarm Optimization (PSO)</i>	Optimization (inialize, evaluasi fitness, update local and global best, update velocity and position)					
15	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan tiap langkah pada metode PSO menggunakan MATLAB <i>Students can explain clearly and sequentially examples of calculations for each step in the PSO method using MATLAB.</i>	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi serta menerapkan constraint handling pada PSO	Tugas: mempresentasikan bagaimana mencari nilai optimum menggunakan PSO pada fungsi $Y = f(a, b, c, d)$ Dengan constrain yang berbeda	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Proses perhitungan posisi, kecepatan, Pbest dan GBest pada PSO menggunakan MATLAB [6: Xin She Yang – Bab 7]	15



16	Final Project	25



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
Desain Produk (Product Design)	TM234744	Perancangan dan Pengembangan Produk	T= 3	P= 0	VII	26 Nopember 2023
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)	
	M. Khoirul Effendi, Ph.D	M. Khoirul Effendi, Ph.D			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. (Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)				
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. (Ability to identify, formulate, analyze, and solve technical problems)				
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi				



		(Ability to effectively communicate both oral and written and apply technology-based entrepreneurship)																	
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data (Ability to plan, solve and evaluate the task based on the analysis of data and information)																	
	CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika (Ability to be responsible to society and obey professional ethics in solving the problem of mechanical systems)																	
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)																		
	CPMK-1	Mahasiswa mampu memahami proses perancangan dan pengembangan produk																	
	CPMK-2	Mahasiswa mampu menganalisa aspek teknik produk seperti fungsi, kekuatan, keamanan, keergonomisan, mampu manufaktur dan perakitan																	
	CPMK-3	Mahasiswa mampu mengembangkan produk dari aspek desain, ergonomis, manufaktur dan perakitan																	
	CPMK-4	Mahasiswa mampu pengembangan produk berdasarkan kebutuhan konsumen																	
			Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-7</td><td>CPL-8</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td></tr><tr><td>CPMK-2</td><td>V</td><td></td></tr><tr><td>CPMK-3</td><td>V</td><td></td></tr><tr><td>CPMK-4</td><td>V</td><td></td></tr></table>			CPMK	CPL-7	CPL-8	CPMK-1	V	V	CPMK-2	V		CPMK-3	V		CPMK-4	V
CPMK	CPL-7	CPL-8																	
CPMK-1	V	V																	
CPMK-2	V																		
CPMK-3	V																		
CPMK-4	V																		
Deskripsi Singkat MK	Mata kuliah ini memberikan dasar-dasar tool optimasi metaheuristic untuk melakukan optimasi yang berkaitan dengan keilmuan yang diajarkan di teknik mesin ITS misal untuk optimasi desain, optimasi proses manufaktur, optimasi parameter PID dalam proses control dll.																		



(Short Description of Course)	<i>This course provides the basics of metaheuristic optimization tools to perform optimization related to the science taught in ITS mechanical engineering, such as design optimization, manufacturing process optimization, PID parameter optimization in control processes, etc.</i>	
Bahan Kajian: Materi Pembelajaran (Course Materials)	1. Dasar-dasar penggunaan software Matlab, 2. Neural network, 3. metode optimasi metaheuristic (genetic algoritma dan particle swarm optimization) dan 4. penggunaan graphical user interface untuk komparasi hasil optimasi	
Pustaka (References)	Utama : (Main)	
	1. Martin T. Hagan, dkk., "Neural network Design 2nd Edition", Hagan and Demuth, 2014. 2. Mark Hudson Beale, dkk., "Neural Network Toolbox User's Guide R2017a" The Matworks, Inc., 2017. 3. S.R. Otto and J.P Denier, "An introduction to Programming and Numerical Methods in MATLAB", Springer, 2005. 4. Andrew Chipperfield, dkk., "Genetic Algorithm Toolbox for Use with MATLAB" 5. Mark A. Abramson, "Genetic Algorithm and Direct Search Toolbox", The Mathwork, 2004. 6. Xin-She Yang, "Nature-Inspired Optimization Algorithm", Elsevier, 2014.	
	Pendukung : (Supplementary)	
Dosen Pengampu	M. Khoirul Effendi, Ph.D	



(Lecturers)							
Matakuliah syarat (Prerequisites)		Tidak ada mata kuliah prasyarat					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami implementasi AI dan optimasi dalam bidang teknik mesin <i>Students can understand the implementation of AI and optimization in mechanical engineering.</i>	Bisa menjelaskan contoh-contoh implementasi AI+Optimasi di bidang Teknik mesin	Tugas mencari dan mempresentasikan implementasi AI+Optimasi di bidang Teknik mesin	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Kontrak kuliah Kuliah Pengantar & Brainstorming - Intro AI dan optimasi metaheuristik - Implementasi AI dan optimasi metaheuristic dalam bidang Teknik mesin [1: Martin T. Hagan – BAB 1]	
2	Mahasiswa mampu memahami dasar-	Mahasiswa mampu	Tugas mempresentasikan penggunaan fitur	Perkuliahan [TM: 3x50"]		- Retooling dasar-dasar Matlab	1%



	dasar mengoperasikan Matlab <i>Students can understand the basics of operating Matlab Programming.</i>	mengoperasikan an tool-tool pada Matlab termasuk Graphical User interface (GUI) untuk menyelesaikan kasus optimasi sederhana	matlab serta Graphical User interface (GUI) untuk menyelesaikan kasus sederhana	Self-Directed Learning, Cooperative Learning		- Graphical User interface with Matlab [2: S.R. Otto and J.P Denier – BAB 2&3]	
3	Mahasiswa mampu memahami parameter dalam NN (activation function, hopfield network) <i>Students are able to understand the parameters in NN (activation function, Hopfield network)</i>	Mahasiswa mengerti berbagai macam fungsi aktivasi pada NN (purelin, harlim, tansig dll) dan implementasi Hopfield network	Tugas: mempresentasikan penggunaan toolbox Hopfield untuk mengidentifikasikan huruf dan menganalisa pengaruh noise pada proses training dan testing	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Parameter dalam NN (activation function, hopfield network) [1: Martin T. Hagan – BAB 2] [2: Mark Hudson Beale – BAB 1]	1%
4	Mahasiswa mampu memahami	Mahasiswa mengerti dan bisa	Tugas: mempresentasikan penggunaan coding	Perkuliahan [TM: 3x50"]		Single perceptron dan implementasinya untuk kasus clustering	1%



	prinsip dasar single perceptron dan implementasinya untuk kasus clustering <i>Students can understand the basic principles of single perceptron and its implementation for clustering cases.</i>	mengimplemenasikan single perceptron untuk kasus clustering 2 buah data sederhana	single perceptron untuk kasus clustering dan menjawab beberapa pertanyaan berikut: Berapa epoch sampai berhenti Pengaruh fungsi aktivasi terhadap konvergensi. Perubahan nilai weight dan bias untuk 3x epoch pertama	Self-Directed Learning, Cooperative Learning		[1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 1]	
5	Mahasiswa mampu memahami prinsip dasar multi layer perceptron dan implementasinya untuk kasus clustering <i>Students can understand the basic principles of multi-layer</i>	Mahasiswa mampu memahami prinsip dasar multi layer perceptron untuk kasus yang lebih kompleks seperti clustering logika XOR	Tugas : Mempresentasikan penggunaan multi-layer perceptron untuk clustering kasus XOR	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Multi layer perceptron dan implementasinya untuk kasus clustering [1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 3]	1%



	<i>perceptron and its implementation for clustering cases.</i>						
6	Mahasiswa mampu memahami Implementasi NN Matlab toolbox <i>Students can understand the implementation of Neural networks using the Matlab toolbox</i>	Mahasiswa mampu memahami Implementasi NN matlab toolbox untuk menyelesaikan sebuah kasus sederhana dan bisa menjelaskan beberapa parameter berikut: - Memasukkan input-output - Merubah prosesntase data untuk training testing dan validasi - Menjelaskan jumlah hidden layer dan node	Tugas : Mempresentasikan penggunaan NN Matlab toolbox untuk memngenerate fungsi $Y = f(\sin x)$	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Implementasi NN matlab toolbox untuk kasus $f(x) = \sin(x)$ [1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 3]	1%



		d. Menjelaskan correlation coefficient Menjelaskan stopping criteria					
7	Mahasiswa mampu mendefinisikan data input-output dalam sebuah NN, serta memilih topology, fungsi aktivasi sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil <i>Students can define input-output data in an NN and choose a neural network topology and activation function to obtain</i>	Mahasiswa mampu mendefinisikan a. input-output b. jumlah hidden layer dan node c. fungsi aktivasi dan learning algorithm sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil	Tugas : Mempresentasikan penggunaan NN Matlab toolbox untuk memngenerate fungsi $Y = f(\sin x)$ Dengan variasi jumlah hidden layer, jumlah node, fungsi aktivasi dan learning algorithm	Perkuliahhan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Diskusi dan implementasi NN matlab toolbox untuk kasus yang akan dipresentasikan dalam project 1 [1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 3]	1%



	<i>an NN with the smallest Mean Squared Error (MSE).</i>						
8	ETS: materi perkuliahan minggu 1-7 (mid term exam)						25%
9	Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Genetic Algoritma (GA) <i>Students can define optimization objectives and understand the steps for finding optimization values using Genetic Algorithms (GA).</i>	Mahasiswa mampu memahami Langkah-langkah optimasi menggunakan GA mengenerate populasi menentukan nilai fitness filtering (roulette wheel dan tournament) proses seleksi crossover dan mutasi	Tugas: mempresentasikan bagaimana: mengenerate populasi menentukan nilai fitness filtering (roulette wheel dan tournament) proses seleksi crossover dan mutasi pada coding yang telah diberikan	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Overview GA - Proses seleksi, cross-over dan mutase pada GA [4: Andrew Chipperfield – 1-1 s/d 1-18]	1%
10	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan	Mahasiswa mampu memahami Langkah-	Tugas: mempresentasikan bagaimana mencari nilai	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Proses seleksi, cross-over dan mutase pada GA	1%



	tiap langkah pada metode Genetic Algoritma <i>Students can explain clearly and sequentially examples of calculations for each step in the Genetic Algorithm method.</i>	langkah optimasi menggunakan GA dan mencari nilai optimum pada kasus sederhana $Y = f(\sin x)$	optimum pada fungsi $Y = f(\sin x)$ Pada constraint sudut tertentu $0 < x < 90$			menggunakan MATLAB [4: Andrew Chipperfield – 1-20 s/d 1-37]	
11	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB mulai dari kasus yang sederhana sampai kasus multiobjective optimization <i>Students can operate the Genetic Algorithm toolbox in MATLAB, starting from simple cases to multiobjective optimization cases.</i>	Simulasi penggunaan toolbox Genetic Algorithm untuk beberapa kasus 1. Single input single output (SISO) 2. Single input multi output (SIMO) 3. Multi input single	Tugas: mempresentasikan bagaimana mencari nilai optimum pada fungsi $Y = f(\sin x)$ Pada constraint sudut tertentu $0 < x < 90$	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Membuat fitness function - Menentukan setting parameter - Menampilkan dan membaca hasil optimasi [5: Mark A. Abramson – Bab 4]	1%



		output (MISO) Multi input multi output (MIMO)					
12	Mahasiswa mampu mengadjust tuning parameter toolbox Genetic Algoritma pada MATLAB untuk memecahkan kasus yang memerlukan constraint handling <i>Students can adjust tuning parameters in the Genetic Algorithm toolbox in MATLAB to solve cases that require constraint handling.</i>	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB dengan constraint handling: penalty tipe static, dynamic dan adaptive	Tugas: mempresentasikan bagaimana mencari nilai optimum menggunakan GA pada fungsi $Y = f(a, b, c, d)$ Dengan constrain yang berbeda	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Membuat fitness function - Menentukan setting parameter - Menentukan constraint handling - Menampilkan dan membaca hasil optimasi [7. Chehouri, A. Dkk]	1%
13	QUIZ			Quiz [TM: 3x50"]			25%
14	Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai	Mahasiswa mampu memahami langkah-langkah pencarian nilai	Tugas: mempresentasikan setiap baris coding PSO serta bisa menjelaskan fungsi	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Overview PSO - Proses penentuan posisi, kecepatan, Pbest dan GBest pada PSO	1%



	optimasi dengan Particle Swarm Optimization (PSO) <i>Students are able to define optimization objectives and understand the steps for finding optimization values with Particle Swarm Optimization (PSO).</i>	optimasi dengan Particle Swarm Optimization (inialize, evaluasi fitness, update local and global best, update velocity and position)	dari coding tersebut pada PSO			[6: Xin She Yang – Bab 7]	
15	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan tiap langkah pada metode PSO menggunakan MATLAB. <i>Students can explain clearly and sequentially examples of calculations for each step in the PSO</i>	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi serta menerapkan constraint handling pada PSO	Tugas: mempresentasikan bagaimana mencari nilai optimum menggunakan PSO pada fungsi $Y = f(a, b, c, d)$ Dengan constrain yang berbeda	Perkuliahhan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Proses perhitungan posisi, kecepatan, Pbest dan GBest pada PSO menggunakan MATLAB [6: Xin She Yang – Bab 7]	1%



	<i>method using MATLAB.</i>						
16	Evaluasi Akhir Semester / Ujian Akhir Semester/Project team - <i>colaborative Learning</i> <i>Final Exam/Final Project</i>						38%



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
Optimasi proses Process Optimization	TM235329	Proses manufaktur Manufacturing process	T= 3	P= 0	VII	26 Nopember 2023
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Graduate Program)	
	M. Khoirul Effendi, Ph.D	M. Khoirul Effendi, Ph.D			Arif Wahjudi, PhD	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global.				



		(Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources)																							
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. (Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)																							
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. (Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)																							
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)																								
	CPMK-1	Mahasiswa mampu memahami proses perancangan dan pengembangan produk																							
	CPMK-2	Mahasiswa mampu menganalisa aspek teknik produk seperti fungsi, kekuatan, keamanan, keergonomisan, mampu manufaktur dan perakitan																							
	CPMK-3	Mahasiswa mampu mengembangkan produk dari aspek desain, ergonomis, manufaktur dan perakitan																							
	CPMK-4	Mahasiswa mampu pengembangan produk berdasarkan kebutuhan konsumen																							
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-5</td><td>CPL-6</td><td>CPL-7</td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-2</td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-4</td><td>V</td><td>V</td><td></td></tr></table>				CPMK	CPL-5	CPL-6	CPL-7	CPMK-1	V	V	V	CPMK-2	V	V		CPMK-3	V	V		CPMK-4	V	V	
CPMK	CPL-5	CPL-6	CPL-7																						
CPMK-1	V	V	V																						
CPMK-2	V	V																							
CPMK-3	V	V																							
CPMK-4	V	V																							



Deskripsi Singkat MK <i>(Short Description of Course)</i>	Mata kuliah ini memberikan dasar-dasar tool optimasi metaheuristic untuk melakukan optimasi yang berkaitan dengan keilmuan yang diajarkan di teknik mesin ITS misal untuk optimasi desain, optimasi proses manufaktur, optimasi parameter PID dalam proses control dll. <i>This course provides the basics of metaheuristic optimization tools to perform optimization related to the science taught in ITS mechanical engineering, such as design optimization, manufacturing process optimization, PID parameter optimization in control processes, etc.</i>	
Bahan Kajian: Materi Pembelajaran <i>(Course Materials)</i>	1. Dasar-dasar penggunaan software Matlab, 2. Neural network, 3. metode optimasi metaheuristic (genetic algoritma dan particle swarm optimization) dan 4. penggunaan graphical user interface untuk komparasi hasil optimasi 1. <i>Fundamental of Matlab programming,</i> 2. <i>Neural networks,</i> 3. <i>Metaheuristic optimization methods (genetic algorithms and particle swarm optimization) and</i> 4. <i>Graphical user interfaces for comparing optimization results</i>	
Pustaka <i>(References)</i>	Utama : <i>(Main)</i>	
		1. Martin T. Hagan, dkk., "Neural network Design 2nd Edition", Hagan and Demuth, 2014. 2. Mark Hudson Beale, dkk., "Neural Network Toolbox User's Guide R2017a" The Matworks, Inc., 2017. 3. S.R. Otto and J.P Denier, "An introduction to Programming and Numerical Methods in MATLAB", Springer, 2005. 4. Andrew Chipperfield, dkk., "Genetic Algorithm Toolbox for Use with MATLAB" 5. Mark A. Abramson, "Genetic Algorithm and Direct Search Toolbox", The Mathwork, 2004. 6. Xin-She Yang, "Nature-Inspired Optimization Algorithm", Elsevier, 2014.
	Pendukung :	



		(Supplementary)					
		4. Chehour, A. Dkk, "A Constraint-Handling Technique for Genetic Algorithms using a Violation Factor" Journal of computer science, 2016, 12 (7)					
Dosen Pengampu (Lecturers)		M. Khoirul Effendi, Ph.D					
Matakuliah syarat (Prerequisites)		Tidak ada mata kuliah prasyarat					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami implementasi AI dan optimasi dalam bidang teknik mesin <i>Students can understand the implementation of AI and optimization</i>	Bisa menjelaskan contoh-contoh implementasi AI+Optimasi di bidang Teknik mesin	Tugas mencari dan mempresentasikan implementasi AI+Optimasi di bidang Teknik mesin	Perkuliah [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Kontrak kuliah Kuliah Pengantar & Brainstorming - Intro AI dan optimasi metaheuristik - Implementasi AI dan optimasi metaheuristic dalam bidang Teknik mesin [1: Martin T. Hagan – BAB 1]	



	<i>in mechanical engineering.</i>						
2	Mahasiswa mampu memahami dasar-dasar mengoperasikan Matlab <i>Students can understand the basics of operating Matlab Programming.</i>	Mahasiswa mampu mengoperasikan tool-tool pada Matlab termasuk Graphical User interface (GUI) untuk menyelesaikan kasus optimasi sederhana	Tugas mempresentasikan penggunaan fitur matlab serta Graphical User interface (GUI) untuk menyelesaikan kasus sederhana	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Retooling dasar-dasar Matlab - Graphical User interface with Matlab [2: S.R. Otto and J.P Denier – BAB 2&3]	1%
3	Mahasiswa mampu memahami parameter dalam NN (activation function, hopfield network) <i>Students are able to understand the parameters in NN (activation</i>	Mahasiswa mengerti berbagai macam fungsi aktivasi pada NN (purelin, harlim, tansig dll) dan implementasi Hopfield network	Tugas: mempresentasikan penggunaan toolbox Hopfield untuk mengidentifikasikan huruf dan menganalisa pengaruh noise pada proses training dan testing	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Parameter dalam NN (activation function, hopfield network) [1: Martin T. Hagan – BAB 2] [2: Mark Hudson Beale – BAB 1]	1%



	<i>function, Hopfield network)</i>						
4	Mahasiswa mampu memahami prinsip dasar single perceptron dan implementasinya untuk kasus clustering <i>Students can understand the basic principles of single perceptron and its implementation for clustering cases.</i>	Mahasiswa mengerti dan bisa mengimplementasikan single perceptron untuk kasus clustering 2 buah data sederhana	Tugas: mempresentasikan penggunaan coding single perceptron untuk kasus clustering dan menjawab beberapa pertanyaan berikut: a) Berapa epoch sampai berhenti b) Pengaruh fungsi aktivasi terhadap konvergensi. Perubahan nilai weight dan bias untuk 3x epoch pertama	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Single perceptron dan implementasinya untuk kasus clustering [1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 1]	1%
5	Mahasiswa mampu memahami prinsip dasar multi layer perceptron dan implementasinya	Mahasiswa mampu memahami prinsip dasar multi layer perceptron untuk kasus	Tugas : Mempresentasikan penggunaan multi-layer perceptron untuk clustering kasus XOR	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Multi layer perceptron dan implementasinya untuk kasus clustering [1: Martin T. Hagan – BAB 4]	1%



	untuk kasus clustering <i>Students can understand the basic principles of multi-layer perceptron and its implementation for clustering cases.</i>	yang lebih kompleks seperti clustering logika XOR				[2: Mark Hudson Beale – BAB 3]	
6	Mahasiswa mampu memahami Implementasi NN Matlab toolbox <i>Students can understand the implementation of Neural networks using the Matlab toolbox</i>	Mahasiswa mampu memahami Implementasi NN matlab toolbox untuk menyelesaikan sebuah kasus sederhana dan bisa menjelaskan beberapa parameter berikut: a. Memasukkan input-output	Tugas : Mempresentasikan penggunaan NN Matlab toolbox untuk memngenerate fungsi $Y = f(\sin x)$	Perkuliahahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Implementasi NN matlab toolbox untuk kasus $f(x) = \sin(x)$ [1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 3]	1%



		b. Merubah prosesntase data untuk training testing dan validasi c. Menjelaskan jumlah hidden layer dan node d. Menjelaskan correlation coeeficient Menjelaskan stopping citeria					
7	Mahasiswa mampu mendefinisikan data input-output dalam sebuah NN, serta memilih topology, fungsi aktifasi sehingga	Mahasiswa mampu mendefisinisik an a. input-output b. jumlah hidden	Tugas : Mempresentasikan penggunaan NN Matlab toolbox untuk memngenerate fungsi $Y = f(\sin x)$	Perkuliahahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		Diskusi dan implementasi NN matlab toolbox untuk kasus yang akan dipresentasikan dalam project 1 [1: Martin T. Hagan – BAB 4]	1%



	didapatkan NN dengan Mean Squared Error (MSE) yang terkecil <i>Students can define input-output data in an NN and choose a neural network topology and activation function to obtain an NN with the smallest Mean Squared Error (MSE).</i>	layer dan node c. fungsi aktivasi dan learning algorithm sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil	Dengan variasi jumlah hidden layer, jumlah node, fungsi aktivasi dan learning algorithm			[2: Mark Hudson Beale – BAB 3]	
8	ETS: materi perkuliahan minggu 1-7 (mid term exam)						25%
9	Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Genetic Algoritma (GA)	Mahasiswa mampu memahami Langkah-langkah optimasi menggunakan GA	Tugas: mempresentasikan bagaimana: - mengenerate populasi - menentukan nilai fitness	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Overview GA - Proses seleksi, cross-over dan mutase pada GA [4: Andrew Chipperfield – 1-1 s/d 1-18]	1%



	<i>Students can define optimization objectives and understand the steps for finding optimization values using Genetic Algorithms (GA).</i>	a. mengenerate populasi b. menentukan nilai fitness c. filtering (roulette wheel dan tournament) d. proses seleksi crossover dan mutasi	c. filtering (roulette wheel dan tournament) d. proses seleksi crossover dan mutasi pada coding yang telah diberikan				
10	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan tiap langkah pada metode Genetic Algoritma <i>Students can explain clearly and sequentially examples of calculations for each step in the Genetic Algorithm method.</i>	Mahasiswa mampu memahami Langkah-langkah optimasi menggunakan GA dan mencari nilai optimum pada kasus sederhana $Y = f(\sin x)$	Tugas: mempresentasikan bagaimana mencari nilai optimum pada fungsi $Y = f(\sin x)$ Pada constraint sudut tertentu $0 < x < 90$	Perkuliahhan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Proses seleksi, crossover dan mutase pada GA menggunakan MATLAB [4: Andrew Chipperfield – 1-20 s/d 1-37]	1%



11	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB mulai dari kasus yang sederhana sampai kasus multiobjective optimization <i>Students can operate the Genetic Algorithm toolbox in MATLAB, starting from simple cases to multiobjective optimization cases.</i>	Simulasi penggunaan toolbox Genetic Algorithm untuk beberapa kasus 1. Single input single output (SISO) 2. Single input multi output (SIMO) 3. Multi input single output (MISO) Multi input multi output (MIMO)	Tugas: mempresentasikan bagaimana mencari nilai optimum pada fungsi $Y = f(\sin x)$ Pada constraint sudut tertentu $0 < x < 90$	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Membuat fitness function - Menentukan setting parameter - Menampilkan dan membaca hasil optimasi [5: Mark A. Abramson – Bab 4]	1%
12	Mahasiswa mampu mengadjust tuning parameter toolbox Genetic Algoritma pada MATLAB untuk memecahkan kasus yang memerlukan constraint handling	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada	Tugas: mempresentasikan bagaimana mencari nilai optimum menggunakan GA pada fungsi	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Membuat fitness function - Menentukan setting parameter - Menentukan constraint handling	1%



	<i>Students can adjust tuning parameters in the Genetic Algorithm toolbox in MATLAB to solve cases that require constraint handling.</i>	MATLAB dengan constraint handling: penalty tipe static, dynamic dan adaptive	$Y = f(a, b, c, d)$ Dengan constrain yang berbeda			- Menampilkan dan membaca hasil optimasi [7. Chehouri, A. Dkk]	
13	QUIZ			Quiz [TM: 3x50"]			25%
14	Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Particle Swarm Optimization (PSO) <i>Students are able to define optimization objectives and understand the steps for finding optimization values with Particle Swarm Optimization (PSO).</i>	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi dengan Particle Swarm Optimization (inialize, evaluasi fitness, update local and global best, update velocity and position)	Tugas: mempresentasikan setiap baris coding PSO serta bisa menjelaskan fungsi dari coding tersebut pada PSO	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Overview PSO - Proses penentuan posisi, kecepatan, Pbest dan GBest pada PSO [6: Xin She Yang – Bab 7]	1%



15	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan tiap langkah pada metode PSO menggunakan MATLAB. <i>Students can explain clearly and sequentially examples of calculations for each step in the PSO method using MATLAB.</i>	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi serta menerapkan constraint handling pada PSO	Tugas: mempresentasikan bagaimana mencari nilai optimum menggunakan PSO pada fungsi $Y = f(a, b, c, d)$ Dengan constrain yang berbeda	Perkuliahan [TM: 3x50"] Self-Directed Learning, Cooperative Learning		- Proses perhitungan posisi, kecepatan, Pbest dan GBest pada PSO menggunakan MATLAB [6: Xin She Yang – Bab 7]	1%
16	Evaluasi Akhir Semester / Ujian Akhir Semester/Project team - collaborative Learning <i>Final Exam/Final Project</i>						38%



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM - ITS					
MATA KULIAH		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Direvisi
SIMULASI SISTEM DINAMIS		TM234725	OTOMASI INDUSTRI	T=3	P=0	Pilihan	
OTORISASI		Pengembang RP		Koordinator RMK		KaPRODI Sarjana	
		Suwarmin		Latifah		Is Bunyamin Suryo	
Capaian Pembelajaran MK	Program Studi	A. Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (mechanical system). B. Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa social dan tekno ekonomi berbasis ilmu dan teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. D. Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. E. Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. G. Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data.					
	Mata Kuliah	1. [A, B] Mahasiswa mampu memodelkan relasi antara social ekonomi dan teknik dalam suatu sistem dinamik. [D, E, G] Mahasiswa mampu merancang dan mengevaluasi simulasi sistem untuk diterapkan pada sistem dinamis tersebut dengan logika yang benar, baik secara mandiri maupun dalam tim.					
	Diskripsi Bahan Kajian & Pokok Bahasan	Bahan Kajian	Prinsip simulasi system dinamis , <i>Causal Loop</i> dan <i>Stock-Flow Diagram</i> Simulasi sistem dinamis, pemodelan dinamis multi input dan output.				



	Pokok Bahasan	
	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Prinsip Simulasi sistem dinamis: Pola pemikiran, pemodelan dan aplikasi - <i>Causal Loop</i> dan <i>Stock-Flow</i> diagram - Teknik simulasi sistem dinamis - Parameter estimasi dan Analisa sensitivitas - Rekayasa simulasi sistem dinamis Skenario perencanaan dan Pemodelan simulasi sistem dinamis	
Pustaka	Utama :	
	[3]. Forrester, Jay W. , 2009, Some Basic Concepts in System Dynamics, MIT [4]. Pruyt, E., 2013. Small System Dynamics Models for Big Issues: Triple Jump towards Real-World Complexity, Delft, TU Delft Library. [5]. Bala, Bilash Kanti, 2016, System Dynamics: Modelling and Simulation, Springer. Haraldsson, Hördur V., 2000, Introduction to Systems and Causal Loop Diagrams, Lund University	
	Pendukung :	
	[6]. Barlas, Yaman , System Dynamics: Systemic Feedback Modeling for Policy Analysis, Encyclopedia of Life Support System [7]. Bardi, Ugo, 2011, <i>The Limits to Growth Revisited</i>, Springer. ---, 2007, Ventana Simulation Environment, Ventana Systems, Inc.	
Media Pembelajaran	Software :	Hardware :
	Vensim dan Anylogic	PC & LCD Projector
Team Teaching	Suwarmin	
Assessment	Latihan Soal Homework (<i>Case-Study</i>) Evaluasi tertulis Proyek (<i>Case-Study</i> / software application)	



		Presentasi				
Matakuliah Syarat		Sistem Dinamika dan Pengendalian				
Mg Ke-	Sub-Capaian Pembelajaran MK	Materi Pembelajaran [Pustaka]	Metode / Strategi Pembelajaran [Estimasi Waktu]	Assessment		
				Indikator	Bentuk	Bobot
(1)	Mahasiswa mampu memahami prinsip simulasi system dinamis	- Course outline prinsip simulasi system dinamis [1]: Bab 1 [3]: Bab 1	Kuliah pengantar & Brainstorming Latihan identifikasi system dinamis [TM: 1x(3x50'')]	Mahasiswa mampu memberikan contoh simulasi system dinamis	- Diskusi	
(2)	Mahasiswa mampu memahami struktur pemikiran sistem dinamis: identifikasi masalah, hipotesa, causal loop, Stock-Flow dll.	- Pola pemikiran system dinamis. [3]: Bab 2	Pola pemikiran system dinamis. [3]: Bab 2 [TM: 1x(3x50'')]	Mampu dan terampil membedakan masalah, hipotesa, causal loop dan stock flow	- Diskusi - Pemberian tugas klasifikasi causal loop dan stock flow	5 %
(3)	Mahasiswa mampu memahami dan menggunakan perangkat lunak Vensim	- Penggunaan perangkat lunak Vensim [7]:	- Kuliah Studi Kasus [TM: 1x(3x50'')]	Mampu mengoperasikan perangkat lunak Vensim	- Latihan soal Membuat simulasi dinamis sederhana	5 %



(4)	Mahasiswa mampu memahami dan merancang skema Causal loop Diagram.	- Causal Loop Diagram [4]: Bab 2, 3	Kuliah Studi Kasus [TM: 1x(3x50'')]	- Mampu mengidentifikasi kasus riil. Mampu merancang cause loop kasus riil.	Latihan soal Homework Quiz	5 %
(5)	Mahasiswa mampu memahami dan merancang prinsip dasar Stock-Flow diagram.	- Stock-Flow diagram [3]: Bab 4	- Kuliah Studi Kasus [TM: 1x(3x50'')]	- Mampu mengidentifikasi kasus riil dan merancang stock flow. Mampu menggunakan Stock, flow, Converter & Delay	Latihan soal Homework - Quiz	5 %
(6)	Mahasiswa mampu memahami dan merancang Stock-Flow diagram lebih lanjut dengan fungsi lainnya.	- Stock-Flow Diagram [3]: Bab 4	Kuliah Studi Kasus [TM: 1x(3x50'')]	- Mampu mengidentifikasi kasus riil dan merancang stock flow. Mampu menggunakan fungsi interval, terpadu	- Latihan soal Homework	
(7)	Mahasiswa mampu memahami dan membuat simulasi dinamis dengan Teknik standard.	- Teknik simulasi system dinamis [2]: Bab 10	Kuliah Studi Kasus [TM: 1x(3x50'')]	Mampu mengidentifikasi kasus riil dan membuat simulasi system dinamis Teknik dasar	Latihan soal Homework	5 %
(8)	Evaluasi Tengah Semester					25%



(9)	Mahasiswa mampu memahami dan membuat simulasi dinamis dengan variasi teknis lainnya lebih lanjut.	- Teknik simulasi dinamis terintegrasi [2]: Bab 10	Kuliah Studi Kasus [TM: 1x(3x50'')]	Mampu mengidentifikasi kasus riil dan membuat simulasi system dinamis Teknik lanjut dan terpadu	- Diskusi Latihan soal	
(10)	Mahasiswa mampu memahami dan memilih penggunaan parameter estimasi simulasi system dinamis berbasis data.	- Parameter estimasi simulasi system dinamis berbasis data [3]: Bab 5	Kuliah Praktikum [TM: 1x(3x50'')]	Mampu memahami memilih dan menggunakan data sebagai parameter estimasi simulasi dinamis.	Latihan soal Studi kasus	
(11)	Mahasiswa mampu memahami dan memilih penggunaan parameter estimasi simulasi system dinamis berbasis fungsi.	- Parameter estimasi simulasi system dinamis berbasis fungsi [3]: Bab 5	Kuliah Praktikum - Diskusi [TM: 1x(3x50'')]	Mampu memahami memilih dan menggunakan fungsi sebagai parameter estimasi simulasi dinamis.	- Latihan soal Quiz	5 %
(12)	Mahasiswa mampu memahami dan menganalisa sensitivitas hasil simulasi dinamis	- Analisa sensitivitas [3]: Bab 5	- Kuliah Studi Kasus - Diskusi [TM: 1x(3x50'')]	Mampu memahami dan dapat menentukan factor sensitivitas pada simulasi dinamis	- Diskusi	
(13)	- Mahasiswa mampu memahami struktur	- Perencanaan scenario Simulasi system dinamis	Kuliah Studi Kasus [TM: 1x(3x50'')]	Mampu memahami dan merencanakan scenario dalam	- Diskusi	



	simulasi system dinamis. Mahasiswa mampu memahami dan memilih scenario perencanaan simulasi system dinamis.	[3]: Bab 7		membuata simulasi dinamis.		
(14)	- Mahasiswa mampu membuat skema causal loop, Stock-Flow diagram dan simulasi system dinamis secara lengkap. Identifikasi studi kasus	- Studi kasus simulasi system dinamis [3]: Bab 8, 9	- Kuliah Studi Kasus [TM: 1x(3x50'')]	Mampu memahami dan menganalisa hasil simulasi dinamis.	- Diskusi	10 %
(15)	- Identifikasi studi kasus - Persiapan project akhir simulasi system dinamis	- Studi kasus simulasi system dinamis [3]: Bab 10, 11,12 -	Kuliah Studi Kasus [TM: 1x(3x50'')]	Mampu memahami dan Analisa dari beberapa sutudi kasus	Diskusi Presentasi	10
(16)	- Evaluasi Akhir Semester (Presentasi proyek)					25%



					SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING			Document Code	
SEMESTER LEARNING PLAN									
COURSE (Course)		CODE		MK Group		WEIGHT (credits)		SEMESTER	Date of Compilation
DYNAMIC SYSTEMS AND CONTROL		TM184521				T= 4 P= 0		5	May 5, 2019
AUTHORIZATION		RPS Developer			RMK Coordinator			Head of PRODI	
Learning Outcomes (CP)	CPL-PRODI charged to MK								
	CPL -4	Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics .							
	CPL -5	Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience .							
	CPL-7	Ability apply methods , skills and tools modern techniques are needed For practice system mechanics .							
	CPL-8	Ability identify , formulate , analyze and solve problem technique							
	Course Learning Outcomes (CPMK)								
	CPMK -1	Student capable modeling a system dynamic (CPL-4, CPL-8)							



	CPMK -2	Student capable design and evaluate system control automatic For applied to the system dynamic the with correct logic , good in a way independent and also in team. (CPL-5, CPL-7)			
		CPMK Matrix			
		CPMK	CPL-1	...	
		CPMK-1		V	V
		...	V		
			V	V	
		...			
MK Brief Description	Modeling system dynamic , design system control				
Study Material: Learning Material	Modeling system dynamic , design system control				
Library	Main :				
	[8]. Norman S. Nise . Control Systems Engineering, 7 th edition. John Wiley and Sons, Inc, 2015.				
	[9]. Close, CM, Frederick, DK, Newell, JC, Modeling and Analysis of Dynamic Systems, 3 rd edition, John Wiley and Sons, Inc, 2002.				
	Supporters :				
	[10]. Richard C. Dorf and Robert H. Bishop. Modern Control Systems, 13th edition. Pearson, 2016. [11]. Paul Lewis and Chang Yang. Basic Control Systems Engineering. Prentice Hall, 1997. [12]. Amos Gilat. Matlab: An Introduction with Applications, 5th edition. Wiley, 2014.				



Supporting lecturer		Bambang Pramujati , Nur Yuniarto , Arif Wahyudi , Excellent English: Wasiwitono , Latifah Nurahmi					
Required courses		Kinematics and Dynamics					
Mg Ke	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Student capable understand and explain the concept of open-loop and closed-loop control systems	Student capable give example types system control and its application	Oral Post-Test (random) : Exercise Question Task Independent :	Lecture [TM: 3x50"] Studying Introduction & Brainstorming Exercise question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Course outline - Automatic control in practice - Basic principles of control - Classification of control	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calssroom	
2	Student capable formulate / derive mathematical	Capable and skilled connect elements in a system , for	Oral Post-Test (random) : Exercise Question Task Independent : Homework	Lecture [TM: 3x50"] Studying Exercise question Study Structured [TM: 3x60"]	- Laplace transform - Mathematical models: mechanical, electrical, and	[1]: Chapter 8 [2]: Handout on myITS Calssroom	10%



	models with using Laplace transform	produce schematic and free-body diagrams, so that equality motion can obtained	Quiz : 3 questions 150 min Quiz	Study Independent [TM: 3x60"]	electromechanical systems		
3	Student capable formulate / derive mathematical models with using Laplace transform	Capable and skilled connect elements in a system , for produce schematic and free-body diagrams, so that equality motion can obtained	Oral Post-Test (random) : Exercise Question Task Independent : Homework Quiz : 3 questions 150 min Quiz	Lecture [TM: 3x50"] Studying Exercise question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Laplace transform - Mathematical models: mechanical, electrical, and electromechanical systems	[1]: Chapter 8 [2]: Handout on myITS Calsroom	10%
4	Student capable compare response dynamics in the system order one , two , and high ,	- Capable using polish/zeroes from transfer function for determine the response time of system control .	Oral Post-Test (random) : Exercise Question Task Independent : Exercises on Matlab software	Lecture [TM: 3x50"] Studying Exercise question Practicum Study Structured [TM: 3x60"]	- Time response - Introduction to Matlab - Introduction to Simulink	[1]: Chapter 8 [2]: Handout on myITS Calsroom	



	with different inputs . Student capable applying mathematical models to software	- Capable describe in a way quantitative transient response of system order one and two		Study Independent [TM: 3x60"]			
5	Student capable compare response dynamics in the system order one , two , and high , with different inputs . Student capable applying mathematical models to software	- Capable using polish/zeroes from transfer function for determine the response time of system control . - Capable describe in a way quantitative transient response of system order one and two	Oral Post-Test (random) : Exercise Question Task Independent : Exercises on Matlab software	Lecture [TM: 3x50"] Studying Exercise question Practicum Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Time response - Introduction to Matlab - Introduction to Simulink	[1]: Chapter 9 [2]: Handout on myITS Calsroom	
6	Student capable create block diagrams	- Capable simplify the block diagram of a multi sub-system into a	Oral Post-Test (random) : Exercise Question Task Independent :	Lecture [TM: 3x50"] Studying Exercise question	- Block diagram reduction - Signal flow graphs	[1]: Chapter 9 [2]: Handout on myITS Calsroom	10%



		single block, to used in analyze and design transient response - Capable convert blockc diagram into signal flow graphs and simplify them using Mason's rule	Homework Quiz : 3 questions 150 min Quiz	Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
7	Student capable analyze stability from system dynamic	Capable create and interpret Routh tables, to determine stability from a system	Oral Post-Test (random): Exercise Question	Lecture [TM: 3x50"] Studying Exercise question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Stability analysis: Routh-Hurwitz criterion -	[1]: Chapter 9 [2]: Handout on myITS Calssroom	
8	Mid Semester Evaluation / Mid Semester Exam						30%
9	Students are able to analyze steady-state	- Capable determine steady-state error and	Oral Post-Test (random): Exercise Question Task Independent :	Lecture [TM: 3x50"] Studying Exercise question	- Steady-state errors - Sensitivity	[1]: Chapters 5 and 7 [2]: Handout on myITS Calssroom	



	error and sensitivity of dynamic systems.	- steady-state error performance , for system bait back unity and non-unity	Homework	Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
10	- Student capable make root locus diagram, comparing PID controller and its combinations . - Student capable designing controller with software.	- Capable defines the root locus, states its properties , and use them For determine the parameters for use fulfil transient response specifications . - Capable compare PID controller and its combinations as well as use Ziegler-Nichols method or Sisotool , for designing controller	Oral Post-Test (random): Exercise Question Task Independent : Homework Quiz : 3 questions 150 min Quiz	Lecture [TM: 3x50"] Studying Exercise question Practicum Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Root locus: properties and rules of construction - Root locus construction using Matlab - PID controller and its combination - Ziegler-Nichols controller design - Controller design using Matlab : Sisotool	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	10%



11	- Student capable create a root locus diagram, compare PID controller and its combinations . - Student capable designing controller with software.	- Capable defines the root locus, states its properties , and use them For determine the parameters for use fulfil transient response specifications . - Capable compare PID controller and its combinations as well as use Ziegler-Nichols method or Sisotool , for designing controller	Oral Post-Test (random): Exercise Question Task Independent : Homework Quiz : 3 questions 150 min Quiz	Lecture [TM: 3x50"] Studying Exercise question Practicum Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Root locus: properties and rules of construction - Root locus construction using Matlab - PID controller and its combination - Ziegler-Nichols controller design - Controller design using Matlab : Sisotool	[1]: Chapter 7 [2]: Handouts in myITS Classroom	10%
12	- Student capable make root locus diagram, comparing PID controller and its	- Capable defines the root locus, states its properties , and use them For determine the parameters for use fulfil	Oral Post-Test (random): Exercise Question Task Independent : Homework	Lecture [TM: 3x50"] Studying Exercise question Practicum Study Structured [TM: 3x60"]	- Root locus: properties and rules of construction - Root locus construction using Matlab	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%



	combinations . - Student capable designing controller with software.	transient response specifications . - Capable compare PID controller and its combinations as well as use Ziegler-Nichols method or Sisotool , for designing controller	Quiz : 3 questions 150 min Quiz	Study Independent [TM: 3x60"]	- PID controller and its combination - Ziegler-Nichols controller design - Controller design using Matlab : Sisotool		
13	Student capable design and realize PID controller and its combinations	Capable using Root locus for designing a controller, which aims to For correct steady-state error, transient response, or both of them , and realize it .	Oral Post-Test (random) : Exercise Question Task Independent : Homework	Lecture [TM: 3x50"] Studying Exercise question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Controller design via Root locus: PID, lead, lag, lead-lag compensation - Physical realization	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%
14	Student capable design and realize PID controller	Capable using Root locus for designing a controller, which aims to For correct	Oral Post-Test (random) : Exercise Question Task Independent :	Lecture [TM: 3x50"] Studying Exercise question Practicum	- Controller design via Root locus: PID, lead, lag, lead-lag compensation	[1]: Chapter 10 [2]: Handout on myITS Calsroom	10%



	and its combinations	steady-state error, transient response, or both of them , and realize it .	Homework	Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Physical realization		
15	Student capable design and realize PID controller and its combinations	Capable using Root locus for designing a controller, which aims to For correct steady-state error, transient response, or both of them , and realize it .	Oral Post-Test (random) : Exercise Question Task Independent : Homework	Lecture [TM: 3x50"] Studying Exercise question Practicum Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Controller design via Root locus: PID, lead, lag, lead-lag compensation - Physical realization	[1]: Chapter 10 [2]: Handout on myITS Calssroom	10%
16	Final Semester Evaluation / Final Semester Exam						30%

Notes :

4. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
5. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.



6. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.
7. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
8. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.
9. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
10. **Forms of assessment:** test and non-test.
11. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
12. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.
13. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.
14. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.
15. TM=Face to Face, PT=Structured assignment, BM=Independent learning.

10. Plan Semester Learning (RPS)

Semester Learning Plan Document, documented individually for all MK

For study programs that participate in international accreditation, the RPS document is a reference for being transferred into a template that is in accordance with the requests of the accreditation body.



		SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING					Document Code	
SEMESTER LEARNING PLAN								
COURSE (Course)		CODE	MK Group		WEIGHT (credits)		SEMESTER	Date of Compilation
HYDRAULIC & PNEUMATIC POWER SYSTEM		TM184758			T= 3	P= 1	Choice	May 5, 2019
AUTHORIZATION		RPS Developer		RMK Coordinator		Head of PRODI		
						Suwarno		
Learning Outcomes (CP)	CPL-PRODI charged to MK							
	CPL -4	Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics .						
	CPL -5	Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience						
	CPL-7	Ability apply methods , skills and tools modern techniques are needed For practice system mechanics .						
	CPL-8	Ability identify , formulate , analyze and solve problem technique						
	Course Learning Outcomes (CPMK)							
	CPMK - 1	Student capable modeling a system dynamic . (CPL-5, CPL-7)						



	CPMK - 2	Student capable measure and evaluate system control the with component proper and correct control , both in a way independent and also in team. (CPL-4, CPL-8)				
		CPMK Matrix				
		CPMK	CPL-1	...		
		CPMK-1		V	V	
		...	V			
			V	V		
		...				
MK Brief Description	Principle system hydraulic and pneumatic power , design and utilization , systems control and its circuit					
Study Material: Learning Material	In eye studying This will learn the main points discussion as following : - Introduction system Hydraulic and Pneumatic Power : Principles and Uses in equipment mechanical - Fluid work and characteristics system hydraulics and pneumatic power - Component Hydraulic and Pneumatic power : Pumps , compressors , controllers and actuators . - Circuit system hydraulic and pneumatic power - System Servo and proportional control and characteristics .					
Library	Main :					
	[13]. Cundiff, John S., Fluid power circuits and controls, crc Press, 2002. [14]. Rabie, MG, Fluid Power Engineering, McGraw Hill, 2009. [15]. Younkin, GW, Industrial Servo Control Systems, Marcell Dekker, 2003.					
	Supporters :					



	[16]. Lecture Handout						
Supporting lecturer	Suwarmin						
Required courses							
Mg Ke	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	- Student capable understand and explain System concept hydraulics & pneumatics power	- Student capable give example hydraulics, pneumatics and system equipment the application	Oral Post-Test (random): Exercise question	Lecture [TM: 3x50"] Studying Introduction & Brainstorming Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Course outline - Principle Hydraulics & Pneumatics systems - Application in industry	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calsroom	



2	- Student capable understand and differentiate function fluid work (oil) hydraulic) system hydraulic power	- Capable and skilled choose type fluid Work based on characteristics and applications .	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Fluid work and its characteristics	[1]: Chapter 8 [2]: Handout on myITS Calssroom	
3	- Student capable understand principle work , characteristics and choosing component in hydraulic systems.	- Capable choose component in simulation with software. - Capable apply between software and component simulation on the test bench.	Oral Pre-Test (random): Exercise Question Practice on fluidsim software	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Component main hydraulic system - Pumps , Valves and actuators	[1]: Chapter 8 [2]: Handout on myITS Calssroom	10%
4	- Student capable understand principle work , characteristics and	- Capable choose component in simulation with software.	Oral Pre-Test (random): Exercise Question	Lecture [TM: 3x50"] Studying Practicum	- Component main hydraulic system - Pumps , Valves and actuators	[1]: Chapter 8 [2]: Handout on myITS Calssroom	10%



	choosing component in hydraulic systems.	- Capable apply between software and component simulation on the test bench.	Practice on fluidsim software	Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]			
5	- Student capable understand principle work , characteristics and choosing component in hydraulic systems.	- Capable choose component in simulation with software. - Capable apply between software and component simulation on the test bench.	Oral Pre-Test (random): Exercise Question Practice on fluidsim software	Lecture [TM: 3x50"] Studying Practicum Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Component main hydraulic system - Pumps , Valves and actuators	[[1]: Chapter 9 [2]: Handout on myITS Calssroom	10%
6	- Student make hydraulic circuit and control system.	- Capable analyze system real , modeling with software.	Oral Pre-Test (random): Exercise Question	Lecture [TM: 3x50"] Studying	- Hydraulics control circuits and systems	[1]: Chapter 9 [2]: Handout on myITS Calssroom	10%



	- Student capable evaluate characteristics system control .	- Realizing with components and evaluate characteristics the control .	Practice on fluidsimsim software Quiz	Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]			
7	Student capable understand servo hydraulics system	Capable and skilled choose servo components based on characteristics and applications .	Oral Pre-Test (random): Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Servo hydraulics system	[1]: Chapter 9 [2]: Handout on myITS Calssroom	
8	Mid Semester Evaluation / Mid Semester Exam						30%
9	- Student capable make hydraulic circuit and control system.	- Capable analyze system real , modeling with software. - Realizing with components and	Oral Pre-Test (random): Exercise Question	Lecture [TM: 3x50"] Study Structured [TM: 3x60"]	- Servo hydraulics system	[1]: Chapters 5 and 7 [2]: Handout on myITS Calssroom	



	- Student capable evaluate characteristics system control proportional	evaluate characteristics the control .	Practice on fluids sim software	Study Independent [TM: 3x60"]			
10	- Student capable understand and differentiate function fluid work (air) pressurized) system pneumatic power	Capable and skilled choose type fluid work (air) pressurized) based on characteristics and applications .	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Practicum Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Fluid pneumatics system work and characteristics	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	
11	- Student capable understand principle work , characteristics and choosing component in pneumatics systems.	- Capable choose component in simulation with software. - Capable apply between software and component simulation on the test bench .	Oral Pre-Test (random): Exercise Question Practice on fluids sim software	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question	- Component Main pneumatics system: Compressor , Valve and actuator	[1]: Chapter 7 [2]: Handouts in myITS Classroom	



				Study Independent [TM: 3x60"]			
12	- Student capable understand principle work , characteristics and choosing component in pneumatics systems.	- Capable choose component in simulation with software. - Capable apply between software and component simulation on the test bench .	Oral Pre-Test (random): Exercise Question Practice on fluidsims software	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Component Main pneumatics system: Compressor , Valve and actuator	[1]: Chapter 16 [2]: Handout on myITS Calsroom	
13	- Student make hydraulic circuit and control system. - Student capable evaluate characteristics system control .	- Capable analyze system real , modeling with software. - Realizing with components and evaluate characteristics the control .	Oral Pre-Test (random): Exercise Question Exercises on fluidsims software	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question	- Pneumatics control circuits and systems	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%



				Study Independent [TM: 3x60"]			
14	- Student capable understand pneumatics servo system	Capable and skilled choose servo components based on characteristics and applications .	Oral Pre-Test (random) : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Servo pneumatics system	[1]: Chapter 10 [2]: Handout on myITS Calsroom	
15	- Student capable make pneumatics circuits and control systems. - Student capable evaluate characteristics system control proportional .	- Capable analyze system real , modeling with software. - Realizing with components and evaluate characteristics the control .	Oral Pre-Test (random) : Exercise Question Practice on fluids sim software	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question	- Proportional control system	[1]: Chapter 10 [2]: Handout on myITS Calsroom	10%



				Study Independent [TM: 3x60"]			
16	Final Semester Evaluation / Final Semester Exam						30%

Notes :

5. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
6. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.
7. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.
8. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
9. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.
10. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
11. **Forms of assessment:** test and non-test.
12. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
13. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.



14. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.
15. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.
16. TM=Face to Face, PT=Structured assignment, BM=Independent learning.

10. Plan Semester Learning (RPS)

Semester Learning Plan Document, documented individually for all MK

For study programs that participate in international accreditation, the RPS document is a reference for being transferred into a template that is in accordance with the requests of the accreditation body.



	SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING					Document Code
SEMESTER LEARNING PLAN						
COURSE (Course)	CODE	MK Group	WEIGHT (credits)		SEMESTER	Date of Compilation
MAINTENANCE TECHNIQUES AND MANAGEMENT	TM184728		T= 3	P= 0	7	May 5, 2019
AUTHORIZATION	RPS Developer		RMK Coordinator		Head of PRODI	
					Suwarno	
Learning Outcomes (CP)	CPL-PRODI charged to MK					
	CPL -5	Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience .				
	CPL -7	Ability apply methods , skills and tools modern techniques are needed For practice system mechanics .				
	CPL-8	Ability identify , formulate , analyze and solve Technical problems .				
	CPL-10	Ability planning , completing and evaluating task based on results analysis information and data				
	Course Learning Outcomes (CPMK)					
	CPMK - 1	Student capable explain maintenance principles and functions (Preventive, Predictive, Proactive, Corrective, Reactive) and classifying equipment based on method / type maintenance . (CPL-10)				
	CPMK - 2	Student capable explain the law tool measurement used in condition monitoring (vibration , analysis) lubricants , NDT) and have ability base in usage tool measure and interpret results measurement . (CPL-8)				



	CPMK-3	Student capable calculate practice and evaluate the MTBF, reliability & availability of equipment and components . (CPL-7)			
	CPMK-4	Student Capable explain and use RCM, TPM, RBI methods in its implementation under maintenance. (CPL-5)			
	CPMK-5	Student capable explain and evaluate damage equipment based on RCFA & FMEA, performance maintenance function based on KPI. (CPL-8)			
		CPMK Matrix			
		CPMK	CPL-1	...	
		CPMK-1		V	V
		...	V		
			V	V	
		...			
MK Brief Description	Studying This discuss management maintenance (PM, PdM , RM , CM, Proactive RCM, TPM) and applications technique in maintenance (NDT, vibration diagnosis, shaft alignment, balancing, oil analysis and cathodic protection).				
Study Material: Learning Material	In eye studying This will learn the main points discussion as following : - Preventive, Predictive, Corrective Maintenance (PM, PdM , CM) and free maintenance functions . - Planning and scheduling . - Tool measuring in condition monitoring (vibration , analysis) lubricants , NDT). Principles measurement and interpretation results measurement . - The principles of MTBF, reliability, availability and maintainability of equipment and components . - Methods and implementation of RCM, TPM, RBI in industry . - Equipment and component failure evaluation (RCFA & FMEA) maintenance function performance based on KPI and identifying potential problems. - Vibration diagnosis such as unbalance, misalignment, bearing fault diagnosis, gear mess frequency, loosen component, crack shaft.				



	- Alignment method, balancing method. - Cathodic protection for stationary equipment.						
Library	Main :						
	[17]. Sullivan, GP., 2004, Operations & Maintenance Best Practices, Department of Energy (DOE). [18]. Scheffer , C., 2004, Practical Machinery Vibration Analysis & Predictive Maintenance, Burlington, Elsevier. [19]. Smith, AM., 2004, RCM: Gateway to World Class Maintenance, Elsevier. [20]. NASA, 2000, RCM Guide for Facilities and Collateral Equipment, Washington, NASA.						
	Supporters :						
	[21]. Joh O.McClain and L.Joseph Thomas: Operations management [22]. Martin K. Starr: Operations Management [23]. Grant and Leavenworth: Principles of Engineering Economy.						
Supporting lecturer	Witanty , Ari Kurniawan, Nur Yuniarto , Yusuf Kaelani , Suwarmin						
Required courses	-						
Mg Ke	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Student capable explain maintenance principles , understanding PM, PdM , RM , CM, RCM, TPM etc.	- Capable and skilled explain maintenance principles , understanding PM, PdM , RM , CM, RCM, TPM etc.	Oral Post-Test (random): Exercise Question	Lecture [TM: 3x50"] Studying Introduction & Brainstorming Study Structured [TM: 3x60"]	- Contract Studying maintenance principles - understanding PM, PdM , RM , CM, RCM, TPM etc.	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calsroom	



				Exercise question Study Independent [TM: 3x60"]			
2	Student capable explain and calculate Reliability, MTBF, MTTR, Availability .	- Capable and skilled finish Calculation of Reliability, MTBF, MTTR, Availability .	Oral Post-Test (random): Exercise Question Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- Reliability, MTBF, MTTR, Availability .	[1]: Chapter 8 [2]: Handout on myITS Calsroom	
3	Student capable explain and analyze Strategy Maintenance, Procedure use of RCM or TPM in industry .	- Capable and skilled explain Maintenance Strategy and applying RCM and TPM in cases maintenance in industry	Oral Post-Test (random): Exercise Question Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise question	- Maintenance Strategy , Procedure use RCM or TPM in industry	[1]: Chapter 8 [2]: Handout on myITS Calsroom	10%



				Study Independent [TM: 3x60"]			
4	Student capable read and explain PFD and P&ID diagrams and be able to classify equipment in the diagram	Capable explain with accurate PFD and P&ID diagrams and Capable classify type equipment in industry in a way Correct .	Oral Post-Test (random): Exercise Question	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- PFD and P&ID diagrams - Classification equipment in industry	[1]: Chapter 8 [2]: Handout on myITS Calssroom	
5	Student capable explain and interpret Monitoring principles & technologies (vibration, thermography & tribology/lubricant analysis)	- Capable explain monitoring principles & technologies (vibration, thermography & tribology/lubricant analysis) - Able to interpret monitoring data results	Oral Post-Test (random): Exercise Question Quiz : 2 questions 100 min Quiz	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- Principles & technologies of monitoring (vibration , thermography & tribology / analysis) lubricant)	[[1]: Chapter 9 [2]: Handout on myITS Calssroom	10%



6	Student capable explain and analyze Designing Experiments to Measure and Improve Reliability SIL, QRA, HAZOP, ECR	Capable explain and analyze Designing Experiments to Measure and Improve Reliability SIL, QRA, HAZOP, ECR	Oral Post-Test (random): Exercise Question	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- Designing Experiments to Measure and Improve the Reliability of SIL, QRA, HAZOP, ECR	[1]: Chapter 9 [2]: Handout on myITS Calsroom	
7	Student capable explain and analyze FMEA & RCFA in maintenance machine	Capable explain and analyze FMEA & RCFA in maintenance machine	Oral Post-Test (random): Exercise Question Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- FMEA & RCFA	[1]: Chapter 9 [2]: Handout on myITS Calsroom	10%
8	Mid Semester Evaluation / Mid Semester Exam						30%
9	Student capable to apply draft	Capable to apply draft maintenance includes	Oral Post-Test (random):	Lecture [TM: 3x50"]	- Planning, Scheduling & Turnaround	[1]: Chapters 5 and 7	



	maintenance includes Planning, Scheduling & Turnaround	Planning, Scheduling & Turnaround	Exercise Question Task Independent : Homework	Studying Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]		[2]: Handout on myITS Calsroom	
10	- Student capable explain Principle work and characteristics of Rotating Equipment (Pumps/ compressors/steam turbines/gas turbines) and implementing their maintenance systems.	Capable explain Principle work and characteristics of Rotating Equipment (Pumps/compressors/ steam turbines/gas turbines) and their maintenance systems.	Oral Post-Test (random): Exercise Question Presentation Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Task Presentation Study Independent [TM: 3x60"]	- Principle Working and characteristics of Rotating Equipment (Pumps/compressors/steam turbines/gas turbines)	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	
11	- Student capable explain Principle work and characteristics Stationary Equipment (Vessel/piping/Boiler/H eat exchanger) and implementing its maintenance system.	Capable explain Principle work and characteristics Stationary Equipment (Vessel/piping/Boiler/H eat exchanger) and systems its maintenance .	Oral Post-Test (random): Presentation Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Task Presentation	- Principle work and characteristics Stationary Equipment (Vessel/piping/Boiler/Heat exchanger)	[1]: Chapter 7 [2]: Handouts in myITS Classroom	10%



				Study Independent [TM: 3x60"]			
12	- Student capable explain Principle work and characteristics of Electrical Equipment (electric motors /generators/transformers) and implementing maintenance systems.	Capable explain Principle work and characteristics of Electrical Equipment (electric motors /generators/transformers) and systems its maintenance .	Oral Post-Test (random): Presentation Task Independent : Homework Quiz : 2 questions 100 min Quiz	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Task Presentation Study Independent [TM: 3x60"]	- Principle work and characteristics Electrical Equipment (Electric motor /Generator/transformer)	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%
13	- Student capable explain Principle the work and characteristics of Instrumentation Equipment (Sensors, transmitters & actuators) and implementing its maintenance system.	Capable explain Principle work and characteristics of Instrumentation Equipment (Sensors, transmitters & actuators) and systems its maintenance .	Oral Post-Test (random): Exercise Question Presentation Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Task Presentation	- Principle work and characteristics Instrumentation Equipment (Sensors, transmitters & actuators)	[1]: Chapter 16 [2]: Handout on myITS Calsroom	



				Study Independent [TM: 3x60"]			
14	- Student capable explain Principle work and characteristics of Mobile Equipment (Vehicle/ Crane/ Conveyor) and implementing its maintenance system.	Capable explain Principle work and characteristics of Mobile Equipment (Vehicle/ Crane/ Conveyor) and systems its maintenance .	Oral Post-Test (random): Presentation Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Task Presentation Study Independent [TM: 3x60"]	- Principle work and characteristics Mobile Equipment (Vehicle/ Crane/ Conveyor	[1]: Chapter 10 [2]: Handout on myITS Calsroom	
15	- Student capable explain Principle the working and characteristics of Mechanical Components (Seals, Bearings & Gears) and implementing their maintenance systems.	Capable explain Principle work and characteristics of Mechanical Components (Seals, Bearings & Gears) and systems its maintenance .	Oral Post-Test (random): Presentation Task Independent : Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Task Presentation Study Independent [TM: 3x60"]	- Principle Working and characteristics of Mechanical Components (Seals, Bearings & Gears) [1]: Chapter 10 [2]: Handout on myITS Calsroom	[1]: Chapter 10 [2]: Handout on myITS Calsroom	



16	Final Semester Evaluation / Final Semester Exam						30%

Notes :

6. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
7. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.
8. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.
9. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
10. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.
11. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
12. **Forms of assessment:** test and non-test.
13. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
14. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.
15. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.



16. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.

17. TM=Face to Face, PT=Structured assignment, BM=Independent learning.

10. Plan Semester Learning (RPS)

Semester Learning Plan Document, documented individually for all MK

For study programs that participate in international accreditation, the RPS document is a reference for being transferred into a template that is in accordance with the requests of the accreditation body.



	SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING					Document Code
	SEMESTER LEARNING PLAN					
COURSE (Course)	CODE	MK Group	WEIGHT (credits)		SEMESTER	Date of Compilation
MECHATRONICS	TM184626		T= 4	P= 0	7	May 5, 2019
AUTHORIZATION	RPS Developer		RMK Coordinator		Head of PRODI	
					Suwarno	
Learning Outcomes (CP)	CPL-PRODI charged to MK					
	CPL -4	Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics (mechanical system).				
	CPL -5	Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science and technology up to date and considering standard technical , aspects performance , reliability , and convenience implementation , and/ or utilise potential source Power local and national with global insight .				
	CPL-7	Ability apply methods , skills and tools modern techniques are needed For practice system mechanics .				
	CPL-8	Ability identify , formulate , analyze and solve problem technique .				
	Course Learning Outcomes (CPMK)					
	CPMK - 1	Student capable modeling a system control discrete and continuous . (CPL-5, CPL-7)				



	CPMK - 2	Student capable measure and evaluate system control the with component proper and correct control , both in a way independent and also in team. (CPL-4, CPL-8)																												
		CPMK Matrix <table><tr><td>CPMK</td><td>CPL-1</td><td>...</td><td></td><td></td></tr><tr><td>CPMK-1</td><td></td><td>V</td><td>V</td><td></td></tr><tr><td>...</td><td>V</td><td></td><td></td><td></td></tr><tr><td></td><td>V</td><td>V</td><td></td><td></td></tr><tr><td>...</td><td></td><td></td><td></td><td></td></tr></table>				CPMK	CPL-1	...			CPMK-1		V	V		...	V					V	V			...				
CPMK	CPL-1	...																												
CPMK-1		V	V																											
...	V																													
	V	V																												
...																														
MK Brief Description	Mechatronics : Design and realization system control Mechanical and Electronics																													
Study Material: Learning Material	In eye studying This will learn the main points discussion as following : - Component System control : Sensors, Controllers and Actuators - Document system control : PFD, Single line diagram and P&ID - System control Discrete : Simulation , ladder diagram, logic diagram and test bench - System control Continuous : Simulation , measurement and evaluation compensator (P, PD, PI & PID) system analog and digital control . - System Project control : Design system control use Arduino or National Instrument with simulation from LabView.																													
Library	Main :																													
	[24]. Meier, Fred, Instrumentation and Control Systems Documentation, ISA 2004																													
	[25]. Bishop, R.H., The Mechatronics Handbook, CRC Press, Boca Raton, 2002																													
	[26]. Bateson, RN, Introduction to Control System Technology 3rd. Ed., Maxwell Macmillan, Ny 1991.																													
	[27]. Schwartz, M., Programming Arduino with LabVIEW, Packt Publishing, Birmingham, 2015																													
	Supporters :																													
	[28]. Timmis , Harold, Practical Arduino Engineering, Springer Science, 2011																													



Supporting lecturer		Suwarmin , Nur Yuniarto , M. Khoirul Effendi, Ari Kurniawan Saputra					
Required courses		DYNAMICS AND CONTROL SYSTEMS					
Mg Ke	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Student capable understand and explain principle how sensors and actuators work	- Student capable explain principle how sensors and actuators work . - Student capable selecting the sensors and actuators used in system control .	Oral Post-Test (random) : Task Independent : Home work	Lecture [TM: 3x50"] Studying Introduction & Brainstorming Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- Course outline - Classification and principles sensor work - Classification and principles Work actuator - Theory failure static	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calsroom	
2	Student capable understand and explain principle	- Student capable explain principle how sensors and actuators work .	Oral Post-Test (random) : Task Independent : Home work	Lecture [TM: 3x50"] Studying Introduction & Brainstorming	- Course outline - Classification and principles sensor work	[1]: Chapter 8 [2]: Handout on myITS Calsroom	



	how sensors and actuators work	- Student capable selecting the sensors and actuators used in system control .		Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- Classification and principles Work actuator		
3	Student capable understand PFD and design P&ID	- Capable and skilled to design element / symbol control from sensors, controls and actuators . - Capable understand the process in P&ID and transfer in single line diagram form .	Oral Post-Test (random) : Exercise Question Task Independent : Home work	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- PFD & P&ID - Symbol control and its use	[1]: Chapter 8 [2]: Handout on myITS Calssroom	
4	- Student capable understand and design system control discrete Student capable apply control discrete in fluidsims software	- Capable to design system control discrete - Capable create ladder diagrams with different models . Capable make control logic diagram	Oral Post-Test (random) : Exercise Question Practice on Fluidsim Task Independent : Home work	Lecture [TM: 3x50"] Studying Practicum Study Structured [TM: 3x60"] Exercise question	- System control discrete - Introduction to Fluidsim	[1]: Chapter 8 [2]: Handout on myITS Calssroom	10%



				Study Independent [TM: 3x60"]			
5	- Student capable understand and design system control discrete - Student capable apply control discrete in fluidsims software	- Capable to design system control discrete - Capable create ladder diagrams with different models . - Capable make control logic diagram	Oral Post-Test (random): Exercise Question Practice on Fluidsim Task Independent : Home work	Lecture [TM: 3x50"] Studying Practicum Study Structured [TM: 3x60"] Exercise question Study Independent [TM: 3x60"]	- System control discrete - Introduction to Fluidsim	[[1]: Chapter 9 [2]: Handout on myITS Calssroom	10%
6	- Student capable use tool measure . - Student capable to design system control discrete and realized on the Festo test bench	- Capable use tool measure (oscilloscope, avometer) for measure response time . - Capable transfer ladder diagram to logic diagram - Capable realize the simulation model to in physical model (Festo test bench)	Oral Pre-Test (random): Exercise question Practicum simulation Fluidsim and physical models pneumatics system Task Independent :	Lecture [TM: 3x50"] Studying Practicum with Tool measure and Festo Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Use tool Measuring - Simulation with Fluidsim - Use of Festo Test bench	[1]: Chapter 9 [2]: Handout on myITS Calssroom	10%



		-					
7	- Student capable use tool measure . - Student capable to design system control discrete and realized on the Festo test bench	- Capable use tool measure (oscilloscope, avometer) for measure response time . - Capable transfer ladder diagram to logic diagram - Capable realize the simulation model to in physical model (Festo test bench)	Oral Pre-Test (random) : Exercise question Practicum simulation Fluidsim and physical models pneumatics system Task Independent :	Lecture [TM: 3x50"] Studying Practicum with Tool measure and Festo Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Use tool Measuring - Simulation with Fluidsim - Use of Festo Test bench	[1]: Chapter 9 [2]: Handout on myITS Calssroom	10%
8	Mid Semester Evaluation / Mid Semester Exam						30%
9	- Students are able to create continuous control system simulations and realize them on a test bench. - Students are able to evaluate the quality of control systems	- Capable select and simulate components in control continuous . - Capable using , measuring and evaluating compensators P, PD, PI and PID.	Oral Pre-Test (random) : Exercise simulation Practical work on the test bench Task Independent :	Lecture [TM: 3x50"] Studying Practicum Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Continuous control system (analog) - Response time system analog control	[1]: Chapters 5 and 7 [2]: Handout on myITS Calssroom	10%



10	- Students are able to create continuous control system simulations and realize them on a test bench. - Students are able to evaluate the quality of control systems	- Capable select and simulate components in control continuous . - Capable using , measuring and evaluating compensators P, PD, PI and PID.	Oral Pre-Test (random): Exercise simulation Practical work on the test bench Task Independent :	Lecture [TM: 3x50"] Studying Practicum Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Continuous control system (analog) - Response time system analog control	[1]: Chapters 5 and 7 [2]: Handout on myITS Calsroom	10%
11	- Students are able to understand the working principles of controllers (Arduino and MATLAB)	- Capable understand principle Work from Arduino chart (Input and output) and Nationl Instrument - Capable understand and implement LabView on Arduino and MATLAB charts	Oral Pre-Test (random): Exercise question Task Independent : Homework Quiz : 3 questions 150 min Quiz	Lecture [TM: 3x50"] Studying Practicum Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- System control continuous (Digital) - Introduction to Arduino - Introduction to LabView	[1]: Chapter 7 [2]: Handouts in myITS Classroom	10%
12	- Students are able to understand the working principles of controllers	- Capable understand principle Work from Arduino chart (Input and output) and Nationl Instrument	Oral Pre-Test (random): Exercise question	Lecture [TM: 3x50"] Studying Practicum	- System control continuous (Digital) - Introduction to Arduino	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%



	(Arduino and MATLAB)	and output) and National Instrument Capable understand and implement LabView on Arduino and MATLAB charts	Task Independent : Homework Quiz : 3 questions 150 min Quiz	Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Introduction to LabView [1]: Chapter 16 [2]: Handout on myITS Calssroom		
13	- Student capable to design simulate and realize system control with Arduino	Capable make system control from sensors, controllers and actuators with using Arduino	Oral Post-Test (random): Realization of system project control .	Lecture [TM: 3x50"] Consultation Design system control Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- System Project control [1]: Chapter 16 [2]: Handout on myITS Calssroom	[1]: Chapter 16 [2]: Handout on myITS Calssroom	
14	- Student capable to design simulate and realize system control with Arduino	Capable make system control from sensors, controllers and actuators with using Arduino	Oral Post-Test (random): Realization of system project control .	Lecture [TM: 3x50"] Consultation Design system control Study Structured [TM: 3x60"]	- System Project control [	[1]: Chapter 10 [2]: Handout on myITS Calssroom	



				Study Independent [TM: 3x60"]			
15	- Student capable to design simulate and realize system control with Arduino	Capable make system control from sensors, controllers and actuators with using Arduino	Oral Post-Test (random): Realization of system project control .	Lecture [TM: 3x50"] Consultation Design system control Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- System Project control	[1]: Chapter 10 [2]: Handout on myITS Calsroom	
16	Final Semester Evaluation / Final Semester Exam						30%

Notes :

7. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
8. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.
9. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.



10. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
11. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.
12. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
13. **Forms of assessment:** test and non-test.
14. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
15. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.
16. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.
17. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.
18. TM=Face to Face, PT=Structured assignment, BM=Independent learning.

10. Rencana Pembelajaran Semester (RPS)

Dokumen Rencana Pembelajaran Semester, didokumentasikan secara sendiri untuk seluruh MK
Untuk prodi-prodi yang ikut akreditasi internasional, dokumen RPS menjadi acuan untuk dipindahkan ke dalam template yang sesuai dengan permintaan badan akreditasi tsb.



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER							
MATA KULIAH (MK)	KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
MEKANISME ROBOT <i>ROBOT MECHANISM</i>	TM184776	Rekayasa Sistem dan Kontrol <i>Systems and Control Engineering</i>		T=2	P=1	Pilihan	20 November 2023
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>SLP Developer</i>		Koordinator RMK <i>Subject Group Coordinator</i>		Ketua PRODI <i>Head of Study Program</i>		
	Unggul Wasiwitono		Latifah Nurahmi		Suwarno		
Capaian Pembelajaran (CP) <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>Study Program Learning Outcomes assigned to the course</i>						
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika. <i>The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.</i>					
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan.					



		<i>The ability to design components, systems, and/or mechanical processes to meet expected needs using an analytical engineering approach based on advanced science and technology, while considering technical standards, performance aspects, reliability, and ease of use.</i>			
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>The ability to apply modern methods, skills, and engineering tools necessary for the practice of mechanical systems.</i>			
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan Teknik <i>The ability to identify, formulate, analyze, and solve engineering problems.</i>			
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcomes (CLO)</i>				
	CPMK-1	Mahasiswa mampu menunjukkan posisi dan perpindahan robot serial dan paralel (CPL-4, CPL-8) <i>Student capable show serial and parallel robot position and displacement (CPL)</i>			
	CPMK-2	Mahasiswa mampu menunjukkan hubungan antara matrix Jacobian dengan singulariti dari sebuah konfigurasi robot (CPL-4, CPL-8) <i>Student capable show connection between the Jacobian matrix and singularity from A robot configuration (CPL-4, CPL-8)</i>			
	CPMK-3	Mahasiswa mampu mendesain struktur robot paralel yang memenuhi derajat kebebasan yang diinginkan (CPL-5, CPL-7) <i>Student capable designing parallel robot structure that meets degrees desired freedom (CPL-5, CPL-7)</i>			
		Matrik CPL – CPMK			
		CPMK	CPL-1	...	
		CPMK-1		V	V
		...	V		
			V	V	



		...				
Deskripsi Singkat MK <i>Course Brief Description</i>	Robot manipulator serial dan parallel, Matrix Jacobian dan Singularity <i>Serial and parallel manipulator robots, Jacobian Matrix and Singularity</i>					
Bahan Kajian: Materi Pembelajaran <i>Study Material: Learning Material</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Jenis robot dan perkembangannya : robot industri, robot humanoid, robot mobile - Analisa posisi dan perpindahan : derajat kebebasan, transformasi koordinat, posisi dan orientasi - Matrix Jacobian dan singulariti : jenis singulariti ditinjau dari matrix Jacobian - Desain robot : teori screw, jenis constraint pada berbagai sambungan - Komputasi : analisa perhitungan posisi dan perpindahan secara komputasi					
Pustaka <i>References</i>	Utama :					
	[29].	Lung-Wen Tsai. Robot Analysis: The Mechanics of Serial and Parallel Manipulators. John Wiley and Sons, Inc, 1999.				
	[30].	Xianwen Kong and Clément Gosselin. Type Synthesis of Parallel Mechanisms. Springer Verlag Berli Heidelberg, 2007.				
	Pendukung :					
	[31].	Jorge Angeles. Fundamentals of Robotic Mechanical Systems: Theory, Methods and Algorithm. Springer Verlag New York, 2nd edition. 2003.				
Dosen Pengampu <i>Lecturer</i>	Latifah Nurahmi					
Matakuliah syarat <i>prerequisite courses</i>						



No	Kemampuan akhir tiap tahapan belajar <i>Final ability of each stage of learning</i> (Sub-CPMK)	Penilaian <i>Evaluation</i>		Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Forms, Learning Methods, Student Assignments,</i> [Estimasi Waktu/ Estimated Time]		Materi Pembelajaran <i>Learning materials</i> [Pustaka/ Reference]	Bobot Penilaian <i>Assessment Weight</i> (%)
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria and Forms</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu mengidentifikasi jenis-jenis robot dan kegunaannya, serta perkembangannya dari tahun ke tahun <i>Student capable identify types of robots and their uses, as well as its development from year to year</i>	Mampu dan terampil menyebutkan jenis-jenis robot berdasarkan bermacam kriteria, misalnya: degree-of-freedom, kinematic structures, motion type, workspace. <i>Capable and skilled mention types of robots based on various criteria, for example: degree-of-freedom, kinematic structures, motion type, workspace</i>	Oral Post-Test (acak): <i>Oral Post-Test (random):</i> Latihan Soal <i>Exercise</i>	Perkuliah [TM: 3x50"] Kuliah Pengantar & Brainstorming Video robot machining dan robot pick-and-place <i>Studying Introduction & Brainstorming Robot machining and pick-and-place robot videos</i>	Kontrak Kuliah <i>Contract Studying</i> Sistem robotika <i>System robotics</i> Klasifikasi robot <i>Classification of robots</i> Serial robot <i>Robot series</i>	[1]: Bab 1, 3 dan 5 [2]: Handout di myITS Calssroom	



				Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Paralel robot <i>Parallel robots</i>		
2	Mahasiswa mampu menganalisa menghitung posisi dan orientasi benda tegar <i>Student capable analyze count position and orientation object tough</i>	Mampu dan terampil menyelesaikan dan merumuskan matriks posisi dan orientasi dari sebuah benda tegar <i>Capable and skilled finalize and formulate matrix position and orientation from A object tough</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Koordinat transformasi benda tegar <i>Coordinate transformation object tough</i>	[1]: Bab 8 [2]: Handout di myITS Calssroom	
3	Mahasiswa mampu merumuskan transformasi koordinat robot serial <i>Student capable formulate transformation serial robot coordinates</i>	Mampu dan terampil mendapatkan parameter Denavit Hartenberg serta merumuskan menjadi matriks transformasi untuk robot serial <i>Capable and skilled get Denavit parameters Hartenberg as well as</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Teori Denavit-Hartenberg Direct kinematics Inverse kinematics	[1]: Bab 8 [2]: Handout di myITS Calssroom	



		<i>formulate become matrix transformation for serial robots</i>					
4	Mahasiswa mampu merumuskan transformasi koordinat robot serial <i>Student capable formulate transformation serial robot coordinates</i>	Mampu dan terampil mendapatkan parameter Denavit Hartenberg serta merumuskan menjadi matriks transformasi untuk robot serial <i>Capable and skilled get Denavit parameters Hartenberg as well as formulate become matrix transformation for serial robots</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Teori Denavit-Hartenberg - Direct kinematics - Inverse kinematics	[1]: Bab 8 [2]: Handout di myITS Calssroom	
5	Mahasiswa mampu menurunkan dan menunjukkan matriks Jacobian robot serial <i>Student capable lower and show Jacobian matrix of serial robot</i>	- Mampu dan terampil merumuskan matriks Jacobian. - <i>Capable and skilled formulate Jacobian matrix</i> - Mampu dan terampil menunjukkan konfigurasi singulariti dari matriks Jacobian. - <i>Capable and skilled show configuration singularity from Jacobian matrix .</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Analisa matriks Jacobian robot serial <i>Jacobian matrix analysis of serial robots</i>	[1]: Bab 9 [2]: Handout di myITS Calssroom	



6	Mahasiswa mampu menurunkan dan menunjukkan matriks Jacobian robot serial <i>Student capable lower and show Jacobian matrix of serial robot</i>	- Mampu dan terampil merumuskan matriks Jacobian. - <i>Capable and skilled formulate Jacobian matrix</i> - Mampu dan terampil menunjukkan konfigurasi singulariti dari matriks Jacobian. - <i>Capable and skilled show configuration singularity from Jacobian matrix.</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Analisa matriks Jacobian robot serial <i>Jacobian matrix analysis of serial robots</i>	[1]: Bab 9 [2]: Handout di myITS Calsroom	
7	Mahasiswa mampu menerapkan hasil perhitungan pada program komputer <i>Student capable apply results calculations in computer programs</i>	Mampu dan terampil menuliskan program komputer untuk mendapatkan solusi direct kinematics dan inverse kinematics. <i>Capable and skilled write computer programs For get direct kinematics and inverse kinematics solutions.</i>	Oral Pre-Test (acak): Tugas pada software Matlab <i>Assignments on Matlab software</i>	Perkuliahan [TM: 3x50"] Software Matlab Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Direct kinematics dan inverse kinematics robot serial planar <i>Direct kinematics and inverse kinematics of planar serial robots</i>	[1]: Bab 9 [2]: Handout di myITS Calsroom	20%



8	Evaluasi Tengah Semester / Ujian Tengah Semester <i>Mid Semester Evaluation / Mid Semester Exam</i>						30%
9	Mahasiswa mampu merumuskan transformasi koordinat robot parallel <i>Student capable formulate transformation parallel robot coordinates</i>	Mampu dan terampil mendapatkan parameter matrikx transformasi untuk robot parallel <i>Capable and skilled get matrix parameters transformation for parallel robots</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Direct kinematics - <i>Direct kinematics</i> - Inverse kinematics - <i>Inverse kinematics</i>	[1]: Bab 5 dan 7 [2]: Handout di myITS Calssroom	
10	Mahasiswa mampu merumuskan transformasi koordinat robot parallel <i>Student capable formulate transformation parallel robot coordinates</i>	Mampu dan terampil mendapatkan parameter matrikx transformasi untuk robot parallel <i>Capable and skilled get matrix parameters transformation for parallel robots</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Direct kinematics - <i>Direct kinematics</i> - Inverse kinematics - <i>Inverse kinematics</i>	[1]: Bab 6 dan 7 [2]: Handout di myITS Calssroom	
11	Mahasiswa mampu menurunkan dan	- Mampu dan terampil merumuskan matriks Jacobian.	Oral Pre-Test (acak): Latihan Soal	Perkuliahan [TM: 3x50"] Kuliah	- Analisa matriks	[1]: Bab 7 [2]: Handout di myITS Classroom	



	menunjukkan matriks Jacobian robot parallel <i>Student capable lower and show Jacobian matrix of parallel robot</i>	- <i>Capable and skilled formulate Jacobian matrix</i> - Mampu dan terampil menunjukkan konfigurasi singulariti dari matriks Jacobian. - <i>Capable and skilled show configuration singularity from Jacobian matrix .</i>	Exercise Homework	Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	Jacobian robot parallel - <i>Jacobian matrix analysis of parallel robots</i>		
12	Mahasiswa mampu menurunkan dan menunjukkan matriks Jacobian robot parallel <i>Student capable lower and show Jacobian matrix of parallel robot</i>	- Mampu dan terampil merumuskan matriks Jacobian. - <i>Capable and skilled formulate Jacobian matrix</i> - Mampu dan terampil menunjukkan konfigurasi singulariti dari matriks Jacobian. - <i>Capable and skilled show configuration singularity from Jacobian matrix .</i>	Oral Pre-Test (acak): Latihan Soal Exercise Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	- Analisa matriks Jacobian robot parallel - <i>Jacobian matrix analysis of parallel robots</i>	[1]: Bab 16 [2]: Handout di myITS Calsroom	
13	Mahasiswa mampu mendesain struktur robot parallel	Mampu menganalisa proses pemeriksaan mesin perkakas	Oral Pre-Test (acak): Latihan Soal	Perkuliahan [TM: 3x50"] Kuliah	- Teori screw - <i>Screw theory</i>	[1]: Bab 16 [2]: Handout di myITS Calsroom	



	<i>Student capable designing parallel robot structure</i>	<i>Capable analyze the inspection process machine tools</i>	<i>Exercise</i> Homework	Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	Type synthesis - <i>Type synthesis</i>		
14	Mahasiswa mampu mendesain struktur robot parallel <i>Student capable designing parallel robot structure</i>	Mampu dan terampil menerapkan teori screw untuk mendesain struktur robot parallel <i>Capable and skilled apply screw theory for designing parallel robot structure</i>	Oral Pre-Test (acak): Latihan Soal <i>Exercise</i> Homework	Perkuliahan [TM: 3x50"] Kuliah Belajar Terstruktur [TM: 3x60"] Latihan Soal Belajar Mandiri [TM: 3x60"]	Teori screw - <i>Screw theory</i> Type synthesis - <i>Type synthesis</i>	[1]: Bab 10 [2]: Handout di myITS Calssroom	
15	Mahasiswa mampu menerapkan hasil perhitungan pada program computer <i>Student capable apply results calculations in computer programs</i>	Mampu dan terampil menerapkan teori screw untuk mendesain struktur robot parallel <i>Capable and skilled apply screw theory for designing parallel robot structure</i>	Oral Pre-Test (acak): Tugas	Perkuliahan [TM: 3x50"] Projek kelompok Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- <i>Direct Kinematics inverse kinematics robot parller</i> - http://www.parallelmic.org/Java/3RRR.html	[1]: Bab 10 [2]: Handout di myITS Calssroom	20%



16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Semester Evaluation / Final Semester Exam</i>						30%

Catatan :

8. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
9. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
10. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
11. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
12. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
13. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
14. **Bentuk penilaian:** tes dan non-tes.



15. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
16. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
17. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
18. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
19. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen	
RENCANA PEMBELAJARAN SEMESTER							
MATA KULIAH (MK)	KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
MEKATRONIKA	TM234502	RSK		T=3	P=1	5	21 November 2023
OTORISASI AUTHORIZATION	Pengembang RPS SLP Developer		Koordinator RMK Subject Group Coordinator			Ketua PRODI Head of Study Program	
	Unggul Wasiwitono		Latifah Nurahmi			Suwarno	
Capaian Pembelajaran (CP) Learning Outcomes	CPL-PRODI yang dibebankan pada MK Study Program Learning Outcomes assigned to the course						
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika. The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.					
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan.					



		<i>The ability to design components, systems, and/or mechanical processes to meet expected needs using an analytical engineering approach based on advanced science and technology, while considering technical standards, performance aspects, reliability, and ease of use.</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian Teknik. <i>The ability to conduct laboratory and/or field experiments as well as analyze and interpret data to enhance engineering judgment.</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>The ability to apply modern methods, skills, and engineering tools necessary for the practice of mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>The ability to identify, formulate, analyze, and solve engineering problems.</i>
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi <i>The ability to communicate effectively, both orally and in writing, and to apply technology-based entrepreneurship.</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcomes (CLO)</i>	
	CPMK-1	Mampu mengidentifikasi dan mendeskripsikan komponen dasar dari sistem mekatronika. <i>Able to identify and describe the basic components of a mechatronics system.</i>
	CPMK-2	Mampu mengidentifikasi dan memilih sensor, aktuator, dan komponen yang sesuai untuk sistem mekatronika. <i>Able to identify and select appropriate sensors, actuators, and components for mechatronics systems.</i>
	CPMK-3	Memahami konsep pemrosesan sinyal dan penggunaan sistem antarmuka. <i>Understanding the concept of signal processing and the use of interface systems.</i>
	CPMK-4	Mampu mendemonstrasikan penggunaan mikrokontroler, integrasi sensor dan aktuator dalam sistem mekatronika. <i>Able to demonstrate the use of microcontrollers, sensor integration, and actuators in a mechatronics system.</i>
	CPMK-5	Mampu merancang dan membangun sistem mekatronika yang terintegrasi penuh untuk melakukan tugas yang ditentukan.



		<i>Able to design and build a fully integrated mechatronics system to perform specified tasks.</i>						
	CPMK-6	Mampu mengkomunikasikan pekerjaan teknik mereka secara efektif dalam bentuk laporan teknis dan presentasi. <i>Able to effectively communicate their engineering work in the form of technical reports and presentations.</i>						
		Metrik CPL – CPMK						
		CPMK	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-9
		CPMK-1	V				V	
		CPMK-2	V		V	V		
		CPMK-3					V	
		CPMK-4			V	V		
		CPMK-5		V	V	V	V	
		CPMK-6						V
Deskripsi Singkat MK <i>Course Brief Description</i>	Mata kuliah ini membahas tentang mekatronika dan penerapannya pada pengendalian mesin/peralatan. Ruang lingkup mata pelajaran meliputi aplikasi sistem kendali dasar, integrasi sensor/aktuator dan sistem kendali serta aplikasi kendali sederhana sistem mekanik dengan komputer/mikrokontroller dan teknik akuisisi data. Mata kuliah ini akan memberikan pengetahuan dasar, alat, dan latar belakang desain mekatronika dan memungkinkan mahasiswa untuk memahami komponen mekatronik modern. <i>This course discusses mechatronics and its applications in the control of machines/equipment. The scope of the subject includes basic control system applications, integration of sensors/actuators and control systems, as well as simple control applications for mechanical systems using computers/microcontrollers and data acquisition techniques. This course will provide foundational knowledge, tools, and a background in mechatronics design, enabling students to understand modern mechatronic components.</i>							
Bahan Kajian: Materi Pembelajaran	1. Komponen dasar mekatronika dan sistem kontrol <i>Basic components of mechatronics and control systems</i> 2. Komponen elektronika pasif dan aktif <i>Passive and active electronic components</i> 3. Sinyal digital dan logika digital							



<i>Study Material: Learning Material</i>	<i>Digital signals and digital logic</i> 4. Sensor dan aktuator <i>Sensors and actuators</i> 5. Implementasi sistem pengendalian digital <i>Implementation of digital control systems</i> 6. Pemrograman Arduino <i>Arduino programming</i> 7. Project sistem mekatronika: perancangan sistem mekatronika dengan menggunakan Arduino <i>Mechatronics system project: designing a mechatronics system using Arduino</i>	
Pustaka <i>References</i>	Utama (Main) :	
	1. Musa Jouaneh, Fundamentals of Mechatronics. Cengage Learning, 2012.	
	Pendukung (Supporting) :	
	1. David G. Alciatore, Introduction to Mechatronics and Measurement Systems, 5th. Ed, Mc Graw Hill Education, 2019 2. Robert H. Bishop, Mechatronic Systems, Sensors, and Actuators: Fundamentals and Modeling, CRC Press, 2008 3. Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th. Ed., Pearson, 2015 4. Arduino Programming: The Ultimate Intermediate Guide To Learn Arduino Programming Step By Step, by Ryan Turner 5. Kunjungi: https://www.arduino.cc/ untuk mengunduh open-source Arduino Software (IDE) 6. kunjungi: www.tinkercad.com untuk melakukan simulasi virtual dari Arduino board	
Dosen Pengampu <i>Lecturer</i>	Suwarmin, Bambang Pramujati, Unggul Wasiwitono, Latifah Nurahmi	
Mata kuliah syarat	Instrumentasi, Pengukuran dan Metrologi (<i>Instrumentation, Measurement and Metrology</i>) Sistem Dinamis dan Pengendalian (<i>Dynamic Systems and Control</i>)	



prerequisite courses							
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar <i>Final ability of each stage of learning (Sub-CPMK)</i>	Penilaian <i>Evaluation</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Forms, Learning Methods, Student Assignments, [Estimasi Waktu/ Estimated Time]</i>		Materi Pembelajaran <i>Learning materials [Pustaka/Reference]</i>	Bobot Penilaian <i>Assessment Weight (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria and Forms</i>	Luring <i>(offline)</i>	Daring <i>(online)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mampu mengidentifikasi dan mendeskripsikan komponen dasar dari sistem mekatronika <i>Able to identify and describe the basic components of a mechatronics system</i>	Ketepatan dalam menjelaskan apa itu sistem mekatronika dan memberi contoh aplikasi sistem mekatronika <i>Accuracy in explaining what a mechatronics system is and providing examples of mechatronics system applications</i>	Homework	Kuliah dan diskusi <i>Lecture and discussion</i> TM: 1x (3x50")		- Pengantar Mekatronika <i>Introduction to Mechatronics</i> - Contoh-contoh sistem mekatronika <i>Examples of mechatronic systems</i> [Ref 1, Bab. 1]	5



2	Mampu memahami dan memilih komponen elektronika pasif dan fungsinya <i>Able to understand and select passive electronic components and their functions</i>	Ketepatan menjelaskan dan memilih komponen elektronika pasif. <i>Accuracy in explaining and selecting passive electronic components</i>	Homework	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> Latihan Soal <i>Exercises</i> TM: 1x (3x50'')		- Elemen elektronika dasar <i>Basic electronic elements</i> - Analisa rangkaian elektronika <i>Electronic circuit analysis</i> [Ref 1, Bab. 2] - [Ref 2, Bab. 2]	5
3	Mampu memahami dan memilih komponen elektronika aktif dan fungsinya <i>Able to understand and select active electronic components and their functions</i>	Ketepatan menjelaskan fisika dasar perangkat semikonduktor dan memilih komponen elektronika aktif. <i>Accuracy in explaining the basic physics of semiconductor devices and selecting active electronic components</i>	Homework	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> Latihan Soal <i>Exercises</i> TM: 1x (3x50'')		- Semiconductor - Diode - Transistor [Ref 1, Bab. 3] [Ref 2, Bab. 3]	5
4	Evaluasi 1						
5	Mampu menerapkan konsep sinyal digital, aljabar boolean dan gerbang logika	Ketepatan dalam menjelaskan, menggunakan dan membuat gerbang logika	Homework	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> Latihan Soal		- Aljabar boolean <i>Boolean algebra</i> - Gerbang logika <i>Logic gates</i>	10



	<i>Able to apply the concepts of digital signals, Boolean algebra, and logic gates</i>	<i>Accuracy in explaining, using, and creating logic gates</i>		<i>Exercises</i> TM: 1x (3x50")		[Ref 1, Bab. 3] [Ref 2, Bab. 6]	
6	Mampu menjelaskan komponen dasar mikrokontroler dan cara kerjanya <i>Able to explain the basic components of microcontrollers and how they work</i>	ketepatan melakukan pemrograman mikrokontroler dengan Arduino <i>Accuracy in programming microcontrollers with Arduino</i>	Homework	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> Latihan Soal <i>Exercises</i> TM: 1x (3x50")		- Pemrograman Arduino <i>Arduino Programming</i> - Praktek penggunaan Arduino dengan simulasi virtual <i>Practice using Arduino with virtual simulation</i>	10
7	Mampu mengkomunikasikan pekerjaan teknik mereka secara efektif <i>Able to effectively communicate their engineering work</i>	Ketepatan dalam berkomunikasi secara efektif baik lisan maupun tulisan <i>Accuracy in communicating effectively, both orally and in writing</i>	Diskusi (<i>Discussion</i>)	Diskusi <i>Discussion</i> TM: 1x (3x50")		- Diskusi project <i>Project discussion</i>	5
8	Evaluasi Tengah Semester / Ujian Tengah Semester / <i>Mid Exam</i>						
9	Mahasiswa mampu memahami dan memilih sensor	Ketepatan menjelaskan dan memilih sensor data dan acquisition	Homework	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i>		- Jenis dan performa sensor <i>Sensor types and performance</i>	5



	data dan acquisition <i>Able to understand and select sensors for data acquisition</i>	<i>Accuracy in explaining and selecting sensors for data acquisition</i>		Latihan Soal <i>Exercises</i> TM: 1x (3x50'')		- Teori Quantisasi <i>Quantization theory</i> [Ref 1, Bab. 7]	
10-11	Mampu mengidentifikasi dan memilih aktuator elektrik <i>Able to identify and select electric actuators</i>	Ketepatan dalam menjelaskan dan memilih aktuator elektrik <i>Accuracy in explaining and selecting electric actuators</i>	Homework	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> Latihan Soal <i>Exercises</i> TM: 1x (3x50'')		- Jenis-jenis aktuator <i>Types of actuators</i> - Karakteristik aktuator <i>Characteristics of actuators</i> - Tipe-tipe motor penggerak <i>Types of drive motors</i> [Ref 1, Bab. 8]	5
12	Mahasiswa mampu memahami dan memilih komponen dasar pengendali <i>Able to understand and select basic control components</i>	Ketepatan dalam menjelaskan dan memilih komponen dasar pengendali <i>Accuracy in explaining and selecting basic control components</i>	Homework	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> Latihan Soal <i>Exercises</i> TM: 1x (3x50'')		- Jenis-jenis pengendalian <i>Types of control</i> - Pengendalian PID <i>PID control</i> - Implementasi digital pengendalian PID <i>Digital implementation of PID control</i> [Ref 1, Bab. 9]	10



13-15	Mampu merancang aplikasi sistem mekatronika dengan beberapa studi kasus bidang mekanika atau bidang multidisiplin <i>Able to design applications for mechatronics systems with several case studies in mechanical or multidisciplinary fields</i>	Ketepatan rumusan masalah; <i>Accuracy in problem formulation;</i> Ketepatan artikel atau sumber rujukan; <i>Accuracy of articles or reference sources</i> Kemutakhiran masalah; <i>Relevance of the problem</i>	Review dokumen rujukan dan rumusan masalah <i>Review reference documents and problem formulation</i>	Tugas perancangan mekatronika <i>Mechatronics design assignment</i> TM: 3x (3x50") BT+BM: 3x (3x50")		- Panduan Tugas perancangan - <i>Design Task Guide</i>	40
16	Evaluasi Akhir Semester / Ujian Akhir Semester / <i>Final Exam</i>						

10. Plan Semester Learning (RPS)

Semester Learning Plan Document, documented individually for all MK

For study programs that participate in international accreditation, the RPS document is a reference for being transferred into a template that is in accordance with the requests of the accreditation body.



					SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING			Document Code	
SEMESTER LEARNING PLAN									
COURSE (Course)		CODE		MK Group		WEIGHT (credits)		SEMESTER	Date of Compilation
OPERATIONAL MANAGEMENT		TM184729				T= 4 P= 0		7	May 5, 2019
AUTHORIZATION		RPS Developer			RMK Coordinator			Head of PRODI	
								Suwarno	
Learning Outcomes (CP)	CPL-PRODI charged to MK								
	CPL -4	Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics .							
	CPL -5	Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience .							
	CPL-8	Ability identify , formulate , analyze and solve problem technique .							
	CPL-10	Ability planning , completing and evaluating task based on results analysis information and data							
	Course Learning Outcomes (CPMK)								
	CPMK -1	Capable identify components from related systems with management operational . (CPL-4)							
	CPMK -2	Capable design , operate and develop related systems with management operational . (CPL-5)							
	CPMK-3	Capable observe problems specifics concerning management operational and capable submit steps repair . (C PL-8)							



	CPMK-4	Capable understand and apply with Good methods and techniques relevant quantitative in field management operational .			
		CPMK Matrix			
		CPMK	CPL-1	...	
		CPMK-1		V	V
		...	V		
			V	V	
MK Brief Description	Management factory / industry Repair performance factory / industry Design factory / industry				
Study Material: Learning Material	- Understanding about system operation ; - Productivity and capability compete ; - Industrial process analysis - Theory queue ; - Forecasting ; - Planning aggregate ; - Scheduling production ; - Analysis election assets ; - Engineering method ; - Layout means production ; - Balancing track ; - Inventory and material requirements planning;				



Library	Main :						
	[32]. Chase and Aquilano : Production and Operations management						
	Supporters :						
	[33].Joh O.McClain and L.Joseph Thomas: Operations management [34].Martin K. Starr: Operations Management [35].Grant and Leavenworth: Principles of Engineering Economy.						
Supporting lecturer	Sudiyono Kromodiharjo , Witantyo						
Required courses	-						
Mg Ke	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Understand with Good peculiarity from system management operational	- Capable recognize system related operations with design , operation and repair system - Capable differentiate system production services and manufacturing - Capable explain and give examples of input,	Oral Post-Test (random): Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Study Structured [TM: 3x60"]	- Understanding about system operation	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calssroom	



		output and conversion processes in diverse system operation - Capable recognize in a way line big history development management operational .		Study Independent [TM: 3x60"]			
2	Capable recognize and determine criteria determination productivity in the production process	- Capable distinguish and explain about efficiency and effectiveness production - Capable explain about productivity and capability competition - Capable to suspect problems and search settlement in problem capable competition - Capable determine productivity employee .	Oral Post-Test (random): Class activities Exercise question	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Productivity and capability competition	[1]: Chapter 8 [2]: Handout on myITS Calssroom	
3	Capable do production process analysis and search repairs - repairs	- Capable do analysis products and processes - Capable choose appropriate products and processes with the ability possessed - Capable recognize interaction part	Oral Post-Test (random): Class activities Exercise question	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer	- Industrial process analysis	[1]: Chapter 8 [2]: Handout on myITS Calssroom	



		production with part other management - Capable analyze industrial process structure related with type flow product		Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
4	Capable understand components in the forecasting process as well as capable estimate request at the time to come come with utilize past data	- Own ability For see components in forecasting such as trends, seasonality , and so on - Capable utilise techniques forecasting such as moving average, exponential smoothing, analysis regression , and so on For predict request later day - Capable utilise device related software with technique forecasting .	Oral Post-Test (random) : Class activities Task Independent : Task Quiz : 3 questions 150 min Mathematical models , calculations	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Forecasting production	[1]: Chapter 8 [2]: Handout on myITS Calssroom	10%
5	Capable understand and plan production in a way aggregate	- Capable understand the concept of matching demand and capacity levels in planning aggregate - Capable understand interaction between	Oral Post-Test (random) : Class activities Exercise question	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer	- Planning aggregate	[[1]: Chapter 9 [2]: Handout on myITS Calssroom	



		- inventory, utilization laborer overtime and regular, subcontracting, in planning aggregate - Capable count cost planning aggregate to match demand or capacity level at a certain level - Capable take advantage of technique research operational For modeling and solving planning aggregate .		Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
6	Capable plan scheduling production and workshop control	- Capable understand draft workshop planning and control and understand interaction between planning production with limitations equipment and resources - Capable do scheduling production For speed up flow production - Capable report and evaluate workshop conditions for control	Oral Post-Test (random): Class activities Exercise question	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	Scheduling production	[1]: Chapter 9 [2]: Handout on myITS Calssroom	



7	Capable understand phenomenon queue in production and associated consequences	- Capable understand about characteristics , and components in theory queue - Capable understand about models in theory queue like structure , quantity queue , number services , and so on - Capable understand related data distributions with theory queue - Capable to design a system queue For interest industry - Capable make simulation a system queue with data changes - Able to utilize software related to queuing theory .	Oral Post-Test (random) : Class activities Task Independent : Task Quiz : 3 questions 150 min Mathematical models , calculations	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Theory queue -	[1]: Chapter 9 [2]: Handout on myITS Calssroom	10%
8	Mid Semester Evaluation / Mid Semester Exam						20%
9	Capable choose asset For	Capable understand about difference mark	Oral Post-Test (random) :	Lecture [TM: 3x50"]	- Analysis election asset	[1]: Chapters 5 and 7	



	interest industry based on analysis economy	- Money now and tomorrow day - Capable transform cash flow from a pattern to another pattern - Capable count mark asset in perspective time with includes cash flow, depreciation , taxes , and is able to make ranking asset selection - Capable choose asset based on common criteria used such as NPV, IRR, and so on	Class activities Task Independent : Task	Studying look at advance Discussion Question and answer Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]		[2]: Handout on myITS Calsroom	
10	- Capable design and repair the steps that related with making product or services that include method , motion , and determination time standard	- Capable understand and create process maps and movement maps - Capable do process analysis for repair production - Capable determine time standard a activity - Work with time study or work sampling method - Capable apply concepts statistics in	Oral Post-Test (random): Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Discussion question Study Structured [TM: 3x60"]	- Engineering method	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	



		determination time standard		Study Independent [TM: 3x60"]			
11	- Capable understand various layout arrangement models location means production	- Capable mention difference between several layout arrangement models means production - Capable mention criteria good layout determination . - Capable mention components important in layout settings means production	Oral Post-Test (random): Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Layout means production	[1]: Chapter 7 [2]: Handouts in myITS Classroom	
12	- Capable arrange placement activities on workstations in a system assembly For produce efficiency good track	- Capable determine amount work station needs according to with request and time making product - Capable put activities in each work according to with time cycle and relationship diagram between activity	Oral Post-Test (random): Class activities Task Independent : Task Quiz : 3 questions 150 min	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Discussion question	- Balancing track	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%



		- Capable utilise the usual heuristics used in balancing track - Capable analyze connection between production output and efficiency track - Capable understand about amount line , station double , and so on in aspect balancing track	Mathematical models , calculations	Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
13	Capable understand interest from inventory planning in the production process and is able to utilise related techniques with good inventory control for independent and dependent demand	- Capable understand role from inventory control in the production process - Capable understand about deterministic inventory planning models and also probabilistic - Capable understand difference between dependent and independent demand - Capable understand objective as well as target from MRP	Oral Post-Test (random): Class activities Task Independent : Task	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Inventory and MRP	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%



		- Capable understand master production planning and bill of material - Capable finish MRP issues for determination of inventory of a product					
14	Capable understand principles from technique simulation and capable make simulation in a way simple a system operation Good related with the manufacturing world and also service	- Capable understand about technique simulation in line big - Capable understand randomness factor in simulation process - Capable explain example utilization technique simulation in the industrial world product or service - Capable do simulation simple search for output of a system on different alternatives with observe data distribution , behavior from system , and options available alternatives	Oral Post-Test (random): Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion Question and answer Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Introduction method simulation	[1]: Chapter 10 [2]: Handout on myITS Calsroom	



		- Capable know device software that can utilized For do simulation					
15	Presentation Group		Quiz : 2 questions 100 min	Lecture [TM: 3x50"] Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- [1]: Chapter 10 [2]: Handout on myITS Calssroom	[1]: Chapter 10 [2]: Handout on myITS Calssroom	20%
16	Final Semester Evaluation / Final Semester Exam						20%

Notes :

9. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
10. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.
11. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.
12. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
13. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.



14. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
15. **Forms of assessment:** test and non-test.
16. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
17. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.
18. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.
19. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.
20. TM=Face to Face, PT=Structured assignment, BM=Independent learning.



		SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING				Document Code	
SEMESTER LEARNING PLAN							
COURSE (Course)		CODE	MK Group		WEIGHT (credits)	SEMESTER	Date of Compilation
OPERATIONAL RESEARCH		TM184889			T= 3	P= 0	Choice May 5, 2019
AUTHORIZATION		RPS Developer		RMK Coordinator		Head of PRODI	
						Suwarno	
Learning Outcomes (CP)		CPL-PRODI charged to MK					
CPL -4		Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics .					
CPL -5		Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience					
CPL-7		Ability apply methods , skills and tools modern techniques are needed For practice system mechanics .					
CPL-8		Ability identify , formulate , analyze and solve problem technique					
Course Learning Outcomes (CPMK)							
CPMK -1		Student capable understand techniques quantitative For taking decisions (CPL-4, CPL-7)					
CPMK -2		Student capable see component problematic in A problem (CPL-8)					



	CPMK-3	Student capable analyze real world problems and state them in form abstraction mathematical . (CPL-8)			
	CPMK-4	Student capable finish problem optimization a objective below constraints . (CPL-7)			
	CPMK-5	Student capable utilise device soft For settlement problem taking decision . (CPL-8)			
	CPMK-6	Student capable modeling and solving example problem real everyday and make presentation . (CPL-5)			
		CPMK Matrix			
		CPMK	CPL-1	...	
		CPMK-1		V	V
		...	V		
			V	V	
		...			
MK Brief Description	Linear Programming, Integer Programming, Dynamic Programming				
Study Material: Learning Material	Theory taking decision ; Element problematic in problem ; Linear Programming Model; Typical models in Linear Programming; Completion Graphics ; Analysis impact function parameter changes Objectives and constraints ; Methods simplex ; Introduction to software; Integer programming; Models in integer programming; Binary Integer Programming; Multiple objectives and goal programming; Dynamic Programming; Project management modeling ; CPM-PERT; Resource Leveling; Introduction theory queue and simulation .				
Library	Main :				



		[36]. Wayne Winston: Operations Research					
		Supporters :					
		[37]. Hamdy Taha: Operations Research					
		[38]. Ronald Rardin :Optimization in Operations Research					
		[39]. Bernard W. Taylor: Introduction to Management Science					
		[40]. Hillier Lieberman: Operations research					
Supporting lecturer							
Required courses							
Mg Ke	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Understand with Good problem taking decision	- Capable recognize elements essential in to suspect a problem - Capable differentiate between something that looks as real issues and problems - Capable explain and give example	Oral Post-Test (random): Class Activities	Lecture [TM: 3x50"] Studying Look at me Advance Discussion Question and answer Study Structured [TM: 3x60"]	- Contract studying - Theory taking decision	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calsroom	



		problem in wide coverage in the industrial world and others		Study Independent [TM: 3x60"]			
2	- Capable recognize and determine element problematic in a problem	- Capable recognize and determine criteria success settlement problem - Capable recognize problem with multiple criteria success - Capable understand interest weighting criteria in problem with multiple criteria - Capable understand the presence of trade-offs as element inevitability in the process of taking decision	Oral Post-Test (random): Class Activities	Lecture [TM: 3x50"] Studying Look at me Advance Discussion Question and answer Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Element problematic in problem	[1]: Chapter 8 [2]: Handout on myITS Calsroom	
3	Capable recognize and	- Capable understand a number of method	Oral Post-Test (random):	Lecture [TM: 3x50"]	- Linear Programming Models	[1]: Chapter 8	



	understand steps modeling mathematical especially related with Linear Programming (LP) method	model making : mathematical models , prototype models, schematic models , etc. - Capable know a number of example line big effort mathematical modeling - Capable understand and know with both related LP model formats with variable decision , function objective , and constraints	Class Activities	Studying Look at me Advance Discussion Question and answer Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]		[2]: Handout on myITS Calsroom	
4	Capable know and understand generic model structure in LP	- Know with Good some LP models that are often found in the industrial world and others such as models: product mix, mixing ingredients, transportation , financial management, waste	Oral Pre-Test (random): Activity class Quiz Task Independent : Task Work	Lecture [TM: 3x50"] Studying Look at me Advance Discussion Question and answer Quiz Study Structured [TM: 3x60"]	- Introduction of typical models in Linear Programming	[1]: Chapter 8 [2]: Handout on myITS Calsroom	20%



		management, resource planning, aggregate planning, and so on. - Capable to suspect forms characteristics that exist in each of the models discussed - Capable mention similar applications from the model discussed in the example another problem		Study Independent [TM: 3x60"]			
5	Capable know and understand generic model structure in LP	- Know with Good some LP models that are often found in the industrial world and others such as models: product mix, mixing ingredients, transportation , financial management, waste management,	Oral Pre-Test (random): Activity class Quiz Task Independent : Task Work	Lecture [TM: 3x50"] Studying Look at me Advance Discussion Question and answer Quiz Study Structured [TM: 3x60"]	- Introduction of typical models in Linear Programming	[1]: Chapter 9 [2]: Handout on myITS Calsroom	20%



		resource planning, aggregate planning, and so on. - Capable to suspect forms characteristics that exist in each of the models discussed - Capable mention similar applications from the model discussed in the example another problem		Study Independent [TM: 3x60"]			
6	Capable finish simple LP problem in a way graphics and view impact change consequence data variation	- Capable represent question two dimensions (or three dimensions as example) in form graphic - Capable to suspect area feasible , constraints strict or loose and capable look for combination points and values function	Oral Pre-Test (random): Class Activities Task Independent :	Lecture [TM: 3x50"] Discussion Question and answer Discussion Question Study Structured [TM: 3x60"]	- Completion Graphics ; Analysis sensitivity impact function parameter changes objective and constraints	[1]: Chapter 9 [2]: Handout on myITS Calsroom	



		optimal objective with utilise depiction constraints and functions objective - Capable see changes that occur consequence variation coefficient function objective and constraints Likewise with variation section right constraint - Capable anticipate changes that can be happen consequence addition or subtraction constraint		Study Independent [TM: 3x60"]			
7	Capable understand in a way line big LP settlement with use simplex method	- Capable understand algorithm LP settlement with simplex method	Oral Pre-Test (random): Discussion Question and answer Discussion Question	Lecture [TM: 3x50"] Discussion Question and answer	- method and software introduction	[1]: Chapter 9 [2]: Handout on myITS Calssroom	3/15



		- Capable state A simple LP problem in simplex format - Capable do steps iteration in frame determine optimal solution - Capable finish A simple LP questions with simplex method so that obtained optimal conditions - Capable change A the primal LP problem becomes dual - Capable finish A LP issues with utilize existing software	Task Independent :	Discussion Question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
8	Mid Semester Evaluation / Mid Semester Exam						20%
9	Capable make formulation related with integer programming (IP) and solve	- Capable to suspect problem related with IP - Know with Good problem related with pure IP, mixed IP, and binary IP	Oral Pre-Test (random): Class Activities Task Independent : Work House	Lecture [TM: 3x50"] Discussion Question and answer Discussion Question	- Integer programming (IP); Models in integer programming; Binary Integer Programming	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	



	with software utilization	- Know and be able to utilise with both special formats in IP such as if-then, either or, switching, fixed charge constraint formats , and so on. - Understand algorithm IP related resolution with Branch and Bound and Cutting Plane algorithms - Capable to predict and model IP applications in problem daily such as in the problems of set covering, capital budgeting, scheduling, and so on.		Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
10	Capable make formulation related with integer programming	- Capable to suspect problem related with IP - Know with Good problem related	Oral Pre-Test (random): Class Activities Task Independent : Work House	Lecture [TM: 3x50"] Discussion Question and answer	- Integer programming (IP); Models in integer programming; Binary Integer Programming	[1]: Chapters 6 and 7 [2]: Handout on myITS Calssroom	



	(IP) and solve with software utilization	- with pure IP, mixed IP, and binary IP - Know and be able to utilise with both special formats in IP such as if-then, either or, switching, fixed charge constraint formats , and so on. - Understand algorithm IP related resolution with Branch and Bound and Cutting Plane algorithms - Capable to predict and model IP applications in problem daily such as in the problems of set covering, capital budgeting, scheduling, and so on.		Discussion Question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
11	Capable make formulation For problem with	- Capable understand and predict as well as give example real	Oral Pre-Test (random): Activity class	Lecture [TM: 3x50"] Discussion	- Multiple objectives and goal programming	[1]: Chapter 7 [2]: Handouts in myITS Classroom	4/15



	objective more from One including utilization goal programming (GP) method	world problems with objective optimization more from One - Capable make formulation problem with objective optimization more from One with a number of method with emphasis on goal programming (GP) method - Capable formulate problem with objective optimization more from One with method weighting - Capable solve and analyze a multi-purpose problem with using software	Quiz	Question and answer Discussion Question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
12	- Capable understand and complete	- Capable to suspect Features special in	Oral Pre-Test (random): Activity class	Lecture [TM: 3x50"] Discussion	- Dynamic Programming	[1]: Chapter 16 [2]: Handout on myITS Calssroom	



	problem related with dynamic programming	dynamic programming(DP) - Capable finish problem related with DP - Capable take advantage of DP method for settlement problem special like problem with data of a nature stochastic - Capable search and compare equivalent settlement of DP and IP on settlement problem if Possible		Question and answer Discussion Question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
13	Capable make modeling mathematical related with project management until to resource leveling stage	- Capable to suspect in a way line big elements important in management project - Capable understand method control project with CPM and PERT methods	Oral Pre-Test (random): Activity class Quiz Task Independent : Task Work	Lecture [TM: 3x50"] Discussion Question and answer Discussion Question	- Project management modeling ; CPM-PERT; Resource Leveling	[1]: Chapter 16 [2]: Handout on myITS Calssroom	20%



		- Capable create a mathematical model that shows relatedness inter-activity in project - Capable determine time beginning and time end implementation activities and time fastest settlement project - Capable determine track critical in project - Capable determine activities with time strict or free time - Capable dampen fluctuation resource needs with prepare a mathematical model for resource leveling and searching settlement		Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			



14	Capable understand in a way line big about theory queue and its application	- Capable understand characteristics and components in theory queue - Capable understand about models in theory queue like structure , quantity queue , number services , and so on - Capable understand related data distributions with theory queue - Capable to design a system queue For interest industry - Capable make simulation a system queue with data changes - Capable utilise device related software with theory queue	Oral Pre-Test (random): Activity class presentation problem real related with mathematical program Task Independent : Task Work	Lecture [TM: 3x50"] Discussion Question and answer Discussion Question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	Introduction theory queue	[1]: Chapter 10 [2]: Handout on myITS Calssroom	
15	Capable understand	- Capable understand about technique	Oral Pre-Test (random):	Lecture [TM: 3x50"]	Introduction method simulation	[1]: Chapter 10	20%



	principles from technique simulation and capable make simulation in a way simple a system operation Good related with the manufacturing world and also service	simulation in line big - Capable understand randomness factor in simulation process - Capable explain example utilization technique simulation in the industrial world product or service - Capable do simulation simple search for output of a system on different alternatives with observe data distribution , behavior from system , and options available alternatives - Capable know device software that can utilized For do simulation	Activity class Evaluation End of Semester Task Independent : Task Work	Discussion Question and answer Discussion Question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	[1]: Chapter 10 [2]: Handout on myITS Calsroom	[2]: Handout on myITS Calsroom	



16	Final Semester Evaluation / Final Semester Exam						20%

Notes :

10. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
11. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.
12. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.
13. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
14. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.
15. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
16. **Forms of assessment:** test and non-test.
17. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
18. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.
19. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.



20. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.

21. TM=Face to Face, PT=Structured assignment, BM=Independent learning.

	SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING					Document Code
	SEMESTER LEARNING PLAN					
COURSE (Course)	CODE	MK Group	WEIGHT (credits)		SEMESTER	Date of Compilation
PROJECT MANAGEMENT	TM184790		T= 3	P= 0	Choice	May 5, 2019
AUTHORIZATION	RPS Developer		RMK Coordinator		Head of PRODI	
					Suwarno	
Learning Outcomes (CP)	CPL-PRODI charged to MK					
	CPL -4	Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics .				
	CPL -5	Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience				
	CPL-7	Ability apply methods , skills and tools modern techniques are needed For practice system mechanics .				
	CPL-8	Ability identify , formulate , analyze and solve problem technique				
	Course Learning Outcomes (CPMK)					
	CPMK -1	Student capable control knowledge management projects that include managerial general , dynamics and environment projects , as well as interpersonal and intrapersonal skills in develop projects oriented towards technopreneurship and sustainability . (CPL-7)				



	CPMK - 2	Student capable do identification , analysis and retrieval effective and efficient decisions at every activity and dynamics project (CPL-8)			
	CPMK- 3	Student capable planning and evaluating eligibility a project in a way integrated from various aspects (CPL-5)			
	CPMK- 4	Student capable apply and integrate in a way dynamic appropriate knowledge , skills , methods and techniques with condition project For manage development and development project as well as operational business in reach stakeholder satisfaction (CPL-5)			
	CPMK- 5	Student capable observe problems specifics concerning management project and able submit steps repair (CPL-4)			
		CPMK Matrix			
		CPMK	CPL-1	...	
		CPMK-1		V	V
		...	V		
			V	V	
		...			
MK Brief Description	Subject This develop competence and skills For planning and controlling projects and understand interpersonal problems that drive results successful projects . Focus on introducing new products and processes , it to study cycle life management project , defining project parameters , challenges management matrix , tools and techniques management effective projects , and the role manager project .				
Study Material:	Work breakdown structure				
Learning Material	Project planning				
	Controlling the project				
Library	Main :				



		[41]. Jack_R._Meredith_and_Samuel_J._Mantel,_Jr._Project management [42]. Joseph, Chase and Aquilano : Production and Operations management Supporters : [43]. Handout t Studying					
Supporting lecturer		Witantyo , Suwarno					
Required courses							
Mg Ke	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Understand with Good function special from management project	- Capable define and understand context management project - Capable differentiate system management general and projects - Capable recognize in a way line big stages and cycles life project	Oral Pre-Test (random) : Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Study Structured [TM: 3x60"]	- Understanding about role management project in A organization	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calsroom	



		Capable explain Why management project required in pursuing organizational targets		Study Independent [TM: 3x60"]			
2	Capable recognize and determine criteria a project manager	- capable recognize criteria a project manager - Understand method do project manager selection - Capable explain problem difference culture - Capable recognize environment institution - Understand multicultural communication and managerial behavior - Capable explain habits and traits negotiation - Capable recognizing and utilizing	Oral Pre-Test (random) : Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Project Manager - Negotiation and management conflict	[1]: Chapter 8 [2]: Handout on myITS Calssroom	



		Partnering, Chartering, and Scope Change - Capable recognize a number of needs and principles negotiation					
3	Capable do analysis election suitable project with the intended target	- Capable describes the Project as part from function organization - Capable explained the Pure Project Organization - Capable explaining Matrix Organization - Capable explain Mixed Organizational System - Capable choose organization project appropriate For its uses - Capable explains Human Factors and Project Team	Oral Pre-Test (random) : Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Organization and management project	[1]: Chapter 8 [2]: Handout on myITS Calssroom	



4	Capable understand MS project software structure	- Capable explain Uses of project management software - Understand technique preparation of WBS (Work breakdown structure) - Capable input WBS and complete it with estimate the time workmanship activity	Oral Pre-Test (random) : Class activities Task work House Quiz	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Microsoft Project Software	[1]: Chapter 8 [2]: Handout on myITS Calsroom	10%
5	Capable running MS project software	- Capable estimate and input all resources needed BS activities - Capable use function calendar on project general and at every source Power - Capable input cost For all resources	Oral Pre-Test (random) : Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Discussion question Study Structured [TM: 3x60"]	- Microsoft Project Software	[1]: Chapter 9 [2]: Handout on myITS Calsroom	



		and compiling cash flow projects		Study Independent [TM: 3x60"]			
6	Capable create project WBS and plan all required activities	- Capable understand draft workshop planning and control and understand interaction between planning production with limitations equipment and resources - Capable do scheduling production For speed up flow production - Capable report and evaluate workshop conditions for control	Oral Pre-Test (random) : Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- WBS and Planning Activity	[1]: Chapter 9 [2]: Handout on myITS Calsroom	
7	Capable understand activity project and able estimate	- Capable understand about characteristics , and	Oral Pre-Test (random) : Class activities Task work House	Lecture [TM: 3x50"] Studying look at advance	- Estimating cost activity [1]: Chapter 9	[1]: Chapter 9 [2]: Handout on myITS Calsroom	10%



	source power and cost	- components in theory queue - Capable understand about models in theory queue like structure , quantity queue , number services , and so on - Capable understand related data distributions with theory queue - Capable to design a system queue For interest industry - Capable make simulation a system queue with data changes - Capable utilise device related software with theory queue .	Quiz	Discussion and Q& A Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	[2]: Handout on myITS Calsroom		
8	Mid Semester Evaluation / Mid Semester Exam						20%
9	Capable schedule activity project For get time	Capable understand about difference mark Money now and tomorrow day	Oral Pre-Test (random) : Class activities Task work House	Lecture [TM: 3x50"] Studying look at advance	- Scheduling activity	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	



	settlement fastest with minimum fee	- Capable transform cash flow from a pattern to another pattern - Capable count mark asset in perspective time with includes cash flow, depreciation , taxes , and is able to make ranking asset selection - Capable choose asset based on common criteria used such as NPV, IRR, and so on .		Discussion and Q& A Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
10	Capable to design allocation source Power For fulfil timetable work that has been done designed	- Capable understand and create process maps and movement maps - Capable do process analysis for repair production - Capable determine time standard a activity Work with	Oral Pre-Test (random) : Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Discussion question Study Structured [TM: 3x60"]	- Allocation Resource	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	



		time study or work sampling method - Capable apply concepts statistics in determination time standard .		Study Independent [TM: 3x60"]			
11	Capable understand system information For monitor all over activity project	- Capable mention difference between several layout arrangement models means production - Capable mention criteria good layout determination - Capable mention components important in layout settings means production .	Oral Pre-Test (random) : Class activities	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	System Information and Monitoring	[1]: Chapter 7 [2]: Handouts in myITS Classroom	
12	Capable arrange activity project such that so that still achieve the target with minimal	Capable determine amount work station needs according to with request and time making product	Oral Pre-Test (random) : Class activities Task work House Quiz	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A	Control Project	[1]: Chapter 16 [2]: Handout on myITS Calsroom	10%



	deviation in cost and time	- Capable put activities in each work according to with time cycle and relationship diagram between activity - Capable utilise the usual heuristics used in balancing track - Capable analyze connection between production output and efficiency track - Capable understand about amount line , station double , and so on in aspect balancing track		Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
13	Capable understand interest owner project and able prepare audit report	- Capable understand role from inventory control in the production process - Capable understand about deterministic inventory planning	Oral Pre-Test (random) : Class activities Task work House	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A	- Project audit	[1]: Chapter 16 [2]: Handout on myITS Calsroom	



		- models and also probabilistic - Capable understand difference between dependent and independent demand - Capable understand objective as well as target from MRP - Capable understand master production planning and bill of material - Capable finish MRP issues for determination of inventory of a product		Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
14	Capable understand principle reporting and creation report history project as a final report	- Capable understand about technique simulation in line big - Capable understand randomness factor in simulation process	Oral Pre-Test (random) : Class activities Presentation	Lecture [TM: 3x50"] Studying look at advance Discussion and Q& A Discussion question	- Closing and reporting	[1]: Chapter 10 [2]: Handout on myITS Calsroom	10%



		- Capable explain example utilization technique simulation in the industrial world product or service - Capable do simulation simple search for output of a system on different alternatives with observe data distribution , behavior from system , and options available alternatives - Capable know device software that can utilized For do simulation		Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]			
15	Capable understand principle reporting and creation report	- Capable understand about technique simulation in line big	Oral Pre-Test (random) : Class activities Presentation	Lecture [TM: 3x50"] Studying look at advance	- Closing and reporting	[1]: Chapter 10 [2]: Handout on myITS Calssroom	20%



	history project as a final report	- Capable understand randomness factor in simulation process - Capable explain example utilization technique simulation in the industrial world product or service - Capable do simulation simple search for output of a system on different alternatives with observe data distribution , behavior from system , and options available alternatives - Capable know device software that can utilized For do simulation		Discussion and Q& A Discussion question Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]				
16	Final Semester Evaluation / Final Semester Exam							20%



Notes :

11. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.
12. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.
13. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.
14. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.
15. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.
16. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
17. **Forms of assessment:** test and non-test.
18. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
19. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.
20. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.
21. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.
22. TM=Face to Face, PT=Structured assignment, BM=Independent learning.



10. Plan Semester Learning (RPS)

Semester Learning Plan Document, documented individually for all MK

For study programs that participate in international accreditation, the RPS document is a reference for being transferred into a template that is in accordance with the requests of the accreditation body.



		SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING					Document Code	
SEMESTER LEARNING PLAN								
COURSE (Course)		CODE	MK Group		WEIGHT (credits)		SEMESTER	Date of Compilation
ROBOT MECHANISM		TM184776			T= 2	P= 1	Choice	May 5, 2019
AUTHORIZATION		RPS Developer		RMK Coordinator			Head of PRODI	
							Suwarno	
Learning Outcomes (CP)	CPL-PRODI charged to MK							
	CPL -4	Ability apply mathematics , science , and principles engineering For finish problem engineering on systems mechanics .						
	CPL -5	Ability designing components , systems and/ or mechanical processes For fulfil expected needs with approach analytical engineering based on science & technology up to date and considering standard technical , aspects performance , reliability , and convenience						
	CPL-7	Ability apply methods , skills and tools modern techniques are needed For practice system mechanics .						
	CPL-8	Ability identify , formulate , analyze and solve problem technique						
	Course Learning Outcomes (CPMK)							
	CPMK -1	Student capable show serial and parallel robot position and displacement (CPL-4, CPL-8)						
	CPMK -2	Student capable show connection between the Jacobian matrix and singularity from A robot configuration (CPL-4, CPL-8)						
	CPMK-3	Student capable designing parallel robot structure that meets degrees desired freedom (CPL-5, CPL-7)						



		CPMK Matrix				
		CPMK	CPL-1	...		
		CPMK-1		V	V	
		...	V			
			V	V		
		...				
MK Brief Description	Serial and parallel manipulator robots, Jacobian Matrix and Singularity					
Study Material: Learning Material	In eye studying This will learn the main points discussion as following : - Types of robots and their development : industrial robots , humanoid robots, mobile robots - Position and displacement analysis : degrees freedom , transformation coordinates , position and orientation - Jacobian matrix and singularities : type singularity reviewed from the Jacobian matrix - Design robot : screw theory , types of constraints on various connection - Computing : analysis calculation position and displacement in a way computing					
Library	Main :					
	[44].	Lung-Wen Tsai. Robot Analysis: The Mechanics of Serial and Parallel Manipulators. John Wiley and Sons, Inc., 1999.				
	[45].	Xianwen Kong and Clement Gosselin. Type Synthesis of Parallel Mechanisms. Springer Verlag Berlin Heidelberg, 2007.				
	Supporters :					
	[46].	Jorge Angeles. Fundamentals of Robotic Mechanical Systems: Theory, Methods and Algorithms. Springer Verlag New York, 2nd edition. 2003.				
Supporting lecturer	English					



Required courses							
Mg Ke-	Final ability of each stage of learning (Sub-CPMK)	Evaluation		Learning Aids, Learning methods, Student Assignments, [Estimated Time]		Learning materials [Library]	Assessment Weight (%)
		Indicator	Criteria & Forms	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Student capable identify types of robots and their uses , as well as its development from year to year	Capable and skilled mention types of robots based on various criteria , for example : degree-of-freedom, kinematic structures, motion type, workspace	Oral Post-Test (random): Exercise Question	Lecture [TM: 3x50"] Studying Introduction & Brainstorming Robot machining and pick-and-place robot videos Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Contract Studying - System robotics - Classification of robots - Robot series - Parallel robots	[1]: Chapters 1, 3 and 5 [2]: Handout on myITS Calsroom	



2	Student capable analyze count position and orientation object tough	Capable and skilled finalize and formulate matrix position and orientation from A object tough	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Coordinate transformation object tough	[1]: Chapter 8 [2]: Handout on myITS Calssroom	
3	Student capable formulate transformation serial robot coordinates	Capable and skilled get Denavit parameters Hartenberg as well as formulate become matrix transformation for serial robots	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Theory Denavit Hartenberg - Direct kinematics - Inverse kinematics	[1]: Chapter 8 [2]: Handout on myITS Calssroom	
4	Student capable formulate	Capable and skilled get	Oral Pre-Test (random):	Lecture [TM: 3x50"]	- Theory Denavit Hartenberg - Direct kinematics	[1]: Chapter 8	



	transformation serial robot coordinates	Denavit parameters Hartenberg as well as formulate become matrix transformation for serial robots	Exercise Question Homework	Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Inverse kinematics	[2]: Handout on myITS Calsroom	
5	Student capable lower and show Jacobian matrix of serial robot	- Capable and skilled formulate Jacobian matrix . - Capable and skilled show configuration singularity from Jacobian matrix .	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Jacobian matrix analysis of serial robots	[1]: Chapter 9 [2]: Handout on myITS Calsroom	



6	Student capable lower and show Jacobian matrix of serial robot	- Capable and skilled formulate Jacobian matrix . Capable and skilled show configuration singularity from Jacobian matrix .	Oral Pre-Test (random) : Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Jacobian matrix analysis of serial robots	[1]: Chapter 9 [2]: Handout on myITS Calsroom	
7	Student capable apply results calculations in computer programs	Capable and skilled write computer programs For get direct kinematics and inverse kinematics solutions .	Oral Pre-Test (random) : Assignments on Matlab software	Lecture [TM: 3x50"] Matlab Software Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Direct kinematics and inverse kinematics of planar serial robots	[1]: Chapter 9 [2]: Handout on myITS Calsroom	20%
8	Mid Semester Evaluation / Mid Semester Exam						30%



9	Student capable formulate transformation parallel robot coordinates	Capable and skilled get matrix parameters transformation for parallel robots	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Direct kinematics - Inverse kinematics	[1]: Chapters 5 and 7 [2]: Handout on myITS Calsroom	
10	Student capable formulate transformation parallel robot coordinates	Capable and skilled get matrix parameters transformation for parallel robots	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Direct kinematics - Inverse kinematics	[1]: Chapters 6 and 7 [2]: Handout on myITS Calsroom	



11	Student capable lower and show Jacobian matrix of parallel robot	Capable and skilled formulate Jacobian matrix . Capable and skilled show configuration singularity from Jacobian matrix .	Oral Pre-Test (random) : Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Jacobian matrix analysis of parallel robots	[1]: Chapter 7 [2]: Handouts in myITS Classroom	
12	Student capable lower and show Jacobian matrix of parallel robot	Capable and skilled formulate Jacobian matrix . Capable and skilled show configuration singularity from Jacobian matrix .	Oral Pre-Test (random) : Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Jacobian matrix analysis of parallel robots	[1]: Chapter 16 [2]: Handout on myITS Calssroom	



13	Student capable designing parallel robot structure	Capable analyze the inspection process machine tools	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Screw theory - Type synthesis	[1]: Chapter 16 [2]: Handout on myITS Calssroom	
14	Student capable designing parallel robot structure	Capable and skilled apply screw theory for designing parallel robot structure	Oral Pre-Test (random): Exercise Question Homework	Lecture [TM: 3x50"] Studying Study Structured [TM: 3x60"] Exercise Question Study Independent [TM: 3x60"]	- Screw theory - Type synthesis	[1]: Chapter 10 [2]: Handout on myITS Calssroom	



15	Student capable apply results calculations in computer programs	Capable and skilled apply screw theory for designing parallel robot structure	Oral Pre-Test (random) : Task	Lecture [TM: 3x50"] Project group Study Structured [TM: 3x60"] Study Independent [TM: 3x60"]	- Direct Kinematics inverse kinematics robot parller - http://www.parallemic.org/java/3RRR.html	[1]: Chapter 10 [2]: Handout on myITS Calsroom	20%
16	Final Semester Evaluation / Final Semester Exam						30%

Notes :

12. **Study Program Graduate Learning Outcomes (CPL-PRODI)** are the abilities possessed by each study program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the study program level obtained through the learning process.

13. **The CPL charged to a course** is a number of learning achievements of study program graduates (CPL-PRODI) which are used to form/develop a course consisting of aspects of attitude, general skills , skills specialty and knowledge.

14. **Course CP (CPMK)** is a capability that is specifically described from the CPL that is assigned to a course, and is specific to the study material or learning material of that course.

15. **Sub-CP Course (Sub-CPMK)** is a capability that is specifically described from CPMK that can be measured or observed and is the final capability planned at each stage of learning, and is specific to the learning material of the course.

16. **Assessment indicators** for student learning process and outcomes are specific and measurable statements that identify student learning outcomes or performance accompanied by evidence.



17. **Assessment Criteria are benchmarks used as a** measure or yardstick for learning achievement in assessment based on established indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
18. **Forms of assessment:** test and non-test.
19. **Forms of learning:** Lectures, Responses, Tutorials, Seminars or equivalent, Practicals, Studio Practicals, Workshop Practicals, Field Practicals, Research, Community Service and/or other equivalent forms of learning.
20. **Learning methods:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning* , and other equivalent methods.
21. **Learning materials** are details or descriptions of study materials that can be presented in the form of several main and sub-main topics.
22. **The assessment weight** is the percentage of the assessment for each sub-CPMK achievement, the amount of which is proportional to the level of difficulty of achieving the sub-CPMK, and the total is 100%.
23. TM=Face to Face, PT=Structured assignment, BM=Independent learning.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER (<i>SEMESTER LEARNING PLAN</i>)						
MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
SISTEM PENGENDALIAN LINEAR <i>LINEAR CONTROL SYSTEM</i>	TM234627	Rekayasa Sistem dan Kontrol <i>Systems and Control Engineering</i>	T=1	P=2	Pilihan	20 November 2023
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>SLP Developer</i>		Koordinator RMK <i>Subject Group Coordinator</i>		Ketua PRODI <i>Head of Study Program</i>	
	Unggul Wasiwitono		Latifah Nurahmi		Suwarno	
Capaian Pembelajaran n (CP) <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>Study Program Learning Outcomes assigned to the course</i>					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika. <i>The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.</i>				
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan. <i>The ability to design components, systems, and/or mechanical processes to meet expected needs using an analytical engineering approach based on advanced science and technology, while considering technical standards, performance aspects, reliability, and ease of use.</i>				



	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>The ability to apply modern methods, skills, and engineering tools necessary for the practice of mechanical systems.</i>				
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>The ability to identify, formulate, analyze, and solve engineering problems.</i>				
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcomes (CLO)</i>					
	CPMK-1	Mahasiswa mampu memodelkan sistem dinamika pada bidang teknik mesin dalam bentuk ruang keadaan (state-space). <i>Students are able to model dynamic systems in the field of mechanical engineering in the form of state-space.</i>				
	CPMK-2	Mahasiswa mampu memahami dan menghitung solusi model ruang keadaan. <i>Students are able to understand and calculate solutions for state-space models.</i>				
	CPMK-3	Mahasiswa mampu menganalisis stabilitas, pengendalian, observasi, dan realisasi model ruang keadaan. <i>Students are able to analyze stability, control, observation, and realization of state-space models.</i>				
	CPMK-4	Mahasiswa mampu mendesain sistem pengendalian linear dengan metode pole placement, Linear Quadratic Regulator. <i>Students are able to design linear control systems using the pole placement method and Linear Quadratic Regulator.</i>				
		Matrik CPL – CPMK				
		CPMK	CPL-4	CPL-5	CPL-7	CPL-8
		CPMK-1			V	V
		CPMK-2	V	V		
		CPMK-3	V		V	V
		CPMK-4	V	V		V



Deskripsi Singkat MK <i>Course Brief Description</i>	Mata kuliah ini merupakan pengantar desain sistem kendali linier modern. Mahasiswa akan mempelajari bagaimana memodelkan sistem dinamika dalam model matematika ruang keadaan, karakteristik struktural: stabilitas, Controllability, Observability, bentuk kanonik, dan realisasi minimal. Perancangan pengontrol ruang keadaan dengan metode pole placement dan Linear Quadratic Regulator. <i>This course is an introduction to modern linear control system design. Students will learn how to model dynamic systems in the mathematical form of state-space, structural characteristics: stability, controllability, observability, canonical forms, and minimal realization. The design of state-space controllers using the pole placement method and Linear Quadratic Regulator.</i>														
Bahan Kajian: Materi Pembelajaran <i>Study Material: Learning Material</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: <i>This course will cover the following main topics:</i> - Pemodelan Ruang Keadaan Sistem Fisik (<i>State-Space Modeling of Physical Systems</i>) - Analisis Stabilitas Model Ruang Keadaan (<i>Stability Analysis of State-Space Models</i>) - keterkontrolan dan keteramatan (<i>Controllability and Observability</i>) - Perancangan Sistem Kontrol Linier (<i>Linear Control System Design</i>) - Kontrol Optimal (Regulator Kuadrat Linier (LQR)) (<i>Optimal Control (Linear Quadratic Regulator (LQR))</i>)														
Pustaka <i>References</i>	<table border="1"> <tr> <td data-bbox="342 930 660 962">Utama (Main) :</td><td data-bbox="660 930 2076 962"></td></tr> <tr> <td colspan="2" data-bbox="342 962 2076 1002">[1]. Robert L. Williams II and Dpuglas A. Lawrence, Linear State-Space Control Systems, John Wiley & Sons, 2007.</td></tr> <tr> <td data-bbox="342 1002 660 1082">Pendukung (Supporting) :</td><td data-bbox="660 1002 2076 1082"></td></tr> <tr> <td colspan="2" data-bbox="342 1082 2076 1121">[2]. E. Hendricks, O. Jannerup and P. H. Sorensen, Linear System Control: Deterministic and Stochastic Methods, Springer, 2008.</td></tr> <tr> <td colspan="2" data-bbox="342 1121 2076 1161">[3]. Joao P. Hespanha, Linear System Theory, Princenton University Press, 2009</td></tr> <tr> <td colspan="2" data-bbox="342 1161 2076 1201">[4]. Chi-Tsong Chen, Linear System Theory and Design, Oxford University Press, 1999.</td></tr> <tr> <td colspan="2" data-bbox="342 1201 2076 1233">[5]. Norman S. Nise, Control System Engineering, Sixth Ed., John Wiley & Sons, 2011</td></tr> </table>	Utama (Main) :		[1]. Robert L. Williams II and Dpuglas A. Lawrence, Linear State-Space Control Systems, John Wiley & Sons, 2007.		Pendukung (Supporting) :		[2]. E. Hendricks, O. Jannerup and P. H. Sorensen, Linear System Control: Deterministic and Stochastic Methods, Springer, 2008.		[3]. Joao P. Hespanha, Linear System Theory, Princenton University Press, 2009		[4]. Chi-Tsong Chen, Linear System Theory and Design, Oxford University Press, 1999.		[5]. Norman S. Nise, Control System Engineering, Sixth Ed., John Wiley & Sons, 2011	
Utama (Main) :															
[1]. Robert L. Williams II and Dpuglas A. Lawrence, Linear State-Space Control Systems, John Wiley & Sons, 2007.															
Pendukung (Supporting) :															
[2]. E. Hendricks, O. Jannerup and P. H. Sorensen, Linear System Control: Deterministic and Stochastic Methods, Springer, 2008.															
[3]. Joao P. Hespanha, Linear System Theory, Princenton University Press, 2009															
[4]. Chi-Tsong Chen, Linear System Theory and Design, Oxford University Press, 1999.															
[5]. Norman S. Nise, Control System Engineering, Sixth Ed., John Wiley & Sons, 2011															
Dosen Pengampu <i>Lecturer</i>	Unggul Wasiwitono														



Mata kuliah syarat <i>prerequisite</i> <i>courses</i>		Sistem Dinamis dan Pengendalian <i>Dynamic Systems and Control</i>					
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar <i>Final ability of each stage of learning</i> (Sub-CPMK)	Penilaian <i>Evaluation</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Forms, Learning Methods, Student Assignments, [Estimasi Waktu/ Estimated Time]</i>		Materi Pembelajaran <i>Learning materials</i> [<i>Pustaka/Reference</i>]	Bobot Penilaian <i>Assessment Weight</i> (%)
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria and Forms</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menjelaskan konsep dasar sistem kendali dan penerapan teori kendali <i>Students are able to explain the basic concepts of control systems and the application of control theory.</i>	Memahami sejarah teori kendali, beberapa konsep dasar sistem kendali, dan penerapan teori kendali <i>Understanding the history of control theory, some basic concepts of control</i>	Latihan Soal <i>Exercises</i>	Transfer Materi Diskusi, tanya-jawab <i>Transfer of Material, Discussion, Q&A</i>		Deskripsi mata kuliah, perspektif, ruang lingkup sejarah dan Konsep dasar sistem kendali. <i>Course description, perspective, scope of history, and basic concepts of control systems.</i> Ref. 1 Bab. 1	5



		<i>systems, and the application of control theory.</i>		[TM: 1x(3x50'')]		Ref. 2 Bab. 1	
2-3	Mahasiswa mampu merumuskan dan mengembangkan model ruang keadaan untuk sistem dinamis dan melinearisasi model non-linier <i>Students are able to formulate and develop state-space models for dynamic systems and linearize non-linear models.</i>	Mampu memodelkan sistem mekanika dinamik dalam bentuk state-space, linierisasi sistem non-linier. <i>Being able to model dynamic mechanical systems in the form of state-space and linearize non-linear systems.</i>	Latihan Soal <i>Exercises</i> Studi kasus <i>Case study</i>	Kuliah, Transfer Materi <i>Lecture, Transfer of Material</i> Studi Kasus <i>Case study</i> [TM: 2x(3x50'')]		Review model fungsi transfer dan pemodelan ruang keadaan <i>Review of transfer function and state-space modeling.</i> Ref. 1 Bab. 2 Ref. 2 Bab. 2	10
4	Mahasiswa mampu memodelkan dan mensimulasikan sistem dinamis dengan menggunakan Simulink dan Simscape multibody <i>Students are able to model and simulate dynamic systems using Simulink and Simscape Multibody.</i>	Mampu memanfaatkan Simulink dan Simscape multibody untuk memodelkan sistem dinamis <i>Being able to utilize Simulink and Simscape Multibody to model dynamic systems.</i>	Latihan Soal <i>Exercises</i> Homework	Kuliah, Transfer Materi <i>Lecture, Transfer of Material</i> [TM: 1x(3x50'')]		Pemodelan sistem dinamika menggunakan Simulink dan Simscape multibody. <i>Dynamic system modeling using Simulink and Simscape Multibody.</i>	10



5	Mahasiswa memahami pengetahuan dasar tentang aljabar linier <i>Students have a basic understanding of linear algebra.</i>	Memahami pengetahuan dasar tentang aljabar linier <i>Understanding basic knowledge of linear algebra.</i>	Latihan Soal <i>Exercises</i> Homework	Kuliah Transfer Materi <i>Lecture, Transfer of Material</i> [TM: 1x(3x50'')]		Review tentang aljabar linier dan Transformasi linier <i>Review of linear algebra and linear transformations.</i> Ref. 3 Bab. 3	5
6	Mahasiswa mampu menghitung solusi model state-space dan realisasi sistem LTI dalam berbagai bentuk <i>Students are able to calculate solutions for state-space models and realize LTI systems in various forms.</i>	Mampu menghitung solusi model state-space dan realisasi sistem LTI dalam berbagai bentuk <i>Being able to calculate solutions for state-space models and realize LTI systems in various forms.</i>	Latihan Soal <i>Exercises</i> Studi kasus <i>Case study</i>	Kuliah Transfer Materi <i>Lecture, Transfer of Material</i> Studi Kasus <i>Case study</i> [TM: 1x(3x50'')]		Dasar-dasar ruang keadaan - solusi komputasi untuk model ruang keadaan - realisasi sistem LTI dalam berbagai bentuk <i>Fundamentals of state-space</i> - <i>Computational solutions for state-space models</i> - <i>Realization of LTI systems in various forms</i> Ref. 1 Bab. 2 Ref. 2 Bab. 3 Ref. 3 Bab. 4	10



7	Mahasiswa mampu menganalisis kestabilan sistem dinamik dengan menggunakan metode Lyapunov <i>Students are able to analyze the stability of dynamic systems using the Lyapunov method.</i>	Mampu menganalisis kestabilan sistem dinamik menggunakan metode Lyapunov <i>Being able to analyze the stability of dynamic systems using the Lyapunov method.</i>	Latihan Soal <i>Exercises</i> Homework	Kuliah Transfer Materi <i>Lecture, Transfer of Material</i> Studi Kasus <i>Case study</i> [TM: 1x(3x50'')]		Analisis stabilitas - Kondisi stabilitas - Stabilitas internal dan eksternal <i>Stability analysis:</i> - <i>Stability conditions.</i> - <i>Internal and external stability.</i> Ref. 1 Bab. 6 Ref. 2 Bab. 3 Ref. 3 Bab. 5	10
8	Evaluasi Tengah Semester / Ujian Tengah Semester						
9	Mahasiswa memahami konsep keterkontrolan dan keterobservasian serta mampu memeriksa keterkontrolan dan keteramatan <i>Students understand the concepts of controllability and observability and are able to examine controllability and observability.</i>	Memahami konsep controllability dan observability serta mampu memeriksa controllability dan observability <i>Understanding the concepts of controllability and observability and being able to examine controllability and observability</i>	Latihan Soal <i>Exercises</i> Homework	Kuliah Transfer Materi <i>Lecture, Transfer of Material</i> Studi Kasus <i>Case study</i> [TM: 1x(3x50'')]		Controllability dan Observability Ref. 1 Bab. 3 & Bab. 4 Ref. 2 Bab. 3 Ref. 3 Bab. 5	5



10-11	Mahasiswa mampu merancang pengontrol berbasis umpan balik keadaan <i>Students are able to design state feedback-based controllers.</i>	mampu merancang pengontrol berbasis umpan balik keadaan <i>Being able to design state feedback-based controllers.</i>	Latihan Soal <i>Exercises</i> Studi kasus <i>Case study</i>	Materi Transfer Kuliah <i>Lecture, Transfer of Material</i> Studi kasus <i>Case study</i> [TM: 2x(3x50'')]		Desain Kontrol Umpan Balik Keadaan Linier - Metode pole placement - Pelacakan keadaan stabil <i>Linear State Feedback Control Design</i> - <i>Pole placement method</i> - <i>Stable state tracking</i> Ref. 1 Bab. 7, Ref. 2 Bab. 4	10
12	Mahasiswa mampu merancang estimator keadaan <i>Students are able to design state estimators.</i>	Mampu merancang estimator keadaan <i>Being able to design state estimators.</i>	Latihan Soal <i>Exercises</i> Studi kasus <i>Case study</i>	Kuliah Transfer Materi <i>Lecture, Transfer of Material</i> Studi Kasus <i>Case study</i> [TM: 1x(3x50'')]		Observer dan Kontrol berbasis Observer <i>Observer-based control and observer design</i> Ref. 1 Bab. 8 Ref. 3 Bab. 8	10
13-14	Mahasiswa memahami konsep dasar pengendalian optimal dan mampu merancang pengontrol LQR	Mampu merancang pengontrol LQR <i>Being able to design LQR controllers.</i>	Latihan Soal <i>Exercises</i> Studi kasus	Materi Transfer Kuliah		Pengantar kontrol Optimal Kuadrat Linier <i>Introduction to Linear Quadratic Optimal Control</i>	15



	<i>Students understand the basic concepts of optimal control and are able to design LQR controllers.</i>		<i>Case study</i>	<i>Lecture, Transfer of Material</i> Studi kasus [TM: 2x(3x50'')]		Ref. 1 Bab. 9 Ref. 2 Bab. 5	
15	Mampu mengkomunikasikan pekerjaan teknik mereka secara efektif <i>Students are capable of effectively communicating their engineering work.</i>	Mahasiswa mampu berkomunikasi secara efektif baik lisan maupun tulisan <i>Students are able to communicate effectively, both orally and in writing.</i>	Diskusi <i>Discussion</i>	Diskusi <i>Discussion</i> Studi Kasus <i>Case study</i> TM: 1x (3x50'')		Diskusi project <i>Project discussion</i>	10
16	Evaluasi Akhir Semester / Ujian Akhir Semester						

10. Rencana Pembelajaran Semester (RPS)

Dokumen Rencana Pembelajaran Semester, didokumentasikan secara sendiri untuk seluruh MK
Untuk prodi-prodi yang ikut akreditasi internasional, dokumen RPS menjadi acuan untuk dipindahkan ke dalam template yang sesuai dengan permintaan badan akreditasi tsb.



						RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM		Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER								
MATA KULIAH (MK)		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan	
SISTEM MANUFAKTUR INDUSTRI		TM234724	Rekayasa Sistem dan Kontrol	T=3	P=0	7	25 Nov 2023	
OTORISASI		Pengembang RPS		Koordinator RMK		Ketua PRODI		
		Witantyo				Suwarno		
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK							
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan.						
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik.						
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi						
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data						
	Capaian Pembelajaran Mata Kuliah (CPMK)							
	CPMK-1	Mampu mengenali tahapan pembuatan sebuah produk dan merancang proses produksinya. (CPL-5, CPL-8)						
	CPMK-2	Mampu mengamati masalah-masalah spesifik yang menyangkut perancangan proses produksi dan mampu mengajukan langkah-langkah perbaikan. (CPL-8, CPL-9)						
	CPMK-3	Mampu merancang sebuah sistem produksi dengan kapasitas tertentu (CPL-5, CPL-8, CPL-9)						



	CPMK-4	Mampu membuat studi kelayakan sistem produksi sehingga bisa diwujudkanl (CPL-8, CPL-9, CPL-10)				
		Matrik CPL – CPMK				
		CPMK	CPL-5	CPL-8	CPL-9	CPL-10
		CPMK-1	V	V	V	
		CPMK-2		V	V	
		CPMK-3	V	V	V	
		CPMK-4		V	V	V
Deskripsi Singkat MK	SMI mengajari dan melatih siswa untuk mampu melakukan analisis terhadap produk dan merancang proses pembuatan produk dengan mempertimbangkan biaya produksi yang minimal untuk standar kualitas produk yang diinginkan. Tahap berikutnya adalah merancang sistem produksi dengan mempertimbangkan dan menghitung fasilitas2 produksi yang digunakan agar sistem produksi ini layak untuk diwujudkan dan bisa menghasilkan produk yang bermutu baik dengan biaya produksi yang minimal.					
Bahan Kajian: Materi Pembelajaran	- Strategi bisnis; - Perancangan produk dengan daya saing; - Perancangan process; - Rekayasa metoda kerja; - Manajemen kapasitas dan learning curve - Perancangan sistem produksi - Tata letak sarana produksi; - Penyeimbangan lintasan; - Produktifitas dan mampu saing; - Analisis pemilihan aset;					
Pustaka	Utama :					



		[47]. Chase and Aquilano: Production and Operations management					
		Pendukung :					
		[48].Joh O.McClain and L.Joseph Thomas:Operations management					
		[49].Martin K. Starr: Operations Management					
		[50].Grant and Leavenworth: Principle of Engineering Economy.					
Dosen Pengampu		Witanty					
Matakuliah syarat		Proses manufaktur					
No	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Memahami lingkup sistem manajemen industri	- Mampu mengenali bagaimana sebuah produk dirancang supaya bisa dijual - Mampu mengingat kembali beberapa metoda proses produksi - Mampu membedakan sistem produksi dengan berbagai kapasitas	Oral Post-Test (acak): Aktifitas di kelas	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	Pemahaman tentang sistem operasi	[1]: Bab 1, 3 dan 5 [2]: Handout di myITS Calsroom	



2	Memahami kriteria bisnis agar bisa berkembang	- Memahami berbagai strategi bersaing dalam bisnis - Mampu menjabarkan strategi operasi bisnis sesuai dengan strategi bersaing - Mampu menjabarkan kriteria produk yang diinginkan konsumen yang sesuai dengan strategi operasi perusahaan	Oral Post-Test (acak): Aktifitas di kelas Latihan soal	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Produktifitas dan mampu saing	[1]: Bab 8 [2]: Handout di myITS Calssroom	
3	Mampu mengenali dan menentukan kriteria pengembangan produk terkait penentuan proses produksi	- Mampu menentukan kriteria pengembangan produk - Mampu membedakan dan menjelaskan tentang efisiensi dan efektifitas proses produksi - Mampu menengarai masalah dan mencari penyelesaian dalam persoalan	Oral Post-Test (acak): Aktifitas di kelas Latihan soal	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Analisis proses industri	[1]: Bab 8 [2]: Handout di myITS Calssroom	



		menurunkan biaya produksi					
4	Perancangan proses produksi	- Mampu merancang urutan proses produksi untuk barang manufaktur - Mampu memilih proses produksi yang paling sesuai dengan kebutuhan produk - Mampu merancang parameter proses produksi yang optimal	Oral Post-Test (acak): Aktifitas di kelas Tugas Mandiri: Tugas Kuis: 3 soal 150 mnt Model matematik, kalkulasi	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Peramalan produksi	[1]: Bab 8 [2]: Handout di myITS Calssroom	10%
5	Mampu melakukan analisis proses produksi dan mencari perbaikan metoda kerja	- Mampu melakukan analisis produk dan proses - Mampu memilih produk dan proses yang sesuai dengan kemam-puan yang dimiliki - Mampu mengenali interaksi bagian produksi dengan bagian manajemen lain	Oral Post-Test (acak): Aktifitas di kelas Latihan soal	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Perencanaan agregat	[[1]: Bab 9 [2]: Handout di myITS Calssroom	



		- Mampu menganalisis struktur proses industri terkait dengan tipe aliran produk					
6	Manajemen kapasitas	- Capacity Planning Concepts - Economies and Diseconomies of Scale - Capacity Planning Considerations in Changing - Capacity - Determining Capacity Requirements - Using Decision Trees to Evaluate Capacity Alternatives	Oral Post-Test (acak): Aktifitas di kelas Latihan soal	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	Penjadwalan produksi -	[1]: Bab 9 [2]: Handout di myITS Calssroom	
7	Learning curve	- What are Learning Curves? - How are Learning Curves Modeled? - Logarithmic Analysis - Learning Curve Tables - Estimating the Learning Percentage	Oral Post-Test (acak): Aktifitas di kelas Tugas Mandiri: Tugas Kuis: 3 soal 150 mnt Model matematik, kalkulasi	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal Belajar Terstruktur [TM: 3x60"]	- Teori antrian -	[1]: Bab 9 [2]: Handout di myITS Calssroom	10%



		- How Long Does Learning Go On? - In Practice, How Much Learning Occurs? - Individual Learning - Organizational Learning		Belajar Mandiri [TM: 3x60"]			
8	Perancangan sistem produksi	- Manufacturing Processes Flow concept - How Manufacturing Processes are Organized - Production system Concept Connections	Oral Post-Test (acak): Aktifitas di kelas Tugas Mandiri: Tugas Kuis: 3 soal 150 mnt Model matematik, kalkulasi	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Teori antrian	[1]: Bab 9 [2]: Handout di myITS Calssroom	
9	Evaluasi Tengah Semester / Ujian Tengan Semester						20%
10	- Mampu merancang dan memperbaiki langkah-langkah yang terkait dengan pembuatan	- Mampu memahami dan membuat peta proses dan peta gerakan - Mampu melakukan analisis proses untuk perbaikan produksi	Oral Post-Test (acak): Aktifitas di kelas	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal	- Rekayasa metoda	[1]: Bab 6 dan 7 [2]: Handout di myITS Calssroom	



	produk atau jasa yang meliputi metode, gerak, dan penentuan waktu baku	- Mampu menentukan waktu baku suatu kegiatan kerja dengan metode time study atau work sampling - Mampu menerapkan konsep-konsep statistika dalam penentuan waktu baku		Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]			
11	- Mampu memahami berbagai model pengaturan tata letak sarana produksi	- Mampu menyebutkan perbedaan antara beberapa model pengaturan tata letak sarana produksi - Mampu menyebutkan kriteria-kriteria penentuan tata letak yang baik. - Mampu menyebutkan komponen-komponen penting dalam pengaturan tata letak sarana produksi	Oral Post-Test (acak): Aktifitas di kelas	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Tata letak sarana produksi	[1]: Bab 7 [2]: Handout di myITS Classroom	
12	- Mampu mengatur penempatan kegiatan-kegiatan pada	- Mampu menentukan jumlah kebutuhan work station sesuai dengan permintaan dan waktu pembuatan produk	Oral Post-Test (acak): Aktifitas di kelas Tugas Mandiri: Tugas	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab	- Penyeimbangan lintasan	[1]: Bab 16 [2]: Handout di myITS Calsroom	10%



	workstation-workstation dalam suatu sistem perakitan untuk menghasilkan efisiensi lintasan yang baik	- Mampu menempatkan kegiatan-kegiatan pada tiap-tiap work sesuai dengan waktu siklus dan diagram keterkaitan antar kegiatan - Mampu memanfaatkan heuristik-heuristik yang biasa digunakan dalam penyeimbangan lintasan - Mampu menganalisis kaitan antara output produksi dan efisiensi lintasan - Mampu memahami tentang jumlah lini, stasiun ganda, dan sebagainya dalam aspek penyeimbangan lintasan	Kuis: 3 soal 150 mnt Model matematik, kalkulasi	Pembahasan soal Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]			
13	Mampu memiih aset untuk kepentingan industri berdasarkan analisis ekonomi	- Mampu memahami tentang perbedaan nilai uang sekarang dan esok hari - Mentransformasikan cash flow dari suatu pola ke pola lain	Oral Post-Test (acak): Aktifitas di kelas Tugas Mandiri: Tugas	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal	- Inventory dan MRP	[1]: Bab 16 [2]: Handout di myITS Calssroom	10%



		- Mampu menghitung nilai aset dalam perspektif waktu dengan menyertakan cash flow, depresiasi, pajak, dan mampu membuat peringkat pemilihan aset		Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]			
14	Mampu memilih aset untuk kepentingan industri berdasarkan analisis ekonomi	- Mampu menghitung nilai aset dalam perspektif waktu dengan menyertakan cash flow, depresiasi, pajak, dan mampu membuat peringkat pemilihan aset - Mampu memilih aset berdasarkan kriteria yang lazim digunakan seperti NPV, IRR, dan sebagainya	Oral Post-Test (acak): Aktifitas di kelas	Perkuliahan [TM: 3x50"] Kuliah tatap muka Diskusi Tanya jawab Pembahasan soal Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Pengenalan metode simulasi	[1]: Bab 10 [2]: Handout di myITS Calssroom	
15	Presentasi Kelompok		Kuis: 2 soal 100 mnt	Perkuliahan [TM: 3x50"] Belajar Terstruktur [TM: 3x60"]	- [1]: Bab 10 [2]: Handout di myITS Calssroom	[1]: Bab 10 [2]: Handout di myITS Calssroom	20%



				Belajar Mandiri [TM: 3x60"]			
16	Evaluasi Akhir Semester / Ujian Akhir Semester						20%

Catatan :

13. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
14. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
15. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
16. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
17. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
18. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
19. **Bentuk penilaian:** tes dan non-tes.
20. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.



21. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
22. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
23. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
24. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN					TM234301
RENCANA PEMBELAJARAN SEMESTER						
MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
Matematika Rekayasa	TM234301	Rekayasa Termal dan Sistem Energi	T=3	P=0	1	1 Agustus 2023
OTORISASI	Pengembang RPS		Koordinator RMK		Ketua PRODI	
	Amirul Hakam, S.Si., M.Si.		Dr. Ir. Bambang Arip Dwiyanoro, ST, MSc.Eng, IPM, AEng		Dr. Ir. Atok Setiyawan, MEng.Sc, IPU, AEng	
CPLCapaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika				
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik.				
	Capaian Pembelajaran Mata Kuliah (CPMK)					
	CPMK-1	Mampu memahami tentang persamaan differensial biasa.				
	CPMK-2	Mampu memahami dan menerapkan transformasi laplace dan transformasi fourier dalam menyelesaikan permasalahan teknik.				
	CPMK-3	Mampu menyelesaikan persamaan diferensial parsial dan terapannya.				
	CPMK-4	Mampu memahami teori fungsi skalar dan vektor serta aplikasinya.				



		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-1</td><td>CPL-2</td><td>CPL-3</td><td>CPL-4</td><td>CPL-5</td><td>CPL-6</td><td>CPL-7</td><td>CPL-8</td><td>CPL-9</td></tr><tr><td>CPMK-1</td><td></td><td></td><td></td><td>V</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CPMK-2</td><td></td><td></td><td></td><td>V</td><td></td><td></td><td></td><td>V</td><td></td></tr><tr><td>CPMK-3</td><td></td><td></td><td></td><td>V</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CPMK-4</td><td></td><td></td><td></td><td>V</td><td></td><td></td><td></td><td>V</td><td></td></tr></table>									CPMK	CPL-1	CPL-2	CPL-3	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-9	CPMK-1				V						CPMK-2				V				V		CPMK-3				V						CPMK-4				V				V	
CPMK	CPL-1	CPL-2	CPL-3	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-9																																																			
CPMK-1				V																																																								
CPMK-2				V				V																																																				
CPMK-3				V																																																								
CPMK-4				V				V																																																				
Deskripsi Singkat MK	Pada mata kuliah ini memperkenalkan materi pendukung untuk menyelesaikan permasalahan dalam bidang mekanika. Materi tersebut meliputi persamaan diferensial biasa, transformasi laplace, transformasi fourier, persamaan diferensial parsial, kalkulus peubah banyak dan kalkulus vektor.																																																											
Bahan Kajian: Materi Pembelajaran	• Persamaan differensial biasa dan aplikasinya • Transformasi laplace, fourier dan Z. • Persamaan differensial parsial dan aplikasinya • Kalkulus vektor																																																											
Pustaka	Utama :																																																											
	1. Nur Asiyah, Buku ajar matematika rekayasa, 2023. 2. Erwin Kreyszig - Advanced Engineering Mathematics-John Wiley & Sons, 9th edition.																																																											
	Pendukung :																																																											
	-																																																											
Dosen Pengampu	Drs. Suhud Wahyudi, M.Si. Drs. Iis Herisman, M.Si. Dra. Nur Asiyah, M.Si Drs. Sentot Didik Surjanto, M.Si.																																																											



	Sena Safarina, S.Si., M.Sc. D.Sc. Amirul Hakam, S.Si., M.Si.
Matakuliah syarat	Kalkulus 1, Kalkulus 2



Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assess- ment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)	(1)	(2)
1 – 2	Mahasiswa mampu memahami persamaan diferensial biasa tingkat 1 dan menguasai metode penyelesaiannya	Ketepatan mahasiswa dalam menyelesaikan persamaan diferensial biasa dan aplikasinya.	Tugas 1: Latihan soal mengenai persamaan diferensial biasa tingkat 1	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	- PD terpisah - PD Homogen - PD Linier tk 1. - PD Bernoulli - PD Eksak	1%
3	Mahasiswa mampu menguasai penyelesaian persamaan diferensial biasa tingkat 2	Ketepatan mahasiswa dalam menyelesaikan persamaan diferensial biasa tingkat 2 menggunakan operator D	Tugas 2: Latihan soal mengenai persamaan diferensial biasa tingkat 2	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	- Persamaan diferensial biasa tingkat 2 - Operator D	1%



					•		
4	Mahasiswa mampu menguasai transformasi laplace dalam menyelesaikan masalah nilai awal	Ketepatan dalam menguasai transformasi laplace dalam menyelesaikan masalah nilai awal	Tugas 3: Latihan soal menyelesaikan masalah nilai awal menggunakan transformasi laplace	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	• Transformasi laplace	1%
5	Mahasiswa mampu memahami hampiran suatu fungsi menggunakan deret fourier.	Ketepatan dalam membangun suatu hampiran fungsi menggunakan deret fourier.	Tugas 4: Latihan soal deret fourier	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	• Deret Fourier	2%
6	Kuis 1			- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous)	PDB orde 1 dan 2	15%
	Mahasiswa mampu memahami hampiran suatu fungsi menggunakan transformasi Z.	Ketepatan dalam membangun suatu hampiran fungsi menggunakan transformasi Z.		Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous)	Transformasi Z	



					[TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]		
7	Mahasiswa mampu menguasai persamaan diferensial parsial	Ketepatan mahasiswa dalam menyelesaikan persamaan diferensial parsial menggunakan teknik integral langsung.	Tugas 5: Latihan soal PDP	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	PDP menggunakan integrasi langsung	2%
8	Evaluasi Tengah Semester / Mid Semester Evaluation						25%
9	Mahasiswa mampu menguasai persamaan diferensial parsial	Ketepatan mahasiswa dalam menyelesaikan persamaan diferensial parsial menggunakan teknik pemisahan variabel.	Tugas 6: Latihan soal PDP	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	PDP menggunakan pemisahan variabel	1%



10	Mahasiswa mampu menguasai persamaan diferensial parsial	Ketepatan mahasiswa dalam menyelesaikan terapan persamaan diferensial parsial.	Tugas 7: Latihan soal terapan PD parsial	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Terapan PDP: - Persamaan gelombang - Persamaan panas	1%
11	KUIS 2			- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Fungsi dua variabel Integral lipat	15%
	Mahasiswa mampu memahami konsep kalkulus variabel banyak	Ketepatan mahasiswa dalam menguasai kalkulus variabel banyak		- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]		2%
12	Mahasiswa mampu menguasai fungsi vektor	Ketepatan mahasiswa dalam menguasai fungsi vektor	Tugas 8: Latihan soal fungsi vektor	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"]	Fungsi Vektor – Operator Delta: - Gradien - Divergensi - Curl	3%



					[BM : 3 x 60"] [PT : 3 x 60"]		
13	Mahasiswa mampu menguasai kalkulus vektor	Ketepatan mahasiswa dalam menyelesaikan integral garis dan terapannya	Tugas 8: Latihan soal integral garis	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	- Integral garis - Teorema green	
14	Mahasiswa mampu menguasai kalkulus vektor	Ketepatan mahasiswa dalam menyelesaikan integral permukaan dan terapannya	Tugas 8: Latihan soal integral permukaan	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous) [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]	- Integral permukaan - Teorema stokes	
15	Mahasiswa mampu menguasai kalkulus vektor	Ketepatan mahasiswa dalam menyelesaikan integral volume dan terapannya	Tugas 8: Latihan soal integral volume	- Kuliah - Diskusi kelompok [TM : 3 x 50"] [BM : 3 x 60"]	Diskusi melalui platform myITS classroom (Synchronous dan Asynchronous)	- Integral volume - Teorema gauss	



				[PT : 3 x 60"]	[TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 60"]		
16	Evaluasi Akhir Semester						25%

Catatan :

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, ketrampilan umum, ketrampilan khusus dan pengetahuan.
3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
7. **Bentuk penilaian:** tes dan non-tes.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.



9. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



INSTITUT TEKNOLOGI SEPULUH NOPEMBER
FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM
DEPARTEMEN TEKNIK MESIN
PROGRAM STUDI S1 TEKNIK MESIN

Faculty of Industrial Technology and Systems Engineering
Undergraduate Program of Mechanical Engineering Department

RENCANA PEMBELAJARAN SEMESTER

(Semester Learning Plan)

MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
ENERGY SURYA ENGINEERING OF SOLAR ENERGY	TM234609	KONVERSI ENERGY THERMAL THERMAL ENERGY CONVERSION	T=3	P=0	VII	NOVEMBE R 2023
OTORISASI (Authorization)	Pengembang RPS (Lecture Developer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Graduate Program)	
	Djatismiko Ichsani		Ary Bachtiar		Arif Wahyudi	
Capaian Pembelajaran MK (Learning Outcomes)	Program Studi (Study Program Charge to The Course)		1.1.2 Mampu menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa yang kompleks pada sistem mekanikal dan komponen-komponen yang diperlukan.			



- 1.3.2 Mampu merumuskan solusi untuk masalah rekayasa di bidang sistem mekanikal dan komponen-komponen yang diperlukan dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan
- 2.1.1 Menguasai konsep mekanika dan penjabarannya dalam model matematika untuk dapat berperan sebagai tenaga ahli yang menangani masalah teknik mesin
- 3.2.1 Mampu bekerja mandiri
- 4.5.1 Menghargai keanekaragaman budaya, pandangan, kepercayaan, dan agama serta pendapat/ temuan orisinal orang lain
- 1.1.2 Able to apply mathematics, science, and engineering principles to solve complex engineering problems in mechanical systems and required components.
- 1.3.2 Able to formulate solutions to engineering problems in the field of mechanical systems and required components by considering economic, public health and safety, cultural, social and environmental factors
- 2.1.1 Mastering the concept of mechanics and its description in mathematical models to be able to act as an expert who handles mechanical engineering problems
- 3.2.1 Able to work independently
- 4.5.1 Respecting cultural diversity, views, beliefs, and religions as well as the opinions/original findings of others

Mata Kuliah
Objective of The Course

Mahasiswa mampu menghitung ketersediaan radiasi matahari di permukaan bumi yang merupakan fungsi dari jam, tanggal, lokasi, sudut hadap, dan kemiringan alat pengumpul radiasi matahari (kolektor surya) dari peralatan proses termal. Mahasiswa mampu merencanakan dan menganalisa performansi kolektor surya seperti kolektor surya pemanas air, udara, solar cell, dan pendingin tenaga surya.

Students are able to calculate the availability of solar radiation on the earth's surface which is a function of the hour, date, location, angle of view, and tilt of the solar radiation collector (solar collector) from thermal process equipment. Students are able to plan and analyze the performance of solar collectors such as solar collectors for water heaters, air, solar cells, and solar power coolers.



Diskripsi Bahan Kajian & Pokok Bahasan Description of Studied materials		
	Bahan Kajian Materials of Study	
	Energi Surya: Teknik pemanfaatan tenaga surya dan aplikasinya pada proses thermal	
	Pokok Bahasan Subjects	
Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: 1. Radiasi Matahari : matahari, solar constant, variasi radiasi pada extraterrestrial, arah dari radiasi langsung, sudut datang radiasi matahari langsung yang mengenai permukaan kolektor, radiasi bawuran, ketersediaan radiasi matahari di permukaan bumi pada sembarang lokasi , tanggal, yang mengenai kolektor pada posisi horizontal, miring dengan variasi sudut hadap permukaan kolektor. 2. Perencanaan proses thermal tenaga surya: review proses heat transfer dan termodinamika pada kolektor surya, transmisi dan penyerapan radiasi, indeks kecerahan, dan perhitungan radiasi yang diserap, perencanaan kolektor surya pelat datar dan konsentrator untuk pemanas air, udara, pendingin tenaga surya, perencanaan pembangkit listrik tenaga sel surya pada pada suatu lokasi terpilih. 3. Pengukuran dan pengetesan: faktor efisiensi kolektor, koefisien kehilangan panas total dari kolektor, tes unjuk kerja kolektor, In this course, the following topics will be studied: 1. Solar radiation: the sun, solar constant, radiation variations in extraterrestrial, the direction of direct radiation, the angle of incidence of direct solar radiation that hits the collector surface, bawuran radiation, the availability of solar radiation on the earth's surface at any location, date, which hits the collector in a horizontal position, tilted with variations in the angle of facing the collector surface. 2. Planning of solar thermal processes: review of heat transfer processes and thermodynamics in solar collectors, radiation transmission and absorption, brightness index, and calculation of absorbed radiation, planning of flat plate solar collectors and concentrators for water heaters, air, solar power coolers, planning of solar cell power plants at a selected location.		



	3. Measurement and testing: collector efficiency factor, total heat loss coefficient from the collector, collector performance test,	
Pustaka References	Utama : Main Reference	
	1. John A. Duffie and William A. Beckman, Solar Engineering of Thermal Processes, 4 th Edition, John Wiley & Sons, 2013	
	Pendukung : Supporting Reference	
	1. Frank Kreith, John F. Kreider, Principles of Solar Engineering 2. Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 7 th Edition, John Wiley & Sons, Inc. 3. Frank P. Incropera, David P. Dewitt, Fundamentals of Heat and Mass Transfer, 7 th Edition, John Wiley & Sons, Inc.	
Media Pembelajaran Learning Media	Software :	Hardware :
		PC & LCD Projector
Team Teaching	Djatkiko Ichsani	
Assessment	Latihan Soal Homework (<i>Case-Study</i>) Evaluasi tertulis (Quiz, ETS dan EAS) Practice on Problems Solving Homework (Case-Study) Written evaluation (Quiz, ETS and EAS)	
Matakuliah Syarat	- Termodinamika Teknik	



Prerequest	- Mekanika Fluida - Perpindahan Panas - Engineering Thermodynamics - Fluid Mechanics - Heat Transfer

Mg Ke-	Sub-Capaian Pembelajaran MK	Materi Pembelajaran [Pustaka]	Metode / Strategi Pembelajaran [Estimasi Waktu]	Assessment		
	Sub-learning outcome	Learning Materials [Reference]	Learning Methods [Time Duration]	Indikator	Bentuk	Bobot
				Indicator	Form	Weight
(1)	Mahasiswa mampu merumuskan solusi untuk masalah krisis sumber energy dari fossil fuel ke energy matahari Students are able to formulate solutions to the problem of the energy source crisis from fossil fuels to solar energy.	- Kontrak Kuliah - General principles of sun - Solar constant [Searching at Google and Youtube] Lecture Contract - General principles of sun - Solar constant	- Kuliah Pengantar & Brainstorming - Video Teknologi pemanfaatan tenaga matahari [TM: 1x(3x50")] - Introductory Lecture & Brainstorming about using of Solar Energy - Video Solar energy utilization technology [Time Duration, TM: 1x(3x50")]	Mahasiswa mampu mempunyai pandangan / pemikiran cara-cara pemanfaatan energy surya Students are able to have views/ideas on how to utilize solar energy.	Download alat-alat tenaga surya dan menjelaskan prinsip kerjanya Download solar powered system and explain their working principles	2%
(2)	Mahasiswa mampu menguasai konsep radiasi matahari di ekstrasferrestrial dan arah radiasi langsung Students are able to understand the concept	- Variation of extraterrestrial radiation - Direction of beam radiation [1: Duffie Bab 1] - Variations of extraterrestrial radiation	- Kuliah - Latihan soal [TM: 1x(3x50")] - Lecture - Practice problem solving	Mampu menghitung ketersediaan radiasi matahari di ekstrasferrestrial di sembarang lokasi, waktu, dan sudut hadap kolektor Able to calculate the availability of solar	Latihan Soal Homework - Homework	2%



	of solar radiation in extraterrestrial and direct radiation direction.	- Direction of beam radiation [1: Duffie Chapter 1]	[Time Duration, TM: 1x(3x50'')]	radiation in extraterrestrial at any location, time, and collector facing angle.	- Practice on Problems solving	
(3)	Mahasiswa mampu menguasai konsep dan merumuskan cara menghitung radiasi matahari di ekstraterrestrial pada bidang horizontal maupun miring Students are able to master the concept and formulate ways to calculate solar radiation in extraterrestrial areas on horizontal and inclined planes.	- Solar radiation on a horizontal surface - Solar radiation on a tilted surface - Ratio of beam radiation on tilted surface to that on horizontal surface [1: Duffie Bab 1-lanjutan] Solar radiation on a horizontal surface - Solar radiation on a tilted surface - Ratio of beam radiation on tilted surface to that on horizontal surface	- Kuliah - Latihan soal [TM: 1x(3x50'')] - Lecture - Practice problem solving [Time Duration, TM: 1x(3x50'')]	Mampu memilih lebih untung mana meletakkan kolektor surya pada posisi horizontal atau miring Able to choose which is more profitable to place the solar collector in a horizontal or inclined position.	Latihan Soal Homework menghitung radiasi matahari di kota kelahiran setiap mahasiswa. Homework on Calculating solar radiation in each student's hometown	2%



		[1: Duffie Chapter 1, continue]				
(4-5)	Mahasiswa mampu menguasai konsep dan menganalisa ketersediaan radiasi matahari di permukaan bumi Students are able to master the concept and analyze the availability of solar radiation on the earth's surface	- Pengukuran dan alat ukur radiasi matahari - Analisa data radiasi matahari - Halangan atmospheric pada radiasi matahari - Estimation of average solar radiation - Beam and diffuse solar radiation [1: Duffie Bab 2] Measurement and measuring instruments for solar radiation - Analysis of solar radiation data - Atmospheric obstructions to solar radiation - Estimation of average solar radiation - Beam and diffuse solar radiation	- Kuliah - Latihan soal - Percobaan pengukuran radiasi matahari dengan pyranometer [TM: 1x(3x50")] Lecture - Practice questions - Experiments on measuring solar radiation with a pyranometer [TM: 1x(3x50")]	Mampu menganalisa data radiasi matahari dan mengestimasi besarnya radiasi matahari di setiap lokasi, waktu, dan tanggal baik yang berupa beam or diffuse radiation. Able to analyze solar radiation data and estimate the amount of solar radiation at each location, time, and date, either in the form of beam or diffuse radiation.	Presentasi perhitungan radiasi di kota kelahiran mahasiswa Latihan Soal Homework Quiz pada minggu ke 5 Presentation of radiation calculations in the student's hometown, Practice problem solving. Homework Quiz in week 5	2%



		[1: Duffie Chapter 2]				
(6-7)	Mahasiswa mampu menguasai konsep mekanisme perpindahan panas pada kolektor surya Students are able to master the concept of heat transfer mechanisms in solar collectors	- Konsep tahanan termal pada kolektor surya - Radiation heat transfer coefficient - Natural convection between flat parallel plates - Metode mengurangi kerugian panas konveksi - Heat transfer relation for internal flow [1: Duffie Bab 3] The concept of thermal resistance in solar collectors - Radiation heat transfer coefficient - Natural convection between flat parallel plates - Methods for reducing convection heat losses	- Kuliah - Latihan soal [TM: 1x(3x50")] - Lecture - Practice of Problem solving [TM: 1x(3x50")]	Mampu menghitung koefisien perpindahan panas dan tahanan termal yang terjadi pada kolektor. Mampu menganalisa bagaimana cara mengurangi heat loss Able to calculate the heat transfer coefficient and thermal resistance that occurs in the collector. Able to analyze how to reduce heat loss	Latihan Soal Quis - Homework - Practice on Problems solving - Class Discussion on Problems of - Quiz	2%



		- Heat transfer relation for internal flow				
(8)	Mahasiswa mampu memahami konsep dan merumuskan karakteristik radiasi pada opaque materials Students are able to understand the concept and formulate radiation characteristics in opaque materials	- Relationships among absorptance, emittance, reflectance - Calculation of emittance and reflectance [1: Duffie Bab 4] - Relationships among absorptance, emittance, reflectance - Calculation of emittance and reflectance [1: Duffie Chapter 4]	- Kuliah - Latihan soal [TM: 1x(3x50")] - Lecture - Practice questions [TM: 1x(3x50")]	Mampu menghitung absorpsiviti permukaan benda Able to calculate the surface absorptivity of objects	- Latihan soal - Home work - Practice Problems solving - Home work	2%
(9)	Evaluasi Tengah Semester (ETS) , Mid Term Exame 38%					
(10)	Mahasiswa mampu memahami konsep	- refleksi dan absorpsi radiasi oleh kaca	- Kuliah - Latihan soal [TM: 1x(3x50")]	Mampu menghitung transmittance, absorptance dari kolektor surya.	- Latihan soal - Home work	2%



	transmisi radiasi melalui kaca Students are able to understand the concept of radiation transmission through glass - reflection and absorption of radiation by glass	- Sifat-sifat optic dari system kaca penutup - Transmittan untuk radiasi deffuse - Transmittance and absorptance product - Effec surface layer on transmittance [1: Duffie Bab 5] Optical properties of the cover glass system - Transmittance for diffuse radiation - Transmittance and absorptance product - Effect of surface layer on transmittance [1: Duffie Chapter 5]	- Lecture - Practice questions [TM: 1x(3x50'')]	Mampu menghitung dan menganalisa besarnya radiasi matahari yang diserap oleh kolektor - Able to calculate transmittance, absorptance of solar collectors. - Able to calculate and analyze the amount of solar radiation absorbed by the collector	- Practice Problems solving - Home work	
(11)	Mahasiswa mampu memahami konsep	- Description of Flat Plate Collector.	- Kuliah - Latihan soal	Mampu merencanakan dan	- Latihan soal - Home work	2%



	mekanikal dan merumuskan dalam model matematik untuk merencanakan kolektor surya Students are able to understand the mechanical concept and formulate it in a mathematical model to design solar collectors	- Temperatur distribution - Collectpr efficiency factor - Design of water heater collector - Effects of dust and shading [1: Duffie Bab 6] Description of Flat Plate Collector. - Temperature distribution - Collectpr efficiency factor - Design of water heater collector - Effects of dust and shading [1: Duffie Chapter 6]	[TM: 1x(3x50")] - Lecture - Practice questions [TM: 1x(3x50")]	menganalisa kolektor surya Able to design and to analyze solar collector performances	- Practice onProblems solving - Home work	
(12)	Mahasiswa mampu menganalisa performansi kolektor surya	- Design of air heater - Measurement of collector performance - Collector characterization - Collector test of efficiency - Test data [1: Duffie Bab 6]	- Kuliah - Latihan soal [TM: 1x(3x50")] - Lecture	Mampu menganalisa mengenai performansi kolektor surya	- Latihan soal - Home work	2%



	Students are able to analyze the performance of solar collectors	Design of air heater - Measurement of collector performance - Collector characterization - Collector test of efficiency - Test data [1: Duffie Chapter 6]	- Practice questions [TM: 1x(3x50'')]	Able to analyze the performance of solar collectors	- Practice Problems solving - Home work	
(13)	Mahasiswa mampu merencanakan kolektor konsentrasi yang bekerja pada temperature lebih tinggi dari pada kolektor pelat datar Students are able to design a concentration collector that works at a higher temperature than a flat plate collector	- Collector configuration - Concentration ratio - Thermal performance of concentrating collector - Optical performance of concentrating collector [1: Duffie Bab 7] - Collector configuration - Concentration ratio - Thermal performance of concentrating collector - Optical performance of concentrating collector [1: Duffie Chapter 7]	- Kuliah - Latihan soal [TM: 1x(3x50'')] - Lecture - Practice questions [TM: 1x(3x50'')]	Mampu menganalisa mengenai performansi concentrating collector Able to analyze the performance of concentrating collector	- Latihan soal - Home work - Practice Problems solving - Home work	2%



(14)	Mahasiswa mampu menganalisa performansi concentrating collector dan energy storage Students are able to analyze the performance of concentrating collectors and energy storage	- Cylindrical absorber arrays - Optical characteristic of nonimaging concentrator - Performance of CPC collector - Energy storage in solar process systems - Stratification in storage tanks - Packed-bed storage [1: Duffie Bab 7-8] - Cylindrical absorber arrays - Optical characteristics of nonimaging concentrators - Performance of CPC collectors - Energy storage in solar process systems - Stratification in storage tanks - Packed-bed storage [1: Duffie Chapter 7-8]	- Kuliah - Latihan soal [TM: 1x(3x50'')] - Lecture - Practice questions [TM: 1x(3x50'')]	Mampu menganalisa mengenai performansi concentrating dan system energy storage Able to analyze the performance of concentrating and energy storage systems	- Practice Problems solving - Home work - Practice Problems solving - Home work	2%



(15)	Mahasiswa mampu merencanakan dan menganalisa performansi pembangkit listrik tenaga surya Students are able to plan and analyze the performance of solar power plants	- Konverter photovoltaic - Karakteristik pembangkit listrik photovoltaic dan model - Pengaruh temperature photovoltaic terhadap performansi - Kontrol untuk mendapatkan maximum power point. [1: Duffie Bab 23] - Photovoltaic converters - Characteristics of photovoltaic power plants and models - Effect of photovoltaic temperature on performance - Control to obtain maximum power point. [1: Duffie Chapter 23]	- Kuliah - Latihan soal [TM: 1x(3x50")] - Lecture - Practice questions [TM: 1x(3x50")]	Mampu merencanakan dan menganalisa performansi system pembangkit listrik photovoltaic Able to design and analyze the performance of photovoltaic power generation systems	- Latihan soal - Home work - Practice Problems solving - Home work	2%
(16)	Evaluasi Akhir Semester , Final Exame 38 %					



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>UNDERGRADUATE PROGRAM OF MECHANICAL ENGINEERING</i> <i>DEPARTMENT</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEM ENGINEERING</i>					Kode Dokumen <i>Document Code</i>	
	RENCANA PEMBELAJARAN SEMESTER <i>Semester Learning Plan</i>						
	MATA KULIAH (MK) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>CREDIT</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date</i>
	KERJA PRAKTIK <i>INTERNSHIP</i>	TM234801		T=2	P=0	VIII (8)	7 November 2023
	OTORISASI <i>Autorization</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Undergraduate Program</i>	
	Tri Vicca Kusumadewi, ST., MSc.		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng		
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>						
	CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan,					



Learning Outcome		menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>Graduates are expected to demonstrate attitudes and behaviors that reflect devotion to God Almighty; uphold high ethical standards and integrity; possess noble character; exhibit sensitivity and responsiveness to social and environmental issues; respect cultural diversity and pluralism; uphold and comply with the rule of law; prioritize the interests of the nation and society at large; and pursue excellence through creativity, innovation, strong leadership, effective collaboration, and the optimal development of their personal potential to achieve meaningful outcomes.</i>
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi. <i>Able to manage self-directed learning and develop oneself as a lifelong learner to compete at national and international levels, with a genuine contribution to problem-solving through implementing information and communication technology, while considering the principles of sustainability and understanding technology-based entrepreneurship.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi <i>Ability to effectively communicate both oral and written and apply technology-based entrepreneurship</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>
	CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika <i>Ability to be responsible to society and obey professional ethics in solving the problem of mechanical systems</i>
	Capaian Pembelajaran Mata Kuliah (CPMK)	
	CPMK-1	Mahasiswa mampu menerapkan aturan yang diterapkan dalam panduan Kerja Praktik <i>Students are able to apply the regulations outlined in the Internship/Industrial Training Guidelines.</i>



	CPMK-2	Mahasiswa mampu menerapkan ilmu teknik mesin, ranah kerja, dan tanggung jawab disiplin Ilmu Teknik Mesin di Industri <i>Students are able to apply mechanical engineering knowledge, understand the scope of work, and carry out the responsibilities of the mechanical engineering discipline in an industrial context.</i>																																																
	CPMK-3	Mahasiswa mampu mengaplikasikan professional skills secara professional dan tanggungjawab <i>Students are able to demonstrate and apply professional skills with professionalism and accountability.</i>																																																
	CPMK-4	Mahasiswa mampu berpikir kritis dan berkomunikasi baik secara tulis maupun lisan secara baik <i>Students are able to think critically and communicate effectively, both in written and oral forms.</i>																																																
	CPMK-5	Mahasiswa mampu bekerjasama dalam tim pada masing-masing pihak <i>Students are able to work collaboratively in teams with various stakeholders.</i>																																																
	CPMK-6	Mahasiswa mampu membuat laporan kerja praktik dan mempresentasikannya <i>Students are able to prepare and present an industrial training report.</i>																																																
		Matrik CPL – CPMK <i>Matrix of CPL -CPMK</i>																																																
		CPMK	CPL-1	CPL-3	CPL-8	CPL-9	CPL-10	CPL-11	CPMK-1		v			v		CPMK-2		v	v		v	v	CPMK-3	v		v			v	CPMK-4				v			CPMK-5	v			v			CPMK-6			v	v		
		CPMK	CPL-1	CPL-3	CPL-8	CPL-9	CPL-10	CPL-11																																										
		CPMK-1		v			v																																											
		CPMK-2		v	v		v	v																																										
		CPMK-3	v		v			v																																										
		CPMK-4				v																																												
		CPMK-5	v			v																																												
CPMK-6			v	v																																														
Deskripsi Singkat MK	Dalam mata kuliah ini mahasiswa diberikan kesempatan untuk mengembangkan kompetensi di industri tentang profesi <i>engineer</i> , termasuk peran, etika, budaya serta tanggung jawab profesi <i>engineer</i> dalam disiplin ilmu teknik mesin. Mahasiswa dikenalkan tentang konsep dan																																																	



Short Description of Course	aturan-aturan kerja praktik serta divisi/departemen di industri mitra. Di samping itu, mahasiswa akan diberikan tugas yang berkaitan dengan studi kasus secara nyata di industri mitra. Dengan mengikuti mata kuliah kerja praktik ini, mahasiswa diharapkan mampu dapat meningkatkan kompetensinya dan mengembangkan kreativitas dalam praktik industry. <i>In this course, students are given the opportunity to develop their competencies in the industry, particularly regarding the engineering profession, including its roles, ethics, culture, and professional responsibilities within the field of mechanical engineering. Students are introduced to the concepts and regulations of industrial internships, as well as the structure and functions of divisions or departments within partner industries. In addition, students will be assigned real-world case studies related to the partner industry. Through this industrial internship course, students are expected to enhance their competencies and foster creativity in industrial practice.</i>								
Bahan Kajian: Materi Pembelajaran Course Materials	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Panduan kerja praktik - Sistem organisasi dan pengenalan industri - Pelaksanaan pekerjaan proyek/tugas kerja praktik - Kelengkapan laporan kerja praktik <i>This course covers the following main topics:</i> - <i>Industrial internship guidelines</i> - <i>Organizational systems and industry overview</i> - <i>Execution of project tasks during the internship</i> - <i>Requirements and preparation of the internship report</i>								
Pustaka References	<table border="1"> <tr> <td data-bbox="282 1011 568 1051">Utama :</td><td data-bbox="568 1011 2110 1051"></td></tr> <tr> <td colspan="2" data-bbox="282 1051 2110 1131"> [1]. Panduan Kerja Praktik Departemen Teknik Mesin <i>Mechanical Engineering Department Internship Guidelines</i> </td></tr> <tr> <td data-bbox="282 1131 568 1171">Pendukung :</td><td data-bbox="568 1131 2110 1171"></td></tr> <tr> <td colspan="2" data-bbox="282 1171 2110 1251"> [2]. Peraturan-peraturan akademik <i>Academic Regulations</i> </td></tr> </table>	Utama :		[1]. Panduan Kerja Praktik Departemen Teknik Mesin <i>Mechanical Engineering Department Internship Guidelines</i>		Pendukung :		[2]. Peraturan-peraturan akademik <i>Academic Regulations</i>	
Utama :									
[1]. Panduan Kerja Praktik Departemen Teknik Mesin <i>Mechanical Engineering Department Internship Guidelines</i>									
Pendukung :									
[2]. Peraturan-peraturan akademik <i>Academic Regulations</i>									
Dosen Pengampu	Koordinator Kerja praktek, Dosen Pembimbing <i>Internship Coordinator, Academic Supervisor</i>								



Lecturers							
Matakuliah syarat Prerequisites							
Telah menempuh 100 SKS (SKS Tempuh) perkuliahan, dan Telah lulus mata kuliah Metalurgi I, Elemen Mesin I, Mekanika Fluida I, dan Termodinamika I Telah lulus/sedang mengambil mata kuliah Proses Manufaktur I, dan Elemen Mesin II, yang ditunjukkan dengan transkrip mata kuliah dan FRS semester berjalan <i>Have completed 100 credit hours (completed credits) of coursework, and Have passed the courses Metallurgy I, Machine Elements I, Fluid Mechanics I, and Thermodynamics I, Have passed or are currently enrolled in the courses Manufacturing Process I and Machine Elements II, as evidenced by the academic transcript and current semester's study plan (FRS).</i>							
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final Ability of Each Learning Stage</i>	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Model, Learning Method, Student Assignment</i>		Materi Pembelajaran <i>Learning Materials</i>	Bobot Penilaian (%) <i>Assesment Credits (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria & Model</i>	Luring <i>Offline</i>	Daring <i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami konsep dan peraturan kerja praktik <i>Students are able to understand the concepts and</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dan peraturan kerja praktik <i>Completeness, clarity, accuracy (of content and timing), and originality in explaining</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i>	Menyelesaikan tugas kerja praktik Mempelajari pedoman kerja praktik <i>Completing the internship assignments Studying the internship guidelines</i>	- Konsep, tujuan dan peraturan kerja praktik - Kontrak kerja praktik dengan mitra kerja praktik - Pengenalan mitra kerja praktik [Panduan dan SOP Kerja praktik]	



	<i>regulations of the industrial internship.</i>	<i>the concepts and regulations of the industrial internship.</i>	Asistensi dan Diskusi <i>Assistance and Discussion</i>	Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")		- <i>Concepts, objectives, and regulations of the internship</i> - <i>Internship agreement with the industry partner</i> - <i>Introduction to the industry partner</i> <i>[Internship Guidelines and Standard Operating Procedures (SOP)]</i>	
2	Mahasiswa mampu memahami proses industri terkait dengan pendekatan <i>engineering</i> khususnya disiplin ilmu teknik mesin <i>Students are able to understand industrial processes related to engineering approaches, particularly</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan persoalan di perusahaan dengan pendekatan <i>engineering</i> (teknik mesin/sistem mekanikal) <i>Completeness, clarity, accuracy (of content and timing), and originality in solving problems in the company using an engineering approach</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi <i>Assistance and Discussion</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	Menyelesaikan tugas kerja praktik Mempelajari pedoman kerja praktik <i>Completing the internship assignments</i> <i>Studying the internship guidelines</i>	Pengenalan departemen/divisi mitra kerja praktik <i>Introduction to the departments/divisions of the internship partner</i>	3



	<i>within the discipline of mechanical engineering.</i>	<i>(mechanical engineering/mechanical systems).</i>					
3-14	Mahasiswa mampu menyelesaikan tugas kerja praktik dan permasalahan di industri dan membuat kelengkapan laporan kerja praktik dengan professional dan tanggung baik secara mandiri maupun berkelompok <i>Students are able to complete internship assignments and solve</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan persoalan di perusahaan dengan pendekatan <i>engineering</i> (teknik mesin/sistem mekanikal) <i>Completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems in the company using an engineering approach (mechanical engineering/mechanical systems).</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi Studi kasus <i>Assistance and Discussion</i> <i>Case study</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	Menyelesaikan tugas kerja praktik Studi kasus permasalahan di Industri Mempelajari pedoman kerja praktik <i>Completing the internship assignments</i> <i>Case study: Problem in Industry</i> <i>Studying the internship guidelines</i>	Pengisian tugas mingguan dan rancangan laporan kerja praktik serta penyelesaian tugas dari pembimbing lapangan <i>Completion of weekly assignments and drafting of the internship report, as well as fulfilling tasks assigned by the field supervisor.</i>	



	<i>industrial problems, and prepare a comprehensive internship report with professionalism and responsibility, both independently and in teams.</i>						
15	Mahasiswa menyusun laporan kerja praktik dengan menerapkan pengetahuan keteknikmesinan (<i>engineering</i>) dan keterampilan selama pelaksanaan kerja praktik sesuai dengan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan penyusunan laporan kerja praktik <i>Completeness, clarity, accuracy (of content and timing), and originality in addressing issues related to the preparation of the internship report.</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi Studi kasus <i>Assistance and Discussion Case study</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	Menyusun laporan kerja Praktik <i>Preparing the Internship Report</i>	Pengisian tugas mingguan dan rancangan laporan kerja praktik <i>Completion of weekly assignments and drafting of the internship report.</i>	10



	aturan yang berlaku <i>Students prepare the internship report by applying mechanical engineering knowledge and skills acquired during the internship, in accordance with the applicable regulations.</i>						
16	Mahasiswa mengumpulkan laporan kerja praktik dan mempresentasikan hasil kerja praktik pada pihak industri dan kampus <i>Students submit the internship</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mempresentasikan laporan hasil kerja praktik <i>Completeness, clarity, accuracy (of content and timing), and originality in presenting the</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi Presentasi	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning	Presentasi <i>Presentation</i>	Pengumpulan Laporan kerja praktik dan Evaluasi Presentasi <i>Submit internship report Presentation</i>	



	<i>report and present the results of the internship to both the industry and the university.</i>	<i>internship report results.</i>	<i>Assistance and Discussion Presentation</i>	<i>Expository & Discovery Learning</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")			

Catatan :

Notes:

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
Program Learning Outcomes (PLOs) are the competencies possessed by each graduate of the study program, which represent the internalization of attitudes and mastery of knowledge and skills according to the level of the program, acquired through the learning process
3. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan. *PLOs assigned to a course refer to selected program learning outcomes that contribute to the development of the course. These outcomes encompass aspects of attitude, general skills, specific skills, and knowledge.*
4. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
Course Learning Outcomes (CLOs) are specific abilities derived from the PLOs assigned to a course and are directly related to the subject matter or learning content of the course.
5. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
Sub-Course Learning Outcomes (Sub-CLOs) are more specific capabilities derived from the CLOs, measurable and observable, representing the final learning abilities expected at each stage of the learning process, and specific to the course content.



6. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
Assessment Indicators are specific and measurable statements that identify student learning abilities or performance, along with the evidence supporting them, used to assess both the process and outcomes of learning.
7. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
Assessment Criteria are the standards used to measure the achievement of learning outcomes, based on predetermined indicators. These criteria serve as a guide for evaluators to ensure consistent and unbiased assessment. Criteria may be quantitative or qualitative.
8. **Bentuk penilaian:** tes dan non-tes.
Form of Assessment: tests and non-test assessments.
9. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
Form of Learning: Lectures, Response Sessions, Tutorials, Seminars (or equivalent), Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other equivalent forms of learning.
10. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.
Learning Methods: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.
11. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
Learning Materials are detailed topics or descriptions of subject matter, which can be presented as main topics and subtopics.
12. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
Assessment Weight is the percentage assigned to the achievement of each Sub-CLO, proportionally reflecting the difficulty level of each Sub-CLO, with a total weight of 100%.
13. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.
TM = Face-to-Face, PT = Structured Assignments, BM = Independent Learning.





	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>UNDERGRADUATE PROGRAM OF MECHANICAL ENGINEERING DEPARTMENT</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEM ENGINEERING</i>					Kode Dokumen <i>Document Code</i>
RENCANA PEMBELAJARAN SEMESTER <i>Semester Learning Plan</i>						
MATA KULIAH (MK) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>CREDIT</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date</i>
MAGANG 1 <i>INTERNSHIP 1</i>	TM234742		T=3	P=0	VII (7)	7 November 2023
OTORISASI <i>Autorization</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Undergraduate Program</i>	
	Tri Vicca Kusumadewi, ST., MSc.		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>					
	CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan,				



Learning Outcome		menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>Graduates are expected to demonstrate attitudes and behaviors that reflect devotion to God Almighty; uphold high ethical standards and integrity; possess noble character; exhibit sensitivity and responsiveness to social and environmental issues; respect cultural diversity and pluralism; uphold and comply with the rule of law; prioritize the interests of the nation and society at large; and pursue excellence through creativity, innovation, strong leadership, effective collaboration, and the optimal development of their personal potential to achieve meaningful outcomes.</i>
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi. <i>Able to manage self-directed learning and develop oneself as a lifelong learner to compete at national and international levels, with a genuine contribution to problem-solving through implementing information and communication technology, while considering the principles of sustainability and understanding technology-based entrepreneurship.</i>
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi



		<i>Ability to effectively communicate both oral and written and apply technology-based entrepreneurship</i>						
CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data	<i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>						
CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika	<i>Ability to be responsible to society and obey professional ethics in solving the problem of mechanical systems</i>						
Capaian Pembelajaran Mata Kuliah (CPMK)								
CPMK-1	Mahasiswa mampu menerapkan aturan yang diterapkan dalam SOP magang dan Panduan Magang	<i>Students are able to apply the rules outlined in the internship Standard Operating Procedures (SOP) and Internship Guidelines</i>						
CPMK-2	Mahasiswa mampu menerapkan ilmu teknik mesin, ranah kerja, dan tanggung jawab disiplin Ilmu Teknik Mesin di Industri	<i>Students are able to apply mechanical engineering knowledge, work domains, and discipline responsibilities in the field of Mechanical Engineering in the industry</i>						
CPMK-3	Mahasiswa mampu mengaplikasikan professional skills secara professional dan tanggungjawab	<i>Students are able to demonstrate and apply professional skills with professionalism and accountability.</i>						
CPMK-4	Mahasiswa mampu berpikir kritis dan berkomunikasi baik secara tulis maupun lisan secara baik	<i>Students are able to think critically and communicate effectively, both in written and oral forms.</i>						
CPMK-5	Mahasiswa mampu bekerjasama dalam tim pada masing-masing pihak	<i>Students are able to work collaboratively in teams with various stakeholders.</i>						
CPMK-6	Mahasiswa mampu membuat laporan magang dan mempresentasikannya	<i>Students are able to prepare and present an internship report.</i>						
		Matrik CPL – CPMK <i>Matrix of CPL -CPMK</i>						
		CPMK	CPL-1	CPL-3	CPL-8	CPL-9	CPL-10	CPL-11
		CPMK-1		v			v	
		CPMK-2		v	v		v	v



		CPMK-3	v		v			v
		CPMK-4				v		
		CPMK-5	v			v		
		CPMK-6			v	v		
Deskripsi Singkat MK <i>Short Description of Course</i>	Dalam mata kuliah ini mahasiswa diberikan kesempatan untuk mengembangkan kompetensi di industri tentang profesi <i>engineer</i> , termasuk peran, etika, budaya serta tanggung jawab profesi <i>engineer</i> dalam disiplin ilmu teknik mesin. Mahasiswa dikenalkan tentang konsep dan aturan-aturan magang serta divisi/departemen di industri mitra. Di samping itu, mahasiswa akan diberikan tugas yang berkaitan dengan studi kasus secara nyata di industri mitra. Dengan mengikuti mata kuliah Magang ini, mahasiswa diharapkan mampu dapat meningkatkan kompetensinya dan mengembangkan kreativitas dalam praktik industry. <i>In this course, students are allowed to develop their competencies in the industry, particularly regarding the engineering profession, including its roles, ethics, culture, and professional responsibilities within the field of mechanical engineering. Students are introduced to the concepts and regulations of industrial internships and the structure and functions of divisions or departments within partner industries. In addition, students will be assigned real-world case studies related to the partner industry. Through this industrial internship course, students are expected to enhance their competencies and foster creativity in industrial practice.</i>							
Bahan Kajian: Materi Pembelajaran <i>Course Materials</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Panduan dan SOP Magang - Panduan MBKM - Sistem organisasi dan pengenalan industri - Pelaksanaan pekerjaan proyek magang - Kelengkapan laporan magang <i>This course covers the following main topics:</i> - <i>Internship Standard Operating Procedures (SOP) and Internship Guidelines</i> - <i>MBKM Guidelines</i>							



	- <i>Organizational systems and industry overview</i> - <i>Execution of project tasks during the internship</i> - <i>Requirements and preparation of the internship report</i>						
Pustaka <i>References</i>	Utama :						
	[1]. Panduan dan SOP Magang Departemen Teknik Mesin <i>Internship Standard Operating Procedures (SOP) and Internship Guidelines</i>						
	[2]. Panduan MBKM Departemen Teknik Mesin <i>MBKM Guidelines</i>						
	Pendukung :						
	[2]. Peraturan-peraturan akademik <i>Academic Regulations</i>						
Dosen Pengampu <i>Lecturers</i>	Koordinator Magang, Dosen Pembimbing <i>Internship Coordinator, Academic Supervisor</i>						
Matakuliah syarat <i>Prerequisites</i>	Mahasiswa minimal berada di semester 6 atau telah lulus 90 sks Mendaftar di sistem ITS dan menyerahkan proposal magang Lolos seleksi yang diselenggarakan oleh mitra magang/industri <i>Students must be at least in their 6th semester or have completed at least 90 credit units.</i> <i>Register through the ITS system and submit an internship proposal.</i> <i>Pass the selection process conducted by the internship partner/industry</i>						
Mg Ke <i>Week</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Model, Learning Method,</i> <i>Student Assignment</i>		Materi Pembelajaran <i>Learning Materials</i>	Bobot Penilaian (%) <i>Assesment</i> <i>Credits (%)</i>
				Indikator	Kriteria & Bentuk		



	<i>Final Ability of Each Learning Stage</i>	<i>Indicator</i>	<i>Criteria & Model</i>	<i>Offline</i>	<i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami konsep dan peraturan Magang & MBKM <i>Students are able to understand the concepts and regulations of the industrial internship & MBKM.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dan peraturan magang <i>Completeness, clarity, accuracy (of content and timing), and originality in explaining the concepts and regulations of the industrial internship.</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi <i>Assistance and Discussion</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	Menyelesaikan tugas magang Mempelajari pedoman dan SOP magang, pedoman MBKM Menyelesaikan logbook mingguan di MyITS Student Connect <i>Completing the internship assignments</i> <i>Studying the internship guidelines and SOP</i> <i>Completing the logbook in MyITS Student Connect</i>	- Konsep, tujuan dan peraturan magang - Kontrak magang dengan mitra industry - Pengenalan mitra [Panduan dan SOP Magang - <i>Concepts, objectives, and regulations of the internship</i> - <i>Internship agreement with the industry partner</i> - <i>Introduction to the industry partner</i> <i>[Internship Guidelines and Standard Operating Procedures (SOP)]</i>	
2	Mahasiswa mampu memahami proses industri terkait dengan pendekatan engineering	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan persoalan di perusahaan dengan pendekatan	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk:	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i>	Menyelesaikan tugas magang Mempelajari pedoman magang Menyelesaikan logbook mingguan di MyITS Student Connect	Pengenalan departemen/divisi mitra magang <i>Introduction to the departments/divisions of the internship partner</i>	3



	terutama disiplin ilmu teknik mesin <i>Students are able to understand industrial processes related to engineering approaches, particularly within the discipline of mechanical engineering.</i>	engineering (teknik mesin/sistem mekanikal) <i>Completeness, clarity, accuracy (of content and timing), and originality in solving problems in the company using an engineering approach (mechanical engineering/mechanical systems).</i>	Model: Asistensi dan Diskusi <i>Assistance and Discussion</i>	Metode: Method: Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	<i>Completing the internship assignments</i> <i>Studying the internship guidelines</i>		
3-14	Mahasiswa mampu menyelesaikan tugas magang dan permasalahan di industri dan membuat kelengkapan laporan magang dengan profesional dan tanggung baik secara mandiri	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan persoalan di perusahaan dengan pendekatan <i>engineering</i> (teknik mesin/sistem mekanikal) <i>Completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems in the company using an engineering</i>	Kriteria: Criteria: Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: Model: Asistensi dan Diskusi <i>Assistance and Discussion</i> Studi kasus <i>Case study</i>	Bentuk: Model: kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: Method: Ekspositori dan discovery learning <i>Expository & Discovery Learning</i>	Menyelesaikan tugas magang Studi kasus permasalahan di Industri Mempelajari pedoman magang Menyelesaikan laporan logbook mingguan dan unggah di My ITS Student Connect <i>Completing the internship assignments</i> <i>Case study: Problem in Industry</i>	Pengisian tugas mingguan dan rancangan laporan magang serta penyelesaian tugas dari pembimbing lapangan <i>Completion of weekly assignments and drafting of the internship report, as well as fulfilling tasks assigned by the field supervisor.</i>	



	maupun berkelompok <i>Students are able to complete internship assignments and solve industrial problems, and prepare a comprehensive internship report with professionalism and responsibility, both independently and in teams.</i>	<i>approach (mechanical engineering/mechanical systems).</i>		(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	<i>Studying the internship guidelines Completing the weekly logbook and submit in MyITS Student Connect</i>		
15	Mahasiswa menyusun laporan magang dengan menerapkan pengetahuan keteknikmesinan (engineering) dan keterampilan selama	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan penyusunan laporan magang <i>Completeness, clarity, accuracy (of content and timing), and originality in addressing issues related to the</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan	Menyusun laporan magang dan menyiapkan PPT Presentasi serta diunggah di My ITS Student Connect <i>Preparing the Internship Report and PPT Submit in My ITS StudentConnect</i>	Pengisian tugas mingguan dan rancangan laporan magang <i>Completion of weekly assignments and drafting of the internship report.</i>	10



	pelaksanaan magang sesuai dengan aturan yang berlaku <i>Students prepare the internship report by applying mechanical engineering knowledge and skills acquired during the internship, following the applicable regulations.</i>	<i>preparation of the internship report.</i>	Studi kasus <i>Assistance and Discussion Case study</i>	<i>discovery learning Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")			
16	Mahasiswa mengumpulkan laporan magang dan mempresentasikan hasil magang pada pihak industri dan kampus <i>Students submit the internship report and present</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mempresentasikan laporan hasil magang <i>Completeness, clarity, accuracy (of content and timing), and originality in presenting the internship report results.</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi Presentasi	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i>	Presentasi <i>Presentation</i>	Pengumpulan magang dan Evaluasi Presentasi <i>Submit internship report Presentation</i>	



	<i>the results of the internship to both the industry and the university.</i>		<i>Assistance and Discussion Presentation</i>	<i>Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")			

Catatan :

Notes:

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
Program Learning Outcomes (PLOs) are the competencies possessed by each graduate of the study program, which represent the internalization of attitudes and mastery of knowledge and skills according to the level of the program, acquired through the learning process
16. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan. *PLOs assigned to a course refer to selected program learning outcomes that contribute to the development of the course. These outcomes encompass aspects of attitude, general skills, specific skills, and knowledge.*
17. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
Course Learning Outcomes (CLOs) are specific abilities derived from the PLOs assigned to a course and are directly related to the subject matter or learning content of the course.
18. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.



Sub-Course Learning Outcomes (Sub-CLOs) are more specific capabilities derived from the CLOs, measurable and observable, representing the final learning abilities expected at each stage of the learning process, and specific to the course content.

19. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

Assessment Indicators are specific and measurable statements that identify student learning abilities or performance, along with the evidence supporting them, used to assess both the process and outcomes of learning.

20. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

Assessment Criteria are the standards used to measure the achievement of learning outcomes, based on predetermined indicators. These criteria serve as a guide for evaluators to ensure consistent and unbiased assessment. Criteria may be quantitative or qualitative.

21. **Bentuk penilaian:** tes dan non-tes.

Form of Assessment: tests and non-test assessments.

22. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.

Form of Learning: Lectures, Response Sessions, Tutorials, Seminars (or equivalent), Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other equivalent forms of learning.

23. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.

Learning Methods: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.

24. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.

Learning Materials are detailed topics or descriptions of subject matter, which can be presented as main topics and subtopics.



25. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.

Assessment Weight is the percentage assigned to the achievement of each Sub-CLO, proportionally reflecting the difficulty level of each Sub-CLO, with a total weight of 100%.

26. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

TM = Face-to-Face, PT = Structured Assignments, BM = Independent Learning.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>UNDERGRADUATE PROGRAM OF MECHANICAL ENGINEERING DEPARTMENT</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEM ENGINEERING</i>					Kode Dokumen <i>Document Code</i>
RENCANA PEMBELAJARAN SEMESTER <i>Semester Learning Plan</i>						
MATA KULIAH (MK) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>CREDIT</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date</i>
MAGANG 1 <i>INTERNSHIP 2</i>	TM234743		T=3	P=0	VII (7)	7 November 2023
OTORISASI <i>Autorization</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Undergraduate Program</i>	
	Tri Vicca Kusumadewi, ST., MSc.		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>					
	CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan,				



Learning Outcome		menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>Graduates are expected to demonstrate attitudes and behaviors that reflect devotion to God Almighty; uphold high ethical standards and integrity; possess noble character; exhibit sensitivity and responsiveness to social and environmental issues; respect cultural diversity and pluralism; uphold and comply with the rule of law; prioritize the interests of the nation and society at large; and pursue excellence through creativity, innovation, strong leadership, effective collaboration, and the optimal development of their personal potential to achieve meaningful outcomes.</i>
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi. <i>Able to manage self-directed learning and develop oneself as a lifelong learner to compete at national and international levels, with a genuine contribution to problem-solving through implementing information and communication technology, while considering the principles of sustainability and understanding technology-based entrepreneurship.</i>
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi



		<i>Ability to effectively communicate both oral and written and apply technology-based entrepreneurship</i>						
CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data	<i>Ability to plan, solve and evaluate the task based on the analysis of data and information</i>						
CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika	<i>Ability to be responsible to society and obey professional ethics in solving the problem of mechanical systems</i>						
Capaian Pembelajaran Mata Kuliah (CPMK)								
CPMK-1	Mahasiswa mampu menerapkan aturan yang diterapkan dalam SOP magang dan Panduan Magang	<i>Students are able to apply the rules outlined in the internship Standard Operating Procedures (SOP) and Internship Guidelines</i>						
CPMK-2	Mahasiswa mampu menerapkan ilmu teknik mesin, ranah kerja, dan tanggung jawab disiplin Ilmu Teknik Mesin di Industri	<i>Students are able to apply mechanical engineering knowledge, work domains, and discipline responsibilities in the field of Mechanical Engineering in the industry</i>						
CPMK-3	Mahasiswa mampu mengaplikasikan professional skills secara professional dan tanggungjawab	<i>Students are able to demonstrate and apply professional skills with professionalism and accountability.</i>						
CPMK-4	Mahasiswa mampu berpikir kritis dan berkomunikasi baik secara tulis maupun lisan secara baik	<i>Students are able to think critically and communicate effectively, both in written and oral forms.</i>						
CPMK-5	Mahasiswa mampu bekerjasama dalam tim pada masing-masing pihak	<i>Students are able to work collaboratively in teams with various stakeholders.</i>						
CPMK-6	Mahasiswa mampu membuat laporan magang dan mempresentasikannya	<i>Students are able to prepare and present an internship report.</i>						
		Matrik CPL – CPMK <i>Matrix of CPL -CPMK</i>						
		CPMK	CPL-1	CPL-3	CPL-8	CPL-9	CPL-10	CPL-11
		CPMK-1		v			v	
		CPMK-2		v	v		v	v



		CPMK-3	v		v			v
		CPMK-4				v		
		CPMK-5	v			v		
		CPMK-6			v	v		
Deskripsi Singkat MK <i>Short Description of Course</i>	Dalam mata kuliah ini mahasiswa diberikan kesempatan untuk mengembangkan kompetensi di industri tentang profesi <i>engineer</i> , termasuk peran, etika, budaya serta tanggung jawab profesi <i>engineer</i> dalam disiplin ilmu teknik mesin. Mahasiswa dikenalkan tentang konsep dan aturan-aturan magang serta divisi/departemen di industri mitra. Di samping itu, mahasiswa akan diberikan tugas yang berkaitan dengan studi kasus secara nyata di industri mitra. Dengan mengikuti mata kuliah Magang ini, mahasiswa diharapkan mampu dapat meningkatkan kompetensinya dan mengembangkan kreativitas dalam praktik industry. <i>In this course, students are allowed to develop their competencies in the industry, particularly regarding the engineering profession, including its roles, ethics, culture, and professional responsibilities within the field of mechanical engineering. Students are introduced to the concepts and regulations of industrial internships and the structure and functions of divisions or departments within partner industries. In addition, students will be assigned real-world case studies related to the partner industry. Through this industrial internship course, students are expected to enhance their competencies and foster creativity in industrial practice.</i>							
Bahan Kajian: Materi Pembelajaran <i>Course Materials</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Panduan dan SOP Magang - Panduan MBKM - Sistem organisasi dan pengenalan industri - Pelaksanaan pekerjaan proyek magang - Kelengkapan laporan magang <i>This course covers the following main topics:</i> - <i>Internship Standard Operating Procedures (SOP) and Internship Guidelines</i> - <i>MBKM Guidelines</i>							



	- <i>Organizational systems and industry overview</i> - <i>Execution of project tasks during the internship</i> - <i>Requirements and preparation of the internship report</i>						
Pustaka <i>References</i>	Utama :						
	[1]. Panduan dan SOP Magang Departemen Teknik Mesin <i>Internship Standard Operating Procedures (SOP) and Internship Guidelines</i>						
	[2]. Panduan MBKM Departemen Teknik Mesin <i>MBKM Guidelines</i>						
	Pendukung :						
	[2]. Peraturan-peraturan akademik <i>Academic Regulations</i>						
Dosen Pengampu <i>Lecturers</i>	Koordinator Magang, Dosen Pembimbing <i>Internship Coordinator, Academic Supervisor</i>						
Matakuliah syarat <i>Prerequisites</i>	Mahasiswa minimal berada di semester 6 atau telah lulus 90 sks Mendaftar di sistem ITS dan menyerahkan proposal magang Lolos seleksi yang diselenggarakan oleh mitra magang/industri <i>Students must be at least in their 6th semester or have completed at least 90 credit units.</i> <i>Register through the ITS system and submit an internship proposal.</i> <i>Pass the selection process conducted by the internship partner/industry</i>						
Mg Ke <i>Week</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Model, Learning Method,</i> <i>Student Assignment</i>		Materi Pembelajaran <i>Learning Materials</i>	Bobot Penilaian (%) <i>Assesment</i> <i>Credits (%)</i>
				Indikator	Kriteria & Bentuk		



	<i>Final Ability of Each Learning Stage</i>	<i>Indicator</i>	<i>Criteria & Model</i>	<i>Offline</i>	<i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami konsep dan peraturan Magang & MBKM <i>Students are able to understand the concepts and regulations of the industrial internship & MBKM.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dan peraturan magang <i>Completeness, clarity, accuracy (of content and timing), and originality in explaining the concepts and regulations of the industrial internship.</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi <i>Assistance and Discussion</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	Menyelesaikan tugas magang Mempelajari pedoman dan SOP magang, pedoman MBKM Menyelesaikan logbook mingguan di MyITS Student Connect <i>Completing the internship assignments</i> <i>Studying the internship guidelines and SOP</i> <i>Completing the logbook in MyITS Student Connect</i>	- Konsep, tujuan dan peraturan magang - Kontrak magang dengan mitra industry - Pengenalan mitra [Panduan dan SOP Magang - <i>Concepts, objectives, and regulations of the internship</i> - <i>Internship agreement with the industry partner</i> - <i>Introduction to the industry partner</i> <i>[Internship Guidelines and Standard Operating Procedures (SOP)]</i>	
2	Mahasiswa mampu memahami proses industri terkait dengan pendekatan engineering	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan persoalan di perusahaan dengan pendekatan	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk:	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i>	Menyelesaikan tugas magang Mempelajari pedoman magang Menyelesaikan logbook mingguan di MyITS Student Connect	Pengenalan departemen/divisi mitra magang <i>Introduction to the departments/divisions of the internship partner</i>	3



	terutama disiplin ilmu teknik mesin <i>Students are able to understand industrial processes related to engineering approaches, particularly within the discipline of mechanical engineering.</i>	engineering (teknik mesin/sistem mekanikal) <i>Completeness, clarity, accuracy (of content and timing), and originality in solving problems in the company using an engineering approach (mechanical engineering/mechanical systems).</i>	Model: Asistensi dan Diskusi <i>Assistance and Discussion</i>	Metode: Method: Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	<i>Completing the internship assignments</i> <i>Studying the internship guidelines</i>		
3-14	Mahasiswa mampu menyelesaikan tugas magang dan permasalahan di industri dan membuat kelengkapan laporan magang dengan profesional dan tanggung baik secara mandiri	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan persoalan di perusahaan dengan pendekatan <i>engineering</i> (teknik mesin/sistem mekanikal) <i>Completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems in the company using an engineering</i>	Kriteria: Criteria: Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: Model: Asistensi dan Diskusi <i>Assistance and Discussion</i> Studi kasus <i>Case study</i>	Bentuk: Model: kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: Method: Ekspositori dan discovery learning <i>Expository & Discovery Learning</i>	Menyelesaikan tugas magang Studi kasus permasalahan di Industri Mempelajari pedoman magang Menyelesaikan laporan logbook mingguan dan unggah di My ITS Student Connect <i>Completing the internship assignments</i> <i>Case study: Problem in Industry</i>	Pengisian tugas mingguan dan rancangan laporan magang serta penyelesaian tugas dari pembimbing lapangan <i>Completion of weekly assignments and drafting of the internship report, as well as fulfilling tasks assigned by the field supervisor.</i>	



	maupun berkelompok <i>Students are able to complete internship assignments and solve industrial problems, and prepare a comprehensive internship report with professionalism and responsibility, both independently and in teams.</i>	<i>approach (mechanical engineering/mechanical systems).</i>		(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	<i>Studying the internship guidelines Completing the weekly logbook and submit in MyITS Student Connect</i>		
15	Mahasiswa menyusun laporan magang dengan menerapkan pengetahuan keteknikmesinan (engineering) dan keterampilan selama	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan penyusunan laporan magang <i>Completeness, clarity, accuracy (of content and timing), and originality in addressing issues related to the</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan	Menyusun laporan magang dan menyiapkan PPT Presentasi serta diunggah di My ITS Student Connect <i>Preparing the Internship Report and PPT Submit in My ITS StudentConnect</i>	Pengisian tugas mingguan dan rancangan laporan magang <i>Completion of weekly assignments and drafting of the internship report.</i>	10



	pelaksanaan magang sesuai dengan aturan yang berlaku <i>Students prepare the internship report by applying mechanical engineering knowledge and skills acquired during the internship, following the applicable regulations.</i>	<i>preparation of the internship report.</i>	Studi kasus <i>Assistance and Discussion Case study</i>	<i>discovery learning Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")			
16	Mahasiswa mengumpulkan laporan magang dan mempresentasikan hasil magang pada pihak industri dan kampus <i>Students submit the internship report and present</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mempresentasikan laporan hasil magang <i>Completeness, clarity, accuracy (of content and timing), and originality in presenting the internship report results.</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> Asistensi dan Diskusi Presentasi	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i>	Presentasi <i>Presentation</i>	Pengumpulan magang dan Evaluasi Presentasi <i>Submit internship report Presentation</i>	



	<i>the results of the internship to both the industry and the university.</i>		<i>Assistance and Discussion Presentation</i>	<i>Expository & Discovery Learning</i> (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")			

Catatan :

Notes:

2. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
Program Learning Outcomes (PLOs) are the competencies possessed by each graduate of the study program, which represent the internalization of attitudes and mastery of knowledge and skills according to the level of the program, acquired through the learning process
27. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan. *PLOs assigned to a course refer to selected program learning outcomes that contribute to the development of the course. These outcomes encompass aspects of attitude, general skills, specific skills, and knowledge.*
28. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
Course Learning Outcomes (CLOs) are specific abilities derived from the PLOs assigned to a course and are directly related to the subject matter or learning content of the course.
29. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.



Sub-Course Learning Outcomes (Sub-CLOs) are more specific capabilities derived from the CLOs, measurable and observable, representing the final learning abilities expected at each stage of the learning process, and specific to the course content.

30. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

Assessment Indicators are specific and measurable statements that identify student learning abilities or performance, along with the evidence supporting them, used to assess both the process and outcomes of learning.

31. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

Assessment Criteria are the standards used to measure the achievement of learning outcomes, based on predetermined indicators. These criteria serve as a guide for evaluators to ensure consistent and unbiased assessment. Criteria may be quantitative or qualitative.

32. **Bentuk penilaian:** tes dan non-tes.

Form of Assessment: tests and non-test assessments.

33. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.

Form of Learning: Lectures, Response Sessions, Tutorials, Seminars (or equivalent), Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other equivalent forms of learning.

34. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.

Learning Methods: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.

35. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.

Learning Materials are detailed topics or descriptions of subject matter, which can be presented as main topics and subtopics.



36. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.

Assessment Weight is the percentage assigned to the achievement of each Sub-CLO, proportionally reflecting the difficulty level of each Sub-CLO, with a total weight of 100%.

37. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

TM = Face-to-Face, PT = Structured Assignments, BM = Independent Learning.



INSTITUT TEKNOLOGI SEPULUH NOPEMBER
FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM
DEPARTEMEN TEKNIK MESIN
PROGRAM STUDI S1 TEKNIK MESIN

Faculty of Industrial Technology and Systems Engineering
Undergraduate Program of Mechanical Engineering Department

RENCANA PEMBELAJARAN SEMESTER

(Semester Learning Plan)

MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
Management Energi Energy Management	TM.....	Sistem Konversi Energi Energy Conversion System S	T=3	P=0	VII	November 2023
OTORISASI (Authorization)	Pengembang RPS (Lecture Developer of Semester Learning Plan)		Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Graduate Program)	
	Djatismiko Ichsani		Ary Bachtiar		Arif Wahyudi	
Capaian Pembelajaran MK (Learning Outcomes)	Program Studi (Study Program Charge to The Course)					
	1.1.2 Mampu menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa yang kompleks pada sistem mekanikal dan komponen-komponen yang diperlukan.					
	1.3.2 Mampu merumuskan solusi untuk masalah rekayasa di bidang sistem mekanikal dan komponen-komponen yang diperlukan dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan					



	2.1.1 Menguasai konsep mekanika dan penjabarannya dalam model matematika untuk dapat berperan sebagai tenaga ahli yang menangani masalah teknik mesin 3.2.1 Mampu bekerja mandiri 4.5.1 Menghargai keanekaragaman budaya, pandangan, kepercayaan, dan agama serta pendapat/ temuan orisinal orang lain - 1.1.2 Able to apply mathematics, science, and engineering principles to solve complex engineering problems in mechanical systems and required components. - 1.3.2 Able to formulate solutions to engineering problems in the field of mechanical systems and required components by considering economic, public health and safety, cultural, social and environmental factors - 2.1.1 Mastering the concept of mechanics and its elaboration in mathematical models to be able to act as experts who handle mechanical engineering problems - 3.2.1 Able to work independently - 4.5.1 Respecting cultural diversity, views, beliefs, and religions as well as the opinions/original findings of others	
	Tujuan Mata Kuliah	
	Objective of The Course	Mahasiswa mampu menghitung dan menganalisa bagaimana cara melakukan penghematan penggunaan energy pada suatu proses khususnya industry/pembangkit daya, penghematan biaya, dan mengurangi polusi pada lingkungan. Mahasiswa juga mampu mengambil keputusan didasarkan pada pertimbangan ekonomi biaya terendah. Students are able to calculate and analyze how to save energy use in a process, especially industry/power plants, save costs, and reduce pollution to the environment. Students are also able to make decisions based on the lowest cost economic considerations.



Diskripsi Bahan Kajian & Pokok Bahasan Description of Studied materials	Bahan Kajian Materials of Study	Managemen Energi: Teknik penghematan penggunaan energy yang disertai dengan tinjauan aspek ekonomi untuk mendapatkan biaya terendah (least financial cost) Energy Management: Energy saving techniques accompanied by a review of economic aspects to obtain the lowest cost (least financial cost).
	Pokok Bahasan Subjects	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: Energi dan environment, world energy resource and consumption Energy management and conervation Fundamental concepts of principles of energy conversion Economics and finance analysis. In this course, you will study the following topics: Energy and environment, world energy resources and consumption Energy management and conservation Fundamental concepts of principles of energy conversion Economics and finance analysis.
Pustaka References	Utama : Main Reference	1. Paul W. O'Callaghan, Energy Management, McGraw-Hill Book Company, 1993



	2. William G. Sullivan, Elin M. Wick, C. Patrick Koelling, Engineering Economic, 14 th Edition, Pearson International Edition, 3. M. M. El-Wakil, Powerplant Technology, , McGraw-Hill Book Company, 1985 4. Engineering Economy, Ninth Edition, Gerald J. Thuesen, W. J. Fabryky	
	Pendukung : Supporting Reference	
	1. Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 7 th Edition, John Wiley & Sons, Inc. 2. Frank P. Incropera, David P. Dewitt, Fundamentals of Heat and Mass Transfer, 7 th Edition, John Wiley & Sons, Inc.	
Media Pembelajaran	Software :	Hardware :
		PC & LCD Projector
Team Teaching	Djarmiko Ichsani, Atok Setawan	
Assessment	Latihan Soal Homework (Case-Study) Evaluasi tertulis (Quiz, ETS dan EAS)	
Matakuliah Syarat Prerequisite	- Termodinamika Teknik (Thermodynamics) - Mekanika Fluida (Fluid Mechanic) - Perpindahan Panas (Heat Tansfer) - Mesin-mesin Konversi Energi (Energy Conversion Systems)	

Mg Ke-	Sub-Capaian Pembelajaran MK	Materi Pembelajaran [Pustaka]	Metode / Strategi Pembelajaran	Assessment		
				Indikator	Bentuk	Bobot



Week h	Sub-learning outcome	Learning Materials [Reference]	[Estimasi Waktu] Learning Methods [Time Duration]	Indicator	Form	Weight
(1)	Mahasiswa mampu mempunyai pandangan tentang sumber energy, konsumsi, dan greenhouse effect Students are able to have a view of energy sources, consumption, and the greenhouse effect	- Word fossil fuel reserve and consumption - Historical Lives of fossil fuel - Greenhouse effect - Global Energy ang Environment Management [1: O'Callaghan, Bab 1] - World fossil fuel reserve and consumption - Historical Lives of fossil fuel - Greenhouse effect - Global Energy and Environment Management [1: O'Callaghan, Chapter 1]	- Kuliah Pengantar & Brainstorming Introductory Lecture & Brainstorming	Mahasiswa mampu mempunyai kesadaran perlunya melakukan manajemen dan penghematan energy Students are able to have an awareness of the need to manage and save energy	Download data world reserve and energy consupction Download data world reserve and energy consumption,Fore xample British Petroleum Statistical review	2%
(2)	Mahasiswa mampu melakukan energy	- Energy management - Energy surveying and auditing	- Kuliah - Latihan soal	Mampu membuat flow cahart penggunaan	Latihan Soal Homework	2%



	management and conservasi Students are able to do energy management and conservation	- Flow chart for the construction of an energy audit - Energy throughput, Energy flow chart, energy audit - Energy saving option [1: O'Callaghan, Bab 2] - Energy management - Energy surveying and auditing - Flow chart for the construction of an energy audit - Energy throughput, Energy flow chart, energy audit - Energy saving option [1: O'Callaghan, Chapter 2]	- Lecture - Practice problem solving and discussion	energy dan menghitung besarnya potensi energy yang dapat dihemat Able to make a flow chart of energy usage and calculate the amount of potential energy that can be saved	-Practice problem solving and discussion	
(3-4)	Mahasiswa mampu mengitung performansi steam power plant	- Siklus Rankine sederhana dan ideal - Internally irreversible Rankine cycle - Closed type feed water heater	- Kuliah - Latihan soal	Mampu menghitung performansi seperti efisiensi dan net plant heat rate, SFC dari	Latihan Soal Homework	2%



	Students are able to calculate the performance of steam power plants	- Efficiency and net plant heat rate (NPHR) dan specific fuel consumption (SFC). [3: El-Wakil, Bab 2] - Simple and ideal Rankine cycles - Internally irreversible Rankine cycle - Closed type feed water heater - Efficiency and net plant heat rate (NPHR) and specific fuel consumption (SFC). [3: El-Wakil, Chapter 2]	- Lecture - Practice questions	steam power plant. Able to calculate performance such as efficiency and net plant heat rate, SFC of steam power plants.	Practice Questions Homework	
(4-5)	Mahasiswa mampu menghitung performansi gas turbine and gas engine combined cycle with HRSG	- Principle work of gas turbine and gas engine combined cycle with HRSG - Analysis of energy and mass balances.	- Kuliah - Latihan soal	Mampu menghitung performansi yaitu efisiensi dan net plant heat rate, SFC dari gas turbine, and gas	Latihan Soal Homework	2%



	Students are able to calculate the performance of gas turbine and gas engine combined cycle with HRSG	- Analysis of efficiency, net plant heat rate or specific fuel consumption (SFC) [3: El-Wakil, Bab 8] - Principle work of gas turbine and gas engine combined cycle with HRSG - Analysis of energy and mass balances. - Analysis of efficiency, net plant heat rate or specific fuel consumption (SFC) [3: El-Wakil, Chapter 8]	- Lecture - Practice questions	engine combined cycle with HRSG Able to calculate the performance, namely efficiency and net plant heat rate, SFC of gas turbine, and gas engine combined cycle with HRSG	- Practice Questions - Homework	
(6)	Mahasiswa mampu menghitung kebutuhan dan biaya bahan bakar dan mampu memilih alternative jenis bahan bakar apa yang akan digunakan	- Pengertian capacity factor (CF), base load, dan peak load - Mengitung produksi energy listrik per bulan dan tahun - Menghitung kebutuhan bahan bakar perbulan dan per tahun	- Kuliah - Latihan soal	Mampu menghitung kebutuhan dan biaya bahan bakar per bulan dan per tahun. Mampu memilih jenis bahan bakar apa yang yang murah dengan	Latihan Soal Homework	2%



	Students are able to calculate fuel needs and costs and are able to choose alternative types of fuel to be used	- Menghitung biaya yang dikeluarkan untuk pembelian bahan bakar - Memilih jenis bahan bakar yang murah [El-Wakil, Michael J. Moran, and material from internet] - Understanding capacity factor (CF), base load, and peak load - Calculating electrical energy production per month and year - Calculating fuel needs per month and per year - Calculating costs incurred for purchasing fuel - Choosing cheap types of fuel [El-Wakil, Michael J. Moran, and material from the internet]	- Lecture - Practice questions	tetap memperhatikan aspek teknik Able to calculate fuel needs and costs per month and per year. Able to choose what type of fuel is cheap while still considering technical aspects	Practice Questions Homework	
(8)	Mahasiswa mampu mengukur dan memahami data pengukuran	- Instrumentation and measurement - Measurement of heat flux, radiation, velocity,	- Kuliah - Latihan soal	Mampu mengukur, memahami dan menganalisa data pengukuran	- Latihan soal - Home work	



	Students are able to measure and understand measurement data	pressure and flow rate in fluid - Data analyses [1: O'Callaghan, Bab 6] - Instrumentation and measurement - Measurement of heat flux, radiation, velocity, pressure and flow rate in fluid - Data analyses [1: O'Callaghan, Chapter 6]	-Lecture - Practice questions	Able to measure, understand and analyze measurement data	- Practice questions - Home work	
(9)	Evaluasi Tengah Semester (ETS) Mid Term Exam 40%					
(10)	Mahasiswa mampu menghitung biaya investasi	- Introduction to engineering economics - Discounted cash flow - Investment - Option identification and analyses - Optimization	- Kuliah - Latihan soal	Mampu menghitung biaya investasi dari suatu proyek	- Latihan soal - Home work	2%



	Students are able to calculate investment costs	[1: O'Callaghan, Bab 7 and 2: Sullivan, Bab 4] - Introduction to engineering economics - Discounted cash flow - Single and annual Investments - Option identification and analyses - Optimization [1: O'Callaghan, Chapter 7 and 2: Sullivan, Chapter 4]	- Lecture - Practice questions	Able to calculate investment costs, operation and maintenace cost of a project	- Practice questions - Home work	
(11)	Mahasiswa mampu menghitung net present value, break event point Students are able to calculate net present value, break event point	- Cash flow diagram - Net present value - Future value - Cash flow diagram - Net present value - Future value -	- Kuliah - Latihan soal - Lecture - Practice questions	Mahasiswa mampu menghitung net present value, break event point dari suatu investasi Students are able to calculate net present value, and break event point of an investment	- Latihan soal - Home work - Practice questions - Home work	2%



		: O'Callaghan, Chapter 7 and 2: Sullivan, Chapter 4]		: O'Callaghan, Chapter 7 and 2: Sullivan, Chapter 4]		
(12)	Mahasiswa mampu menghitung dan menganalisa tentang pinjaman (loans) Students are able to calculate and analyze loans	- Annual Percentage Rate (APR) Load - Total repayment of load - Annual repayment of loan - Repayment Schedule 1 : O'Callaghan, Chapter 7 and 2: Sullivan, Chapter 4] - Annual Percentage Rate (APR) Load - Total repayment of load - Annual repayment of loan - Repayment Schedule 1 : O'Callaghan, Chapter 7 and 2: Sullivan, Chapter 4]	- Kuliah - Latihan soal - Lecture - Practice questions	Mahasiswa dapat menghitung dan menganalisa : - Annual Percentage Rate (APR) Load - Total repayment of load - Annual repayment of loan - Repayment Schedule Suatu proyek Students are able to calculate and analyze: - Annual Percentage Rate (APR) Load - Total repayment of load - Annual repayment of loan	- Latihan soal - Home work - Lecture Practice questions	2%



				- Repayment Schedule		
(13)	Mahasiswa mampu membandingkan antara pinjaman dan investasi Students are able to compare between loans and investments	- Pay back period - Rate of Return - Straight Rate of Return - Modification of resource conservation 1 : O'Callaghan, Chapter 7 and 2: Sullivan, Chapter 4] - Pay back period - Rate of Return - Straight Rate of Return - Modification of resource conservation - 1 : O'Callaghan, Chapter 7 and 2: Sullivan, Chapter 4]	- Kuliah - Latihan soal - Lecture - Practice questions	Mahasiswa mampu membandingkan antara pinjaman dan investasi Students are able to compare between loans and investments	- Latihan soal - Home work - Practice questions - Home work	2%
(14)	Mahasiswa mampu memahami dan menganalisis pengaruh inflasi pada investasi	- Ukuran inflasi - Laju inflasi - Memperhatikan efek inflasi - Analisa inflasi pada Investasi	- Kuliah - Latihan soal	Mahasiswa mampu menganalisa efek inflasi pada investasi	- Latihan soal - Home work	2%



	Students are able to understand and analyze the effect of inflation on investment	Engineering Economy, Ninth Edition, Gerald J. Thuesen, W. J. Fabryky [chapter 5 & 6] - Inflation measures - Inflation rate - Paying attention to the effects of inflation - Inflation analysis on investment Engineering Economy, Ninth Edition, Gerald J. Thuesen, W. J. Fabryky [chapter 5 & 6]	- Lecture - Practice questions	Students are able to analyze the effects of inflation on investment	- Practice questions - Home work	
(15)	Mahasiswa mampu menghitung dan menganalisa tentang capital recovery with return and project balance.	- Capital Equivalent amount - Capital recovery with return - Concept of project balance	- Kuliah - Latihan soal	Mahasiswa mampu menghitung dan menganalisa tentang capital recovery with return and project balance.	- Latihan soal - Home work	



	Students are able to calculate and analyze about capital recovery with return and project balance.	Engineering Economy, Ninth Edition, Gerald J. Thuesen, W. J. Fabryky [chapter 5 & 6] - Capital Equivalent amount - Capital recovery with return - Concept of project balance Engineering Economy, Ninth Edition, Gerald J. Thuesen, W. J. Fabryky [chapter 5 & 6]	- Lecture - Practice questions	Students are able to calculate and analyze about capital recovery with return and project balance	- Practice questions - Home work	
(16)	Evaluasi Akhir Semester Final Exam 40%					



					RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM		Kode Dokumen	
RENCANA PEMBELAJARAN SEMESTER								
MATA KULIAH (MK)		KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
TEKNIK PENDINGIN & PENGKONDISIAN UDARA		TM234608	RTSE		T=3 P=0			7 November 2023
OTORISASI		Pengembang RPS		Koordinator RMK			Ketua PRODI	
		Ary Bachtiar Krishna Putra		Ary Bachtiar Krishna Putra				
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK							
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>						
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources</i>						
	CPL 7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems.</i>						



	CPL 8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>Ability to identify, formulate, analyze, and solve technical problems</i>					
	Capaian Pembelajaran Mata Kuliah (CPMK)						
	CPMK-1	Memahami dan menjelaskan prinsip-prinsip dasar termodinamika yang berlaku pada sistem pendingin dan pengkondisian udara.					
	CPMK-2	Menganalisis siklus termodinamika yang digunakan pada sistem pendingin (siklus kompresi uap dan siklus absorpsi)					
	CPMK-3	Mengidentifikasi, menjelaskan fungsi, dan memilih komponen-komponen utama sistem pendingin dan pengkondisian udara					
	CPMK-4	Menghitung beban pendinginan pada berbagai aplikasi dan menentukan kapasitas sistem yang dibutuhkan					
	CPMK-5	Menganalisis dan merancang sistem pengkondisian udara sederhana (HVAC)					
	CPMK-6	Memahami jenis-jenis refrigeran, propertinya, serta dampaknya terhadap lingkungan					
	CPMK-7	Menguasai prinsip-prinsip efisiensi energi dan dasar troubleshooting pada sistem pendingin dan pengkondisian udara					
		Matrik CPL – CPMK					
		CPMK	CPL-4	CPL-5	CPL-7	CPL-8	Bobot (%)
		CPMK-1	v	v	v	v	15
		CPMK-2	v	v	v	v	15
		CPMK-3	v	v	v	v	15
		CPMK-4	v	v	v	v	15
		CPMK-5	v	v	v	v	15



		CPMK-6	v	v	v	v	10
		CPMK-7	v	v	v	v	15
		Total bobot (%)	25	25	25	25	100
Deskripsi Singkat MK	Mata kuliah ini membekali mahasiswa dengan pemahaman mendalam tentang prinsip-prinsip termodinamika yang mendasari sistem pendingin dan pengkondisian udara. Mahasiswa akan mempelajari siklus pendingin (siklus kompresi uap, absorpsi), komponen-komponen utama sistem (kompresor, kondenser, evaporator, katup ekspansi), refrigeran, beban pendinginan, serta desain dan aplikasi sistem pengkondisian udara (HVAC). Mata kuliah ini juga mencakup aspek efisiensi energi, dampak lingkungan, dan troubleshooting dasar pada sistem pendingin dan pengkondisian udara.						
Bahan Kajian: Materi Pembelajaran	1. Pendahuluan Sistem Pendingin dan Pengkondisian Udara: ○ Pengertian dan aplikasi. ○ Sejarah dan perkembangan. ○ Jenis-jenis sistem pendingin. 2. Prinsip Dasar Termodinamika Refrigerasi: ○ Hukum Termodinamika I dan II dalam konteks refrigerasi. ○ Konsep entalpi, entropi, tekanan, suhu. ○ Coefficient of Performance (COP). 3. Siklus Kompresi Uap (Vapor Compression Cycle - VCC): ○ Diagram P-h dan T-s. ○ Analisis siklus ideal dan aktual. ○ Efek superheat, subcool, dan tekanan. 4. Komponen Utama Sistem Pendingin: ○ Kompresor: Jenis-jenis (reciprocating, rotary, scroll, screw, centrifugal), prinsip kerja, aplikasi. ○ Kondenser: Jenis-jenis (berpendingin udara, air, evaporatif), prinsip kerja. ○ Evaporator: Jenis-jenis (dry expansion, flooded), prinsip kerja, fenomena perpindahan panas.						



	- o Katup Ekspansi: Jenis-jenis (termal, kapiler, elektronik), fungsi dan prinsip kerja. 5. Refrigeran: - o Klasifikasi dan penamaan refrigeran (CFC, HCFC, HFC, HFO, refrigeran alami). - o Properti termodinamika refrigeran. - o Dampak lingkungan (ODP, GWP) dan regulasi. 6. Siklus Refrigerasi Alternatif: - o Siklus Absorpsi. - o Siklus Adsorpsi (pengenalan). 7. Beban Pendinginan (Cooling Load Calculation): - o Sumber-sumber panas (konduksi, konveksi, radiasi, internal gain, infiltrasi, ventilasi). - o Metode perhitungan beban pendinginan (ASHRAE). - o Faktor-faktor yang mempengaruhi beban pendinginan. 8. Sistem Pengkondisian Udara (HVAC): - o Pengenalan psikrometri dan diagram psikrometrik. - o Proses pengkondisian udara (pemanasan, pendinginan, humidifikasi, dehumidifikasi). - o Jenis-jenis sistem AC (split, duct, VRF, chiller). - o Distribusi udara dan ducting. 9. Efisiensi Energi dalam Sistem Refrigerasi dan HVAC: - o Strategi penghematan energi. - o Konsep EER, SEER, COP, IPLV. 10. Troubleshooting Dasar dan Pemeliharaan: - o Permasalahan umum pada sistem. - o Metode deteksi masalah dan solusi. - o Dasar pemeliharaan preventif	
Pustaka	Utama :	
	[1]. Dossat, R.J. Principles of Refrigeration. Pearson Education.	
	[2]. Wang, S.K. (Rev Handbook of Air Conditioning and Refrigeration. McGraw-Hill Education.	



	Pendukung :
	[3]. ASHRAE Handbook - Fundamentals American Society of Heating, Refrigerating and Air-Conditioning Engineers. [4]ASHRAE Handbook - HVAC Systems and Equipment
Dosen Pengampu	Ary Bachtiar Krisna Putra
Matakuliah syarat	Termodinamika Mekanika Fluid Perpindahan Panas

Tabel Tahapan Pembelajaran Mata Kuliah Teknik Pendingin dan Pengkondisian Udara

Mg Ke-	Kemampuan Akhir (Sub-CPMK)	Indikator	Kriteria & Bentuk Penilaian	Metode & Bentuk Pembelajaran	Estimasi Waktu	Materi Pembelajaran	Referensi	Bobot Penilaian
1	Mahasiswa mampu memahami ruang lingkup sistem pendingin dan pengkondisian udara	Menjelaskan contoh aplikasi sistem	Non-test, rubrik	Kuliah & diskusi, ekspositori	TM: 3x50"; PT+BM: 4x60"	Definisi dan jenis sistem, aplikasi	Handout	-
2	Mahasiswa mampu menganalisis prinsip dasar termodinamika	Menyelesaikan soal hukum I dan II termodinamika sederhana dalam konteks refrigerasi	Non-test	Kuliah & latihan soal	TM: 3x50"; PT+BM: 4x60"	COP, entalpi, entropi, hukum I & II	[1], Handout	-



Mg Ke-	Kemampuan Akhir (Sub-CPMK)	Indikator	Kriteria & Bentuk Penilaian	Metode & Bentuk Pembelajaran	Estimasi Waktu	Materi Pembelajaran	Referensi	Bobot Penilaian
	dalam sistem refrigerasi							
3	Mahasiswa mampu menganalisis siklus kompresi uap ideal	Menghitung kinerja siklus ideal dengan diagram P-h	Non-test	Kuliah & diskusi	TM: 3x50"; PT+BM: 4x60"	Siklus kompresi uap, P-h, T-s	[1], Handout	-
4	Mahasiswa memahami siklus aktual dan pengaruh superheat/subcool	Menentukan COP aktual dan menjelaskan efek subcooling/superheating	Quiz 1	Kuliah & diskusi	TM: 2x50"; PT+BM: 4x60"	Superheat, subcool, tekanan	[1], Handout	25%
5	Mahasiswa mampu mengenal dan memilih komponen utama sistem refrigerasi	Mengidentifikasi dan menjelaskan fungsi kompresor, kondenser, evaporator, ekspansi	Non-test	Kuliah & diskusi	TM: 3x50"; PT+BM: 4x60"	Komponen utama sistem	[1], Handout	-
6	Mahasiswa mampu memahami berbagai jenis refrigeran dan sifatnya	Menjelaskan jenis refrigeran dan membandingkan ODP & GWP	Non-test	Kuliah & diskusi	TM: 2x50"; PT+BM: 4x60"	Refrigeran, klasifikasi, ODP & GWP	[1], [3], [4]	-
7	Mahasiswa mampu menghitung beban pendinginan	Menghitung total cooling load dari contoh kasus	Tugas individu	Kuliah & latihan soal	TM: 3x50"; PT+BM: 4x60"	Sumber panas, metode ASHRAE	[2], Handout	-



Mg Ke-	Kemampuan Akhir (Sub-CPMK)	Indikator	Kriteria & Bentuk Penilaian	Metode & Bentuk Pembelajaran	Estimasi Waktu	Materi Pembelajaran	Referensi	Bobot Penilaian
8	Evaluasi Tengah Semester (UTS)	-	Ujian tertulis	-	-	-	-	25%
9	Mahasiswa mampu menganalisis sistem pengkondisian udara (HVAC)	Menganalisis proses dalam diagram psikrometri	Non-test	Kuliah & simulasi	TM: 3x50"; PT+BM: 4x60"	Proses AC, psikrometri	[1], [2], Handout	-
10	Mahasiswa mampu memilih sistem AC sesuai aplikasi	Memilih jenis sistem AC berdasarkan kebutuhan	Non-test	Kuliah & diskusi	TM: 3x50"; PT+BM: 4x60"	Split, duct, VRF, chiller	[2], Handout	-
11	Mahasiswa mampu memahami sistem distribusi udara	Mendesain sederhana sistem ducting	Tugas kelompok	Diskusi dan proyek	TM: 3x50"; PT+BM: 4x60"	Ducting, airflow, losses	[2], Handout	-
12	Mahasiswa mampu menganalisis efisiensi energi pada sistem	Menghitung EER, SEER, COP, IPLV	Quiz 2	Kuliah & latihan soal	TM: 2x50"; PT+BM: 4x60"	Strategi efisiensi energi	[2], [3], Handout	25%
13	Mahasiswa memahami dasar troubleshooting sistem pendingin	Menganalisis permasalahan umum pada sistem refrigerasi	Non-test	Studi kasus	TM: 2x50"; PT+BM: 4x60"	Troubleshooting umum	[1], Handout	-



Mg Ke-	Kemampuan Akhir (Sub-CPMK)	Indikator	Kriteria & Bentuk Penilaian	Metode & Bentuk Pembelajaran	Estimasi Waktu	Materi Pembelajaran	Referensi	Bobot Penilaian
14	Mahasiswa mampu menyusun pemeliharaan preventif	Menyusun checklist pemeliharaan sistem	Non-test	Proyek kelompok	TM: 2x50"; PT+BM: 4x60"	Preventive maintenance	Handout	-
15	Review dan latihan UAS	Menyelesaikan soal latihan komprehensif	Non-test	Diskusi & simulasi	TM: 2x50"; PT+BM: 4x60"	Komprehensif	-	-
16	Evaluasi Akhir Semester (UAS)	-	Ujian tertulis	-	-	-	-	25%

Catatan :

14. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

15. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.

38. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

17. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.



18. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
19. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
20. **Bentuk penilaian:** tes dan non-tes.
21. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
22. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
23. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok
24. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
25. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>UNDERGRADUATE PROGRAM OF MECHANICAL ENGINEERING</i> <i>DEPARTMENT</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEM ENGINEERING</i>					Kode Dokumen <i>Document Code</i>
RENCANA PEMBELAJARAN SEMESTER <i>Semester Learning Plan</i>						
MATA KULIAH (MK) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>CREDIT</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date</i>
PERPINDAHAN PANAS <i>HEAT TRANSFER</i>	TM234504	Rekayasa Termal dan Sistem Energi <i>Thermal Engineering and Energy System</i>	T=4	P=0	V (5)	7 November 2023
OTORISASI <i>Autorization</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Undergraduate Program</i>	
	Tri Vicca Kusumadewi, ST., MSc.		Prof. Dr. Ir. Prabowo, MEng, IPU, AEng		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng	



Capaian Pembelajaran (CP) <i>Learning Outcome</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>	
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik <i>Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>	
	CPMK-1	Mampu memahami, menalar, menganalisis konsep dan fisik perpindahan panas, konduksi tunak satu dan dua dimensi, serta konduksi transien <i>Able to comprehend, rational, and analyze concepts and physical aspects of heat transfer, steady-state one and two-dimensional conduction, as well as transient conduction.</i>
	CPMK-2	Mampu memahami, menalar, menganalisis konsep dan fisik perpindahan panas, konveksi paksa dan natural pada aliran dalam maupun luar <i>Able to comprehend, rationalize, and analyze the concepts and physics of heat transfer, forced and natural convection in both internal and external flows</i>
	CPMK-3	Mampu memahami, menalar, menganalisis konsep dan fisik perpindahan panas, konveksi pada perubahan fase boiling dan kondensasi



		<i>Able to comprehend, rationalize, and analyze the concepts and physics of heat transfer and convection during phase change involving boiling and condensation</i>																														
	CPMK-4	Mampu menganalisis dan menerapkan prinsip perpindahan massa <i>Able to analyze and apply the principles of mass transfer</i>																														
	CPMK-5	Mampu merancang peralatan penukar panas <i>Able to design heat exchanger equipment</i>																														
		Matrik CPL – CPMK <i>Matrix of CPL -CPMK</i> <table><tr><th>CPMK</th><th>CPL-4</th><th>CPL-5</th><th>CPL-6</th><th>CPL-8</th></tr><tr><td>CPMK-1</td><td>v</td><td></td><td>v</td><td>v</td></tr><tr><td>CPMK-2</td><td>v</td><td></td><td>v</td><td>v</td></tr><tr><td>CPMK-3</td><td>v</td><td></td><td>v</td><td>v</td></tr><tr><td>CPMK-4</td><td>v</td><td></td><td></td><td>v</td></tr><tr><td>CPMK-5</td><td>v</td><td>v</td><td>v</td><td>v</td></tr></table>	CPMK	CPL-4	CPL-5	CPL-6	CPL-8	CPMK-1	v		v	v	CPMK-2	v		v	v	CPMK-3	v		v	v	CPMK-4	v			v	CPMK-5	v	v	v	v
CPMK	CPL-4	CPL-5	CPL-6	CPL-8																												
CPMK-1	v		v	v																												
CPMK-2	v		v	v																												
CPMK-3	v		v	v																												
CPMK-4	v			v																												
CPMK-5	v	v	v	v																												
Deskripsi Singkat MK <i>Short Description of Course</i>	Perpindahan panas dan massa yang mencakup berbagai konsep dan hukum proses pemanasan dan pendinginan pada suatu benda dengan mekanisme perpindahan panas konduksi, konveksi maupun radiasi serta analisis perancangan alat penukar panas berdasarkan perbedaan temperature rerata logaritmik dan NTU-efektifitas <i>Heat and mass transfer encompass various concepts and laws related to the processes of heating and cooling in an object through the mechanisms of conduction, convection, and radiation. It also involves the analysis and design of heat exchanger equipment based on logarithmic mean temperature difference and NTU-effectiveness.</i>																															
Bahan Kajian: Materi Pembelajaran	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: <i>In this course, the main topics covered include:</i> - Konsep perpindahan panas secara umum yaitu: konduksi, konveksi, dan radiasi. - <i>The general concepts of heat transfer are conduction, convection, and radiation.</i>																															



Course Materials	- Konsep dan pengertian fisik perpindahan panas konduksi satu dan dua dimensi untuk sistim koordinat Cartesian dan Radial. - <i>The concept and physical understanding of one- and two-dimensional heat conduction in Cartesian and radial coordinate systems.</i> - Konsep tahanan thermal, konduksi dengan energi bangkitan, permukaan yang diperluas, tunak, serta perpindahan panas konduksi dengan proses transien. - <i>The concept of thermal resistance, conduction with heat generation, extended surfaces (fins), steady-state conduction, and transient heat conduction processes.</i> - Praktikum Konduksi dan Konveksi - <i>Conduction and convection heat transfer laboratory experiments.</i> - Perpindahan panas dan massa secara konveksi baik aliran luar maupun dalam pada daerah laminar, transisi, dan turbulen. - <i>Heat and mass transfer by convection, both for external and internal flow, in laminar, transitional, and turbulent regions</i> - Proses perpindahan panas secara konveksi untuk aliran yang berubah fase: pool boiling dan film boiling serta kondensasi film dan tetes. - <i>Heat transfer processes involving phase change: pool boiling and film boiling, as well as film and dropwise condensation.</i> - Analisa dan perancangan alat penukar panas berdasarkan perbedaan temperatur rerata logaritmik, NTU dan menganalisis alat penukar panas kompak. - <i>Analysis and design of heat exchangers based on the logarithmic mean temperature difference (LMTD), the NTU (Number of Transfer Units) method, and compact heat exchanger analysis.</i> - Proses perpindahan panas konveksi natural untuk aliran di luar plat datar, plat vertikal, silinder, di dalam enclosure dan channel. - <i>Natural convection heat transfer for flow over flat plates, vertical plates, cylinders, within enclosures, and in channels.</i> - Praktikum Alat penukar panas. - <i>Heat exchanger laboratory experiment.</i>								
Pustaka References	<table><tr><td data-bbox="295 1074 555 1157">Utama : Main:</td><td data-bbox="555 1074 2116 1157"></td></tr><tr><td colspan="2" data-bbox="295 1157 2116 1233">[1]. Bergmann, T.L., Lavine A.S., Incropera, Frank P., and David P. De Witt, “Fundamental of Heat and Mass Transfer”, 8th edition, John Wiley and Sons, New York, 2018.</td></tr><tr><td data-bbox="295 1233 555 1310">Pendukung : Supplementary:</td><td data-bbox="555 1233 2116 1310"></td></tr><tr><td colspan="2" data-bbox="295 1310 2116 1361">[2]. Holman, J.P., “Heat Transfer”, 10th Edition, Mc Graw-Hill Inc, New York, 2010</td></tr></table>	Utama : Main:		[1]. Bergmann, T.L., Lavine A.S., Incropera, Frank P., and David P. De Witt, “Fundamental of Heat and Mass Transfer”, 8 th edition, John Wiley and Sons, New York, 2018.		Pendukung : Supplementary:		[2]. Holman, J.P., “Heat Transfer”, 10 th Edition, Mc Graw-Hill Inc, New York, 2010	
Utama : Main:									
[1]. Bergmann, T.L., Lavine A.S., Incropera, Frank P., and David P. De Witt, “Fundamental of Heat and Mass Transfer”, 8 th edition, John Wiley and Sons, New York, 2018.									
Pendukung : Supplementary:									
[2]. Holman, J.P., “Heat Transfer”, 10 th Edition, Mc Graw-Hill Inc, New York, 2010									



		[3]. Cengel, Y.A., “ Heat and Mass Transfer : Fundamental and Applications”, 5 th edition, McGraw-Hill, 2015 [4]. Adrian Bejan, “ Heat Transfer: Evolution, Design and Performance”, John Wiley and Sons, New York, 2022					
Dosen Pengampu <i>Lecturers</i>		Djarmiko Ichsan, Bambang Sudarmanta, Prabowo, Atok Setiawan, Ary Bachtar Krisna Putra, , Bambang Arip Dwiyanoro, Is Bunyamin, Tri Vicca					
Matakuliah syarat <i>Prerequisites</i>		Termodinamika I & II <i>Thermodynamisc I & II</i> Mekanika Fluida Dasar I & II <i>Basic Fluid Mechanics I & II</i>					
Mg Ke-Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final Ability of Each Learning Stage</i>	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Model, Learning Method, DStudent Assignment</i>		Materi Pembelajaran <i>Learning Materials</i>	Bobot Penilaian (%) <i>Assesment Credits (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria & Model</i>	Luring <i>Offline</i>	Daring <i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu mengerti dan memahami: definisi, proses dan mekanisme perpindahan panas dalam berbagai	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan definisi, proses dan mekanisme	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas)	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i>	- Dokumen RPS di MyITS Classroom - <i>Learning plan document in My ITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture</i>	- Pengantar Kuliah <i>- Lecture Introduction</i> - Peran Perpindahan Panas dan Massa dalam Ilmu Teknik Mesin <i>- The Role of Heat and Mass Transfer in Mechanical Engineering</i> - Metoda Evaluasi, Norma Kelas <i>- Evaluation Methods, Class Norms</i> - Pengantar Perpindahan Panas	



	peralatan industri. <i>Students are able to understand and comprehend the definition, process, and mechanism of heat transfer in various industrial equipment</i>	perpindahan panas dalam berbagai peralatan industri. <i>The assessment is based on completeness, clarity, accuracy (regarding both content and timing), and originality in explaining the definition, process, and mechanism of heat transfer in various industrial equipment</i>	<i>Non-test (assignment)</i>	Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	<i>Presentations on MyITS Classroom</i>	- <i>Introduction to Heat Transfer</i> - Mekanisme transport energy - <i>Mechanisms of Energy Transport</i> - Hukum Kelestarian Energi - <i>Laws of Energy Conservation</i> [1]: Bab 1 <i>Chapter 1</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	
2	Mahasiswa mampu dan terampil menyelesaikan permasalahan persamaan Difusi Energi dan Pemilihan bahan dalam	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode:	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom	- Pengenalan Konduksi - <i>Introduction to Conduction.</i> - Konduktivitas Termal - <i>Thermal Conductivity</i> - Difusivitas panas - <i>Thermal Diffusivity</i> - Persamaan difusi energi - <i>Energy Diffusion Equation</i> - Kondisi batas	



	perangkat termal. <i>Students are expected to be able to proficiently solve problems related to the Energy Diffusion Equation and select appropriate materials for use in thermal systems</i>	Difusi Energi dan Pemilihan bahan dalam perangkat termal <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems involving Energy Diffusion and Material Selection in thermal systems</i>	non-test (tugas) <i>Non-test (assignment)</i>	<i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- <i>Boundary Condition</i> - Kondisi awal - <i>Initial Condition</i> [1]: Bab 2 <i>Chapter 2</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	
3	Mahasiswa mampu dan terampil menyusun sistem perpindahan panas konduksi,	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i>	- Konduksi pada kondisi tunak - <i>Steady State Conduction</i> - Plat/dinding datar - <i>Plane Wall</i> - Resistansi termal/panas - <i>Thermal Resistance</i> - Dinding komposit	



	perancangan tebal insulasi dan system konduksi-konveksi <i>Students are able and skilled in designing conduction heat transfer systems, determining appropriate insulation thickness, and developing conduction-convection systems</i>	menyelesaikan permasalahan sistem perpindahan panas konduksi, perancangan tebal insulasi dan system konduksi-konveksi <i>Assessment is based on the completeness, clarity, accuracy (of content and time management), and originality in addressing problems involving conduction heat transfer systems, insulation thickness design, and combined conduction-</i>	Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- <i>Composite Wall</i> - Media berongga - <i>Porous Media</i> - System radial - <i>Radial System</i> - Energi panas yang dibangkitkan - <i>Heat Generation</i> - Pemukaan tambahan - <i>Extended Surface</i> [1]: Bab 3 <i>Chapter 3</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	



		<i>convection systems</i>					
4	Mahasiswa mampu dan terampil menyusun sistem perpindahan panas konduksi, perancangan tebal insulasi dan system konduksi-konveksi <i>Students are able and skilled in designing conduction heat transfer systems, determining appropriate insulation thickness, and developing conduction-convection systems</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan sistem perpindahan panas konduksi, perancangan tebal insulasi dan system konduksi-konveksi <i>Assessment will be based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> test (Quiz 1) <i>test (Quiz 1)</i>	Bentuk: <i>Model:</i> kuliah <i>Learning</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian Quiz <i>Problem solving quiz</i> Analisa studi kasus <i>Case study analysis</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	-	- Konduksi pada kondisi tunak - <i>Steady State Conduction</i> - Plat/dinding datar - <i>Plane Wall</i> - Resistansi termal/panas - <i>Thermal Resistance</i> - Dinding komposit - <i>Composite Wall</i> - Media berongga - <i>Porous Media</i> - System radial - <i>Radial System</i> - Energi panas yang dibangkitkan - <i>Heat Generation</i> - Pemukaan tambahan - <i>Extended Surface</i> [1]: Bab 3 <i>Chapter 3</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	15



		<i>involving conduction heat transfer systems, insulation thickness planning, and conduction-convection system design</i>					
5	Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi multi dimensi <i>Students are able to explain and analyze the mechanisms of multi-dimensional heat conduction</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan sistem perpindahan panas konduksi multi dimensi <i>Assessment is based on the completeness, clarity, accuracy (of content and time management),</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Konduksi multi dimensi - <i>Multi dimension Conduction</i> - Alternatif pendekatan - <i>Alternative Approach</i> - Metode separasi variable - <i>The Method of Separation Variables</i> - Factor bentuk - <i>The Conduction Shape Factor</i> - Metode finite difference - <i>Finite Difference Method</i> [1]: Bab 4 <i>Chapter 4</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	



		<i>and originality in addressing problems involving multi-dimensional heat conduction systems</i>					
6	Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi multi dimensi <i>Students are able to explain and analyze the mechanisms of multi-dimensional heat conduction</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan sistem perpindahan panas konduksi multi dimensi <i>Assessment is based on the completeness, clarity, accuracy (of content and time management), and originality in addressing</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Konduksi multi dimensi - <i>Multi dimension Conduction</i> - Alternatif pendekatan - <i>Alternative Approach</i> - Metode separasi variable - <i>The Method of Separation Variables</i> - Factor bentuk - <i>The Conduction Shape Factor</i> - Metode finite difference - <i>Finite Difference Method</i> [1]: Bab 4 <i>Chapter 4</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	



		<i>problems involving multi-dimensional heat conduction systems</i>					
7	Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi transien <i>Students are able to explain and analyze transient heat conduction mechanisms</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan mekanisme perpindahan panas konduksi transien <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in solving problems</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Konduksi transien <i>- Transient Conduction</i> - Metode kapasitansi lumpsum <i>- The Lumped Capacitance Method</i> - Analisa kapasitansi lumpsum secara umum <i>- General Lumped Capacitance Analysis</i> - Efek spasial <i>- Spatial Effects</i> - Kpnveksi pada dinding/plat datar <i>- Plane Wall with Convection</i> - Konveksi pada system radial <i>- Radial Systems with Convection</i> - Multi dimesi <i>- Multi Dimension</i> [1]: Bab 5 <i>Chapter 5</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	



		<i>involving transient heat conduction mechanisms</i>					
8	Evaluasi Tengah Semester / Ujian Tengan Semester <i>Midterm Examination</i>						30
9	Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi transien <i>Students are able to explain and analyze transient heat conduction mechanisms</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan mekanisme perpindahan panas konduksi transien <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in solving problems</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> Praktikum <i>Practicums</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Konduksi transien <i>- Transient Conduction</i> - Metode kapasitansi lumpsum <i>- The Lumped Capacitance Method</i> - Analisa kapasitansi lumpsum secara umum <i>- General Lumped Capacitance Analysis</i> - Efek spasial <i>- Spatial Effects</i> - Kpnveksi pada dinding/plat datar <i>- Plane Wall with Convection</i> - Konveksi pada system radial <i>- Radial Systems with Convection</i> - Multi dimesi <i>- Multi Dimension</i> [1]: Bab 5 <i>Chapter 5</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	



		<i>involving transient heat conduction mechanisms</i>					
10	Mahasiswa mampu membedakan tiga jenis boundary layer dan menjelaskan analogi ketiganya pada perpindahan panas konveksi <i>Students are able to distinguish the three types of boundary layers and explain their analogies in convective heat transfer</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan dan analogi tiga boundary layer pada perpindahan panas konveksi <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems and explaining the</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Dasar-dasar Konveksi - <i>Fundamentals of Convection</i> - Kondisi batas pada konveksi - <i>Convection Boundary Layer</i> - Koefisien konveksi - <i>Heat Transfer Coefficient</i> - Aliran laminar dan turbulen - <i>Laminar and Turbulent Flows</i> - Analogi kondisi batas - <i>Boundary Layer Analogy</i> [1]: Bab 6 <i>Chapter 6</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	



		<i>analogies among the three boundary layers in convective heat transfer</i>					
11	Mahasiswa mampu menganalisis berbagai kasus perpindahan panas dan massa external flow <i>Students are able to analyze various cases of heat and mass transfer in external flow</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan perpindahan panas dan massa external flow <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Aliran eksternal - <i>External Flow</i> - Metode analitis dan eksperimental - <i>Analytical and Experimental Methods</i> - Metodologi - <i>Methodology</i> - Plat datar dalam aliran parallel - <i>Flat Plate in Parallel Flow</i> - Silinder dalam aliran lintang - <i>Cylinder in Cross Flow</i> - Bola - <i>Sphere</i> - Lapisan padu - <i>Packed Bed</i> - Penyerbukan jet - <i>Jet Impingement</i> [1]: Bab 7 <i>Chapter 7</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	



		<i>involving heat and mass transfer in external flow</i>					
12	Mahasiswa mampu menganalisis berbagai kasus perpindahan panas dan massa external flow <i>Students are able to analyze various cases of heat and mass transfer in external flow</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan perpindahan panas dan massa external flow <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems involving heat and mass</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> test (Quiz 1) <i>test (Quiz 1)</i>	Bentuk: <i>Model:</i> kuliah <i>Learning</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian Quiz <i>Problem solving quiz</i> Analisa studi kasus <i>Case study analysis</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	-	- Aliran eksternal - <i>External Flow</i> - Metode analitis dan eksperimental - <i>Analytical and Experimental Methods</i> - Metodologi - <i>Methodology</i> - Plat datar dalam aliran parallel - <i>Flat Plate in Parallel Flow</i> - Silinder dalam aliran lintang - <i>Cylinder in Cross Flow</i> - Bola - <i>Sphere</i> - Lapisan padu - <i>Packed Bed</i> - Penyerbukan jet - <i>Jet Impingement</i> [1]: Bab 7 <i>Chapter 7</i> Handout di myITS Classroom <i>Handout in My ITS Classroom</i>	25



		<i>transfer in external flow</i>					
13	Mahasiswa mampu menganalisis berbagai kasus perpindahan panas dan massa internal flow <i>Students are able to analyze various cases of heat and mass transfer in internal flow</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan perpindahan panas dan massa internal flow <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems involving heat and mass transfer in internal flow</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Aliran internal - <i>Internal Flow</i> - Kondisi aliran - <i>Flow Condition</i> - Pertimbangan panas - <i>Thermal Considerations</i> - Aliran berkembang penuh - <i>Fully developed flow</i> - Tubes melingkar - <i>Circular tubes</i> - Tube tidak melingkar - <i>Non-circular tubes</i> [1]: Bab 8 <i>Chapter 8</i> <i>Handout di myITS Classroom</i> <i>Handout in My ITS Classroom</i>	



14	Mahasiswa mampu memahami konsep dasar konveksi bebas dan konsep mekanisme fisik boiling and condensation <i>Students are able to understand the basic concepts of natural convection and the physical mechanisms of boiling and condensation</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan konsep dasar konveksi bebas dan konsep mekanisme fisik boiling and condensation <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems involving the basic concepts of natural convection and</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Konveksi natural - <i>Natural Convection</i> - Pertimbangan fisik - <i>Physical Considerations</i> - Persamaan-persamaan - <i>Governing Equations</i> - Kesamaan - <i>Similiraty</i> - Efek turbulensi - <i>The Effect of Turbulence</i> - Konveksi pada Saluran - <i>Convectiin on the Channel</i> - KOnveksi pada Ruang tertutup - <i>Convection on the Enclosure</i> - Perpindahan panas gabungan - <i>Combined Heat Transfer</i> - Pendidihan dan kondensasi - <i>Boiling and Condensation</i> - Parameter tak berdimensi - <i>Dimensionless Parameters</i> - Mode pendidihan - <i>Boiling Modes</i> - Kolam pendidihan - <i>Pool Boiling</i> - Konveksi paksa - <i>Forced Convection</i> - Kondensasi film - <i>Film Condensation</i> - Kondensasi titik - <i>Dropwise Condensation</i>	



		<i>the physical mechanism of boiling and condensation</i>				[1]: Bab 10 <i>Chapter 10</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
15	Mahasiswa mampu menganalisis dan melakukan rancangan termal berbagai heat exchanger. <i>Students are able to analyze and conduct thermal design of various types of heat exchangers.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan heat exchanger / alat penukar kalor <i>Assessment is based on the completeness, clarity, accuracy (regarding both content and time management), and originality in addressing problems involving the problem of heat exchanger</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> Praktikum <i>Practicums</i> (TM: 4 x 50") (PT: 4 x 60") (BM: 4 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Alat penukar kalor - <i>Heat Exchanger</i> - Klasifikasi dan tipe - <i>Type & Classification</i> - Koefisien keseluruhan perpindahan panas - <i>Overall Heat Transfer Coefficient</i> - Metode LMTD - <i>LMTD Method</i> - Metode E-NTU - <i>E-NTU Method</i> [1]: Bab 11 <i>Chapter 11</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	



16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Examination</i>	30

Catatan :

Notes:

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
Program Learning Outcomes (PLOs) are the competencies possessed by each graduate of the study program, which represent the internalization of attitudes and mastery of knowledge and skills according to the level of the program, acquired through the learning process
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan. *PLOs assigned to a course refer to selected program learning outcomes that contribute to the development of the course. These outcomes encompass aspects of attitude, general skills, specific skills, and knowledge.*
3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
Course Learning Outcomes (CLOs) are specific abilities derived from the PLOs assigned to a course and are directly related to the subject matter or learning content of the course.
4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
Sub-Course Learning Outcomes (Sub-CLOs) are more specific capabilities derived from the CLOs, measurable and observable, representing the final learning abilities expected at each stage of the learning process, and specific to the course content.
5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
Assessment Indicators are specific and measurable statements that identify student learning abilities or performance, along with the evidence supporting them, used to assess both the process and outcomes of learning.



6. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
Assessment Criteria are the standards used to measure the achievement of learning outcomes, based on predetermined indicators. These criteria serve as a guide for evaluators to ensure consistent and unbiased assessment. Criteria may be quantitative or qualitative.
7. **Bentuk penilaian:** tes dan non-tes.
Form of Assessment: tests and non-test assessments.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
Form of Learning: Lectures, Response Sessions, Tutorials, Seminars (or equivalent), Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other equivalent forms of learning.
9. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.*
Learning Methods: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
Learning Materials are detailed topics or descriptions of subject matter, which can be presented as main topics and subtopics.
11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
Assessment Weight is the percentage assigned to the achievement of each Sub-CLO, proportionally reflecting the difficulty level of each Sub-CLO, with a total weight of 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.
TM = Face-to-Face, PT = Structured Assignments, BM = Independent Learning.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER						
MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
RENEWABLE ENERGY	TM234722	RTSE	T=2,5	P=0,5	PILIHAN	20 November 2023
OTORISASI	Pengembang RPS		Koordinator RMK		Ketua PRODI	
	Bambang Sudarmanta		Prabowo (kalab)		Atok Setiyawan	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK					
	CPL-6	Menguasai prinsip-prinsip rekayasa pada sistem mekanika untuk mengidentifikasi, merumuskan dan menyelesaikan bidang Teknik Mesin.				
	CPL-8	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (mechanical system)				
	CPL-10	Mampu merumuskan solusi untuk masalah rekayasa di bidang sistem mekanika dengan memperhatikan faktor ekonomi, keselamatan, lingkungan dan konservasi energi.				
	CPL-11	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu dan teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global.				
	Capaian Pembelajaran Mata Kuliah (CPMK)					
CPMK-1	Mahasiswa mampu memberikan gambaran dan pemahaman mengenai potensi dan assesment terhadap sumber-sumber <i>Renewable Energy</i> , teknologi rekayasa Renewable Energy dan aplikasi produk-produk Renewable Energy.					



	CPMK-2	– Mahasiswa mampu memberikan gambaran peluang serta tantangan pengembangan rekayasa Renewable Energy ditinjau dari ketersediaan energi serta pengaruh pemakaian <i>Renewable Energy</i> terhadap lingkungan serta perkembangan aplikasi Renewable Energy di dunia.					
	CPMK-3	– Mahasiswa mampu melakukan praktikum dan menganalisis hasilnya					
	CPMK-4	– Mahasiswa mempunyai kemampuan bertanya, menjawab pertanyaan, memberikan komentar serta berdiskusi terkait dengan Renewable Energy.					
		Matrik CPL – CPMK					
		CPMK	CPL-6	CPL-8	CPL-10	CPL-11	TOTAL (%)
		CPMK-1	V	V	V	V	20
		CPMK-2	V	V	V	V	30
		CPMK-3	V	V	V	V	25
		CPMK-4	V	V	V	V	25
		TOTAL BOBOT (%)	20	30	30	20	100
Deskripsi Singkat MK	Mata kuliah ini membahas pemahaman pentingnya renewable energi dalam hubungannya dengan sumber energi yang lain. Mempelajari aplikasi variasi energi matahari meliputi solar collectors, solar power systems, photovoltaic systems, dan aplikasi passive solar. Evaluasi performansi aplikasi energi matahari. Analisis turbin angin dan diskusi faktor-faktor yang berpengaruh terhadap aplikasi turbin angin. Mempelajari variasi tipe turbin hidrolis dan evaluasi performansi terhadap turbin hidrolis. Mengenalkan aplikasi pemanasan, pendinginan dan pembangkitan daya dari sistem geothermal. Evaluasi performansi variasi tipe pembangkit daya geothermal. Mereview sumber-sumber biomassa, konversi menjadi biofuel, produk-produk biomassa serta limbah padat perkotaan						



Bahan Kajian:	<u>Bahan Kajian :</u>
Materi	- Renewable Energy Assessment
Pembelajaran	- Teknologi Konversi Termokimia
	- Karakterisasi produk Renewable Energy
	- Aplikasi produk Renewable Energy
	<u>Materi pembelajaran :</u>
	Tinjauan umum mengenai <i>Renewable Energy</i>
	- Pengenalan, potensi dan manfaat <i>Renewable Energy</i>
	- Pemakaian <i>sumber renewable energy</i> : tradisional dan modern
	- Peluang dan tantangan pengembangan <i>sumber-sumber renewable energy</i>
	Klasifikasi terhadap sumber-sumber <i>renewable energy</i>
	Metodologi assesment terhadap sumber-sumber <i>renewable energy</i>
	Karakterisasi kualitas sumber-sumber <i>renewable energy</i>
	Pemahaman terkait :
	• Pentingnya renewable energi dalam hubungannya dengan sumber energi yang lain.
	• Mempelajari aplikasi variasi energi matahari meliputi solar collectors, solar power systems, photovoltaic systems, dan aplikasi passive solar.
	• Evaluasi performansi aplikasi energi matahari.
	• Analisis turbin angin dan diskusi faktor-faktor yang berpengaruh terhadap aplikasi turbin angin.
	• Mempelajari variasi tipe turbin hidrolis dan evaluasi performansi terhadap turbin hidrolis.
	• Mengenalkan aplikasi pemanasan, pendinginan dan pembangkitan daya dari sistem geothermal.
	• Evaluasi performansi variasi tipe pembangkit daya geothermal.
	• Mereview sumber-sumber biomassa, konversi menjadi biofuel, produk-produk biomassa serta limbah padat perkotaan
	Pengaruh pemakaian <i>sumber-sumber renewable energy</i> terhadap lingkungan dan Perkembangan aplikasi renewable energy pada kendaraan di dunia
Pustaka	Utama :



THERMODYNAMICS, AN ENGINEERING APPROACH, EIGHTH EDITION, YUNUS A. ÇENGEL & MICHAEL A. BOLES Published by McGraw-Hill Education, New York, 2015							
Pendukung :							
1. Buku Informasi Bioenergi, Kementrian Energi dan Sumber Daya Mineral Republik Indonesia, Direktorat Jendral Energi Baru Terbarukan dan Konservasi Energi 2. The Biomass Assessment Handbook, Bioenergy for a Sustainable Environment”, Frank Rossilo Calle, Earthscan, UK and USA, 2007. 3. The Handbook of Biomass Combustion and Co-firing, Sjaak Van Loo & Jaap Koppejan, Earthscan, UK and USA, 2008. 4. Planning and Installation Bioenergy System, a Guide for Installers, Architects and Engineers”, James & James Science Publishers, UK and USA, 2005. 5. Biofuels for Transport, Global Potential and Implications for Sustainable Energy and Agriculture, Suzanne C. Hunt, Earthscan, UK and USA, 2007.							
Dosen Pengampu		Tim Teaching : Bambang Sudarmanta, Atok Setiyawan, Ary Bachtiar Krisna Putra					
Matakuliah syarat		- Termodinamika Teknik - Mekanika Fluida - Perpindahan Panas					
Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menganalisis	Mampu dan mengetahui	Diskusi	- Kuliah Pengantar & Brainstorming - Video Bioenergi	- Dokumen RPS di MyITS Classroom	- Kontrak materi Kuliah - Introduction to Renewable Energy	5 %



	sumber-bahan baku, teknologi konversi serta aplikasi produk bioenergi	Renewable Energy		[TM: 1x(3x50'')]	- Review & Summary PPT perkuliahan di MyITS Classroom		
2	Mahasiswa mampu menganalisa dasar-dasar kebijakan pengembangan bioenergi dan turunannya	Mampu dan mengetahui kebijakan pengembangan renewable energy dan turunannya	Tugas	- Kuliah - Latihan soal [TM: 1x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Kebijakan pengembangan renewable energy dan turunannya	5 %
3	Mahasiswa mampu menganalisis assessment terhadap biomassa	Mampu dan mengetahui assessment terhadap sumber-sumber renewable energy	Tugas	- Kuliah - Studi kasus - Tugas [TM: 1x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Assessment dan metodologi sumber-sumber renewable energy	10 %
4	Mahasiswa mampu menganalisis metodologi assessment terhadap biomassa	Mampu dan mengetahui metodologi assesment renewable energy	Tugas	- Kuliah - Studi kasus [TM: 1x(3x50'')]	-	Pentingnya renewable energi dalam hubungannya dengan sumber energi yang lain	5 %



5	Mahasiswa mampu menganalisis dan menyusun bahan baku biomassa	Mampu dan terampil menyusun bahan baku biomassa	Tugas	- Kuliah - Latihan soal [TM: 2x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Mempelajari aplikasi variasi energi matahari meliputi solar collectors dan solar power systems.	5 %
6	Mahasiswa mampu menganalisis Proses konversi termokimia	Mampu dan terampil melakukan konversi termokimia	Presentasi	- Kuliah - Latihan soal - Tugas [TM: 2x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Mempelajari aplikasi variasi photovoltaic systems, dan aplikasi passive solar.	10 %
7	Mahasiswa mampu menganalisis dan menyusun aspek lingkungan dari pembakaran biomassa	Mampu dan terampil mengkarakterisasi pembakaran	Tugas	- Kuliah - Latihan soal [TM: 2x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Evaluasi performansi aplikasi energi matahari	10 %
8	Evaluasi Tengah Semester / Ujian Tengan Semester						(50%)
9	Mahasiswa mampu menganalisis dan menyusun teknologi bioenergi	Mampu menjelaskan teknologi bioenergi		- Kuliah - Latihan soal - praktikum [TM: 2x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Analisis turbin angin dan diskusi faktor-faktor yang berpengaruh terhadap aplikasi turbin angin.	5 %



10	Mahasiswa mampu menganalisis perkembangan teknologi bioenergi	Mampu menjelaskan perkembangan teknologi bioenergy	Quiz/UAS	- Kuliah - Latihan soal [TM: 2x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Mempelajari variasi tipe turbin hidrolis dan evaluasi performansi terhadap turbin hidrolis.	5 %
11	Mahasiswa mampu menganalisis dan menyusun karakterisasi Biofuel	Mampu menjelaskan biofuel dan turunannya	Presentasi	- Kuliah - Latihan soal [TM: 2x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Mengenalkan aplikasi pemanasan, pendinginan dan pembangkitan daya dari sistem geothermal.	10 %
12	Mahasiswa mampu menganalisis dan menyusun karakterisasi biofuel cair	Mampu mengkarakterisasi biofuel cair	Quiz/UAS	- Kuliah - Latihan soal - Tugas [TM: 2x(3x50'')]		Evaluasi performansi variasi tipe pembangkit daya geothermal.	5 %
13	Mahasiswa mampu menganalisis dan menyusun	Mampu mengkarakterisasi biofuel gas	Quiz/UAS	- Kuliah - Latihan soal [TM: 2x(3x50'')]	- Latihan soal & Homework di MyITS Classroom	Mereview sumber-sumber biomassa, konversi menjadi biofuel	5 %



	karakterisasi biofuel gas				- Review & Summary PPT perkuliahan di MyITS Classroom		
14	Mahasiswa mampu menganalisis permasalahan lingkungan	Mampu menganalisis dampak lingkungan dari bioenergi	Presentasi	- Kuliah - Brainstorming [TM: 1x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Produk-produk biomassa limbah perkotaan serta padat	10 %
15	Mahasiswa mampu menganalisis perkembangan biofuel untuk transportasi di dunia	Mampu menganalisa perkembangan biofuel di dunia	Presentasi	- Kuliah - Brainstorming [TM: 1x(3x50'')]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Analisis permasalahan lingkungan dan Perkembangan biofuel untuk transportasi di dunia	10 %
16	Evaluasi Akhir Semester / Ujian Akhir Semester						(50%)

Catatan :

15. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

16. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.

39. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.



18. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
19. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
20. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
21. **Bentuk penilaian:** tes dan non-tes.
22. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
23. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
24. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
25. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
26. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM	Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER		



MATA KULIAH (MK)		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
SISTEM INJEKSI BAHAN BAKAR		TM234630	RTSE	T=2,5	P=0,5	PILIHAN	20 November 2023
OTORISASI		Pengembang RPS		Koordinator RMK		Ketua PRODI	
		Bambang Sudarmanta		Prabowo (kalab)		Atok Setiyawan	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK						
	CPL-6	Menguasai prinsip-prinsip rekayasa pada sistem mekanika untuk mengidentifikasi, merumuskan dan menyelesaikan bidang teknik mesin.					
	CPL-8	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (mechanical system)					
	CPL-10	Mampu merumuskan solusi untuk masalah rekayasa di bidang sistem mekanika dengan memperhatikan faktor ekonomi, keselamatan, lingkungan dan konservasi energi.					
	CPL-11	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu dan teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global.					
	Capaian Pembelajaran Mata Kuliah (CPMK)						
	CPMK-1	Secara umum, ingin memberikan gambaran parameter indikator unjuk kerja motor pembakaran dalam					
	CPMK-2	Memberikan gambaran dan pemahaman mengenai perkembangan teknologi sistem pemasukan bahan bakar, mulai sistem karburator dan sistem injeksi, baik injeksi melalui port maupun injeksi langsung didalam ruang bakar.					
	CPMK-3	Memberikan pemahaman analisis dan skill terkait sistem injeksi bahan bakar					
	CPMK-4	Memberikan gambaran mengenai konfigurasi dan komponen-komponen sistem yang berhubungan dengan mekanisme pemasukan bahan bakar					



		Matrik CPL – CPMK					
		CPMK	CPL-6	CPL-8	CPL-10	CPL-11	TOTAL (%)
		CPMK-1	V	V	V	V	20
		CPMK-2	V	V	V	V	30
		CPMK-3	V	V	V	V	25
		CPMK-4	V	V	V	V	25
		TOTAL BOBOT (%)	20	30	30	20	100
Deskripsi Singkat MK	Sistem injeksi bahan bakar merupakan bagian dari mekanisme sistem pemasukan bahan bakar, yang meliputi karburator, injeksi melalui port dan njeksi langsung didalam ruang bakar. Mencakup Proses pembentukan campuran udara-bahan bakar, Karakteristik injeksi bahan bakar, Komponen sistem injeksi bahan bakar, Klasifikasi sistem injeksi bahan bakar, Sistem manajemen engine, Properties bahan bakar yang mempengaruhi sistem dan proses injeksi. Strategi Pengembangan sistem pemasukan bahan bakar dengan cara meminimalkan konsumsi bahan bakar dan mengurangi kadar polutan emisi gas buang. Dalam cakupan disini juga Sistem injeksi intermitten dan kontinyu, troubleshooting sistem injeksi serta perkembangan Sistem Injeksi untuk bahan bakar bensin, diesel dan bahan bakar alternatif.						
Bahan Kajian: Materi Pembelajaran	Bahan Kajian : • Parameter operasi dan desain engine • Sistem pemasukan bahan bakar • Karakteristik injeksi bahan bakar • Komponen & klasifikasi sistem injeksi bahan bakar • Strategi Pengembangan sistem pemasukan bahan bakar • Sistem Injeksi untuk bahan bakar alternatif Materi pembelajaran :						



	Parameter operasi dan desain engine Mekanisme sistem pemasukan bahan bakar: - Karburator - Injeksi melalui port - Injeksi langsung didalam ruang bakar Proses pembentukan campuran udara-bahan bakar Karakteristik injeksi bahan bakar Komponen sistem injeksi bahan bakar Klasifikasi sistem injeksi bahan bakar Sistem manajemen engine Properties bahan bakar yang mempengaruhi sistem dan proses injeksi Strategi Pengembangan sistem pemasukan bahan bakar : - Meminimalkan konsumsi bahan bakar - Mengurangi kadar polutan emisi gas buang Sistem injeksi intermitten dan kontinyu Troubleshooting sistem injeksi Perkembangan Sistem Injeksi pada mesin bensin: - Damped Speed Influence on the Pressure Wave - Quasi Constant Maximum Pressure - Speed Independent Pressure Modulation - Direct Injection of Fuel/Air Premixture with mechanical Flow Control - Direct Injection of Fuel/Air Premixture with Electronically Controlled Spray Flow Perkembangan Sistem Injeksi pada Mesin Diesel - Injection Rate Modulation - Injection Systems with Speed Dependent Injection Rate - Injection Systems with Accumulated Fuel High-Pressure (Common Rail) - Injection Systems with Speed Dependent Pressure Wave and Variable Flow Passage



		- Injection Systems with Speed Independent Modulation of the Pressure Wave -The Diesel Pressure Pulse System Sistem Injeksi untuk bahan bakar alternatif					
Pustaka		Utama :					
		1. John B.L. Heywood, Internal Combustion Engine Fundamentals, McGraw-Hill, Inc, 1989.					
		Pendukung :					
		6. Kazimierz Lejda & Pawel Woz, Fuel Injection in automotive engineering, In Tech, 2012.					
		7. Cornel Stan, Direct Injection System for spark ignition and compression-ignition engine, Society of automotive engineers (SAE) Inc, Springer, 1999.					
		8. Automotive spark-ignited direct-injection gasoline engines, F. Zhao, M.-C. Lai, D.L. Harrington, Progress in Energy and Combustion Science, Pergamon, 1999.					
		9. Forbes Aird, Bosch Fuel Injection Systems, The Berkley Publishing Group, 2001					
Dosen Pengampu		Tim Teaching : Bambang Sudarmanta, Atok Setiyawan, Ary Bachtiar Krisna Putra					
Matakuliah syarat		- Termodinamika Teknik - Mekanika Fluida - Perpindahan Panas					
Mg Ke	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	[C4,A3][Conceptual knowledge, Analyze]:	Mampu dan paham parameter	Diskusi	- Kuliah Pengantar & Brainstorming	- Dokumen RPS di MyITS Classroom	- Kontrak materi Kuliah	5 %



	Mahasiswa mampu memahami parameter operasi dan desain engine	operasi dan desain engine		- Video parameter operasi dan desain engine	- Review & Summary PPT perkuliahan di MyITS Classroom	- Introduction to Sistem Injeksi Bahan Bakar	
2	[C4,A3][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu memahami mekanisme system pemasukan bahan bakar	Mampu dan mengetahui paham mekanisme system pemasukan bahan bakar	Tugas	- Kuliah - Latihan soal [TM: 1x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Parameter operasi dan desain engine	5 %
3	[C4,A3][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu memahami pembentukan campuran udara-bahan bakar	Mampu dan paham pembentukan campuran udara-bahan bakar	Tugas	- Kuliah - Studi kasus - Tugas [TM: 1x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Mekanisme sistem pemasukan bahan bakar: - Karburator	10 %
4	[C4,A3][<i>Conceptual knowledge, Analyze</i>]:	Mampu dan paham mengenai Karakteristik	Tugas	- Kuliah - Studi kasus [TM: 1x(3x50")]		Mekanisme sistem pemasukan bahan bakar: - Injeksi melalui port	5 %



	Mahasiswa mampu memahami mengenai Karakteristik injeksi bahan bakar	injeksi bahan bakar				- Injeksi langsung didalam ruang bakar	
5	[C5,A4][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu menganalisis system injeksi bahan bakar	Mampu dan terampil analisis system injeksi bahan bakar	Tugas	- Kuliah - Latihan soal [TM: 2x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Proses pembentukan campuran udara-bahan bakar	5 %
6	[C5,A4][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu mengklasifikasi system injeksi bahan bakar	Mampu mengklasifikasi system injeksi bahan bakar	Presentasi	- Kuliah - Latihan soal - Tugas [TM: 2x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Karakteristik injeksi bahan bakar	10 %
7	[C5,A4][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu	Mampu dan terampil analisis system	Tugas	- Kuliah - Latihan soal [TM: 2x(3x50")]	- Latihan soal & Homework di MyITS Classroom	Komponen sistem injeksi bahan bakar	10 %



	menganalisis system manajemen engine	manajemen engine			- Review & Summary PPT perkuliahan di MyITS Classroom		
8	Evaluasi Tengah Semester / Ujian Tengah Semester						(50%)
9	Mahasiswa mampu menganalisis dan menyusun teknologi bioenergi	Mampu memahami properties bahan bakar yang mempengaruhi sistem dan proses injeksi		- Kuliah - Latihan soal - praktikum [TM: 2x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Klasifikasi sistem injeksi bahan bakar	5 %
10	Mahasiswa mampu menganalisis perkembangan teknologi bioenergi	Mampu menganalisis Strategi Pengembangan sistem pemasukan bahan bakar	Quiz/UAS	- Kuliah - Latihan soal [TM: 2x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Sistem manajemen engine	5 %
11	Mahasiswa mampu menganalisis dan menyusun karakterisasi Biofuel	Mampu menguasai dan menganalisis sistem injeksi intermitten dan kontinyu	Presentasi	- Kuliah - Latihan soal [TM: 2x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Properties bahan bakar yang mempengaruhi sistem dan proses injeksi	10 %



12	Mahasiswa mampu menganalisis dan menyusun karakterisasi biofuel cair	Mampu mampu dan terampil selesaikan troubleshooting sistem injeksi	Quiz/UAS	- Kuliah - Latihan soal - Tugas [TM: 2x(3x50")]		Strategi Pengembangan sistem pemasukan bahan bakar : - Meminimalkan konsumsi bahan bakar - Mengurangi kadar polutan emisi gas buang	5 %
13	Mahasiswa mampu menganalisis dan menyusun karakterisasi biofuel gas	Mampu dan paham perkembangan Sistem Injeksi pada mesin bensin	Quiz/UAS	- Kuliah - Latihan soal [TM: 2x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	- Sistem injeksi intermitten dan kontinyu - Troubleshooting sistem injeksi	5 %
14	Mahasiswa mampu menganalisis permasalahan lingkungan	Mampu analisis perkembangan sistem injeksi pada mesin diesel	Presentasi	- Kuliah - Brainstorming [TM: 1x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	- Perkembangan Sistem Injeksi pada mesin bensin: - Perkembangan Sistem Injeksi pada Mesin Diesel	10 %



15	Mahasiswa mampu menganalisis perkembangan biofuel untuk transportasi di dunia	Mampu mampu menganalisis Sistem Injeksi untuk bahan bakar alternatif	Presentasi	- Kuliah - Brainstorming [TM: 1x(3x50")]	- Latihan soal & Homework di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Sistem Injeksi untuk bahan bakar alternatif	10 %
16	Evaluasi Akhir Semester / Ujian Akhir Semester						(50%)

Catatan :

16. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

17. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.

40. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

19. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

20. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

21. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

22. **Bentuk penilaian:** tes dan non-tes.



23. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
24. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
25. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
26. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
27. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>UNDERGRADUATE PROGRAM OF MECHANICAL ENGINEERING DEPARTMENT</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEM ENGINEERING</i>					Kode Dokumen <i>Document Code</i>
RENCANA PEMBELAJARAN SEMESTER <i>Semester Learning Plan</i>						
MATA KULIAH (MK) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>CREDIT</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date</i>
TERMODINAMIKA I <i>THERMODYNAMICS I</i>	TM234306	Rekayasa Termal dan Sistem Energi <i>Thermal Engineering and Energy System</i>	T=2	P=0	III (3)	7 November 2023
OTORISASI <i>Autorization</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Undergraduate Program</i>	
	Tri Vicca Kusumadewi, ST., MSc.		Prof. Dr. Ir. Djatmiko Ichani, MEng, IPU, AEng		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng	
	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>					



Capaian Pembelajaran (CP) <i>Learning Outcome</i>	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>Able to study and utilize science and technology in order to apply them in the field of mechanical engineering, and able to make appropriate decisions based on the results of individual or group work, presented in the form of a final project report or other learning activities equivalent to a final project, through logical, critical, systematic, and innovative thinking</i>
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>
	CPL 8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>	
	CPMK-1	Mampu memahami dan menganalisis konsep-konsep dasar Termodinamika, yang mencakup bentuk energi, sifat, tingkat keadaan (fase tunggal, campuran dan gas ideal), proses dan siklus <i>Able to understand and analyze the basic concepts of Thermodynamics, which encompass forms of energy, properties, states (single phase, mixtures, and ideal gases), processes, and cycles.</i>
	CPMK-2	Mampu menerapkan hukum Termodinamika I dan II pada volume tetap dan massa tetap untuk menyelesaikan permasalahan termodinamika. <i>Able to apply the First and Second Laws of Thermodynamics to closed systems and constant mass to solve thermodynamic problems.</i>
	CPMK- 3	Mampu memahami, menganalisis dan menyelesaikan permasalahan entropi <i>Able to comprehend, analyze, and solve entropy-related problems.</i>
	CPMK-4	Mampu memahami, menganalisis dan menyelesaikan permasalahan exergy <i>Able to comprehend, analyze, and solve exergy-related problems.</i>
	Matrik CPL – CPMK	



		Matrix of CPL -CPMK			
		CPMK	CPL-2	CPL-4	CPL-8
		CPMK-1	v	v	v
		CPMK-2	v	v	v
		CPMK-3	v	v	v
		CPMK-4	v	v	v
Deskripsi Singkat MK <i>Short Description of Course</i>	Termodinamika 1 mencakup berbagai konsep dan hukum (hukum termodinamika 1 & 2) yang menggambarkan perilaku sistem yang berinteraksi dengan lingkungannya, terutama dalam konteks perubahan energi termal, konsep dan aplikasi energy, entropi serta aplikasinya dalam suatu sistem termodinamika. <i>Thermodynamics 1 covers various concepts and laws (the First and Second Laws of Thermodynamics) that describe the behavior of systems interacting with their surroundings, particularly in the context of thermal energy transformation, the concepts and applications of energy and entropy, as well as their applications in thermodynamic systems</i>				
Bahan Kajian: Materi Pembelajaran <i>Course Materials</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: <i>This course will cover the following main topics:</i> - Definisi dan terminology yang digunakan dalam pembelajaran Termodinamika - <i>Definitions and terminology used in the study of Thermodynamics</i> - Tingkat keadaan dan sifat-sifat termodinamika untuk zat cair, campuran, uap/gas dan gas sebagai gas ideal - <i>State levels and thermodynamic properties of substances including liquids, mixtures, vapors/gases, and ideal gases</i> - Persamaan Hukum Termodinamika I dan II baik untuk system tertutup dan system volume atur serta mengaplikasikan ke dalam system-system termodinamika - <i>The First and Second Laws of Thermodynamics, both for closed systems and control volumes, and their application to thermodynamic systems</i> - Analisa system termodinamika untuk proses yang steady state maupun transient - <i>Analysis of thermodynamic systems for both steady-state and transient processes</i> - Mengevaluasi entropi				



		- <i>Evaluation of entropy</i>					
Pustaka <i>References</i>		Utama : <i>Main</i>					
		[1]. M. J. Moran , H.N. Shapiro, D.D. Boettner & M.B. Bailey, “Fundamental of Engineering Thermodynamics”, 9th edition, Willey, 2020.					
		Pendukung : <i>Supplementary</i>					
		[2]. Yunus A. Cengel and Michael A. Boles, “Thermodynamics, An Engineering Approach”, 9bbth edition, McGraw-Hill.2019 [3]. William C. Reynold & Henry J. Perkins, “Engineering Thermodynamics”, 2nd edition, McGraw-Hill.1977					
Dosen Pengampu <i>Lecturers</i>		Djatismiko Ichsani, Bambang Sudarmanta, Prabowo, Atok Setiyawan, Ary Bachtiar Krisna Putra, , Bambang Arip Dwiyanoro, Is Bunyamin, Tri Vicca					
Matakuliah syarat <i>Prerequisites</i>		Fisika Mekanika <i>Physics Mechanics</i> Kalkulus 1 <i>Calculus 1</i>					
Mg Ke- <i>Week</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final Ability of Each Learning Stage</i>	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>Learning Model, Learning Method, DStudent Assignment</i>		Materi Pembelajaran <i>Learning Materials</i>	Bobot Penilaian (%) <i>Assesment Credits (%)</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu mengerti dan memahami: definisi, terminology	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam	Kriteria: <i>Criteria:</i> Rubrik	Bentuk: <i>Model:</i>	- Dokumen RPS di MyITS Classroom	- Kontrak Kuliah - <i>Course contract</i> - Definisi dan terminology	-



	termodinamika, sistem satuan. <i>Students are able to understand and comprehend: definitions, thermodynamic terminology, and unit systems.</i>	menjelaskan definisi, terminology termodinamika, sistem satuan <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in explaining definitions, thermodynamic terminology, and unit systems</i>	<i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- <i>Learning plan document in My ITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- <i>Definition and terminology</i> - Contoh sistem dan aplikasi termodinamika - <i>Example of thermodynamics system & applications</i> - Sistem Satuan - <i>Unit system</i> - Tekanan dan Temperatur - <i>Pressure and Temperature</i> Bab 1 [1], 3 [3] dan 5 [2] <i>Chapter 1 [1], chapter 3 [3] and chapter 5 [2]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
2	Mahasiswa mampu menganalisa energi dan Hukum Termodinamika I <i>Students are able to analyze energy and the First Law of Thermodynamic</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan kekekalan energy dalam system tertutup <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture</i>	- Hukum Termodinamika I: Kekekalan energy - <i>Thermodynamics 1 law: energy conservation</i> - konsep dan jenis-jenis energy - <i>concepts and types of energy</i> - analisa serta perhitungan kekekalan energy pada sistem termodinamika tertutup	



		time management), and originality in complete the problem of energy conservation in the closed system		<i>learning</i> Expository & Discovery Learning Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	<i>Presentations on MyITS Classroom</i>	- <i>analysis and calculation the conservation of energy in a closed thermodynamic system</i> Bab 2 [1] <i>Chapter 2 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
3	Mahasiswa mampu menganalisa energi dan Hukum Termodinamika I <i>Students are able to analyze energy and the First Law of Thermodynamic</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan kekekalan energy dalam system tertutup <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in complete the problem of energy conservation in the closed system</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Hukum Termodinamika I: Kekekalan energy - <i>Thermodynamics 1 law: energy conservation</i> - konsep dan jenis-jenis energy - <i>concepts and types of energy</i> - analisa serta perhitungan kekekalan energy pada sistem termodinamika tertutup - <i>analysis and calculation the conservation of energy in a closed thermodynamic system</i>	



				(TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")		Bab 2 [1] <i>Chapter 2 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
4	Mahasiswa mampu memahami dan mencari sifat-sifat termodinamika dengan cara melihat tabel, grafik dan persamaan matematik <i>Students are able to understand and determine thermodynamic properties by referring to tables, graphs, and mathematical equations</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mendapatkan nilai dari sifat-sifat termodinamika untuk zat cair, campuran, uap dan gas denga cara melihat tabel, grafik dan persamaan matematika <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in obtaining values for thermodynamic properties of liquids, mixtures, vapors, and gases by referring to tables, graphs, and mathematical equations</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> test (Quiz 1) <i>test (Quiz 1)</i>	Bentuk: <i>Model:</i> kuliah <i>Learning</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian Quiz <i>Problem solving quiz</i> Analisa studi kasus <i>Case study analysis</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	-	- sifat-sifat termodinamika dari zat cair, uap dan gas <i>- the thermodynamic properties of liquids, vapors, and gases using graph, tables and mathematical equations</i> Bab 3 [1] <i>Chapter 3 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	25%



5	Mahasiswa mampu memahami dan mencari sifat-sifat termodinamika dengan cara melihat tabel, grafik dan persamaan matematik <i>Students are able to understand and determine thermodynamic properties by referring to tables, graphs, and mathematical equations</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mendapatkan nilai dari sifat-sifat termodinamika untuk zat cair, campuran, uap dan gas denga cara melihat tabel, grafik dan persamaan matematika <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in obtaining values for thermodynamic properties of liquids, mixtures, vapors, and gases by referring to tables, graphs, and mathematical equations</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	sifat-sifat termodinamika dari zat cair, uap dan gas - <i>the thermodynamic properties of liquids, vapors, and gases using graph, tables and mathematical equations</i> Bab 3 [1] <i>Chapter 3 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
6	Mahasiswa Mahasiswa mampu memahami dan menganalisa hukum I & II Termodinamika untuk system volume	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum I & II Termodinamika	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i>	- Persamaan matematika hukum Termodinamika I untuk sistem-sistem volume atur secara steady state dan transient.	



	atur secara steady state dan transient <i>Students are able to understand and analyze the First and Second Laws of Thermodynamics for control volume systems in both steady-state and transient conditions</i>	untuk system volume atur secara steady state dan transient <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the First and Second Laws of Thermodynamics for control volume systems under steady-state and transient conditions</i>	Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- <i>Mathematical equations of the First Law of Thermodynamics for control volume systems in steady-state and transient conditions</i> - Analisa hukum Termodinamika II secara steady state untuk Nozzle/Diffusere, Pompa/Kompresor, Turbin, penukar kalor dan katup - <i>Analysis of the first Law of Thermodynamics under steady-state conditions for nozzles/diffusers, pumps/compressors, turbines, heat exchangers, and valves.</i> Bab 4 [1] <i>Chapter 4 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
7	Mahasiswa Mahasiswa mampu memahami dan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan	Kriteria: <i>Criteria:</i> Rubrik	Bentuk: <i>Model:</i>	- Latihan soal & Homework di MyITS Classroom	- Persamaan matematika hukum Termodinamika I untuk sistem-sistem	



	menganalisa hukum I & II Termodinamika untuk system volume atur secara steady state dan transient <i>Students are able to understand and analyze the First and Second Laws of Thermodynamics for control volume systems in both steady-state and transient conditions</i>	originalitas dalam menyelesaikan permasalahan hukum I & II Termodinamika untuk system volume atur secara steady state dan transient <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the First and Second Laws of Thermodynamics for control volume systems under steady-state and transient conditions</i>	<i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	volume atur secara steady state dan transient. - <i>Mathematical equations of the First Law of Thermodynamics for control volume systems in steady-state and transient conditions</i> Bab 4 [1] <i>Chapter 4 [1]</i> Handout di myITS Calsroom <i>Handout in myITS Classroom</i>	
8	Evaluasi Tengah Semester / Ujian Tengan Semester <i>Midterm Examination</i>						25%
9	Mahasiswa mampu memahami, menganalisa dan menerapkan hukum II Termodinamika untuk system volume atur secara steady state dan transient (nozzle, diffuser, pompa, kompresor, turbin,	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika untuk system volume atur secara steady state dan transient	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas)	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture</i>	- Analisa hukum Termodinamika II secara steady state untuk Nozzle/Diffusere, Pompa/Kompresor, Turbin, penukar kalor dan katup - <i>Analysis of the Second Law of Thermodynamics under steady-state</i>	



	penukar kalor dan katup) <i>Students are able to understand, analyze, and apply the Second Law of Thermodynamics to control volume systems under steady-state and transient conditions (including nozzles, diffusers, pumps, compressors, turbines, heat exchangers, and valves)</i>	(nozzle, diffuser, pompa, kompresor, turbin, penukar kalor dan katup) <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the Second Law of Thermodynamics for control volume systems under both steady-state and transient conditions, covering components such as nozzles, diffusers, pumps, compressors, turbines, heat exchangers, and valves</i>	<i>Non-test (assignment)</i>	Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	<i>Presentations on MyITS Classroom</i>	<i>conditions for nozzles/diffusers, pumps/compressors, turbines, heat exchangers, and valves.</i> - Analisa hukum Termodinamika II untuk sistem-sistem termodinamika yang transient - <i>Analysis of the Second Law of Thermodynamics for transient thermodynamic systems</i> Bab 4 [1] <i>Chapter 4 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
10	Mahasiswa mampu memahami dan menganalisa serta menerapkan hukum II Termodinamika untuk sistem volume atur secara steady state dan transient (nozzle, diffuser, pompa,	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika untuk sistem volume atur secara steady	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode:	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom	- Analisa hukum Termodinamika II secara steady state untuk Nozzle/Diffusere, Pompa/Kompresor, Turbin, penukar kalor dan katup - <i>Analysis of the Second Law of Thermodynamics</i>	



	kompresor, turbin, penukar kalor dan katup) <i>Students are able to understand, analyze, and apply the Second Law of Thermodynamics to control volume systems under steady-state and transient conditions (including nozzles, diffusers, pumps, compressors, turbines, heat exchangers, and valves)</i>	state dan transient (nozzle, diffuser, pompa, kompresor, turbin, penukar kalor dan katup) <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the Second Law of Thermodynamics for control volume systems under both steady-state and transient conditions, covering components such as nozzles, diffusers, pumps, compressors, turbines, heat exchangers, and valves</i>	non-test (tugas) <i>Non-test (assignment)</i>	<i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	<i>under steady-state conditions for nozzles/diffusers, pumps/compressors, turbines, heat exchangers, and valves.</i> - Analisa hukum Termodinamika II untuk sistem-sistem termodinamika yang transient - <i>Analysis of the Second Law of Thermodynamics for transient thermodynamic systems</i> Bab 4 [1] <i>Chapter 4 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
11	Mahasiswa mampu menganalisis dan menerapkan hukum Termodinamika II secara steady state pada sistem tertutup <i>Students are able to analyze and apply the</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk:	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom	- Persamaan clausius dan pernyataan Kelvin Plank - <i>Clausius equation and the Kelvin-Planck statement</i> - Persamaan matematika hukum Termodinamika II	



	<i>Second Law of Thermodynamics under steady-state conditions for closed systems.</i>	untuk system tertutup secara steady state <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to the Second Law of Thermodynamics for closed systems under steady-state conditions</i>	<i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	<i>Metode:</i> <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- <i>Mathematical equations of the Second Law of Thermodynamics</i> - Analisa hukum Termodinamika II secara steady state pada system tertutup - <i>Analysis of the Second Law of Thermodynamics under steady-state conditions for closed systems</i> Bab 5 [1] <i>Chapter 5 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
12	Mahasiswa mampu menganalisis dan menerapkan hukum Termodinamika II secara steady state pada system tertutup <i>Students are able to analyze and apply the Second Law of Thermodynamics under steady-state conditions for closed systems.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika untuk system tertutup secara steady state <i>Assessment is based on the completeness,</i>	<i>Kriteria:</i> <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> <i>Bentuk:</i> <i>Model:</i> test (Quiz 1) <i>test (Quiz 1)</i>	<i>Bentuk:</i> <i>Model:</i> kuliah <i>Learning</i> <i>Metode:</i> <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian Quiz		- Persamaan clausius dan pernyataan Kelvin Plank - <i>Clausius equation and the Kelvin-Planck statement</i> - Persamaan matematika hukum Termodinamika II - <i>Mathematical equations of the Second Law of Thermodynamics</i>	25%



		<i>clarity, accuracy (in terms of content and timing), and originality in solving problems related to the Second Law of Thermodynamics for closed systems under steady-state conditions</i>		<i>Problem solving quiz</i> Analisa studi kasus <i>Case study analysis</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")		- Analisa hukum Termodinamika II secara steady state pada system tertutup - <i>Analysis of the Second Law of Thermodynamics under steady-state conditions for closed systems</i> Bab 5 [1] <i>Chapter 5 [1]</i> Handout di myITS Calsroom <i>Handout in myITS Classroom</i>	
13	Mahasiswa mampu menganalisis dan menghitung entropi <i>Students are able to analyze and calculate entropy</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan entropi <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Ketidaksamaan clausius - <i>Clausius inequality</i> - Hubungan antara entropi dan hukum Termodinamika II termasuk: perpindahan dan prinsip kenaikan entropi - <i>The relationship between entropy and the Second Law of Thermodynamics, including entropy transfer and the entropy generation principle</i>	



		<i>related to entrophy</i>		<i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")		- Evaluasi entropi, analisa proses isentropika menggunakan data yang sesuai - <i>Entropy evaluation and analysis of isentropic processes using appropriate data</i> - Mengaplikasikan persamaan untuk keseimbangan entropi pada system tertutup dan volume atur - <i>Application of entropy balance equations for closed systems and control volumes</i> Bab 6 [1] <i>Chapter 6 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
14	Mahasiswa mampu menganalisa dan menerapkan proses isentropic dalam aplikasi termodinamika <i>Students are able to analyze and apply isentropic processes in</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan proses isentropic untuk nozzle, pompa,turbin,	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i>	- Proses isentropic - <i>Iisentropic process</i> - Evaluasi efisiensi - <i>Efficiency evaluation</i> - isentropik untuk nozzle, pompa,turbin, penukar kalor dan katup	



	<i>thermodynamic applications</i>	penukar kalor dan katup Perubahan entropy pada proses reversible internal <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to isentropic processes in nozzles, pumps, turbines, heat exchangers, and valves, as well as entropy changes in internally reversible processes</i>	Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- <i>Isentropic processes in nozzles, pumps, turbines, heat exchangers, and valves</i> - Perubahan entropy pada proses reversible internal - <i>Entropy changes in internally reversible processes</i> - Laju neraca entropi dalam volume tetap - <i>Rate of entropy balance in control volumes</i> Bab 6 [1] <i>Chapter 6 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
15	Mahasiswa mampu mengalisa dan menerapkan aliran exergi, neraca laju exergy untuk volume	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i>	- Neraca exergy system tertutup - <i>Exergy balance for closed systems</i> - aliran exergy	



	atur dalam aplikasi termodinamika <i>Students are able to analyze and apply exergy flow and the exergy rate balance for control volumes in thermodynamic applications</i>	permasalahan aliran exergi, neraca laju exergy untuk volume atur dalam aplikasi termodinamika <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to exergy flow and exergy rate balance for control volumes in thermodynamic applications</i>	<i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	<i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- <i>Exergy flow</i> - neraca laju exergi untuk volume atur - <i>Exergy rate balance for control volumes</i> - efisiensi exergetic - <i>Exergetic efficiency</i> Bab 7 [1] <i>Chapter 7 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Examinations</i>						25%

Catatan :

Notes:

- Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

Program Learning Outcomes (PLOs) are the competencies possessed by each graduate of the study program, which represent the internalization of attitudes and mastery of knowledge and skills according to the level of the program, acquired through the learning process

- CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum,



keterampilan khusus dan pengetahuan. *PLOs assigned to a course refer to selected program learning outcomes that contribute to the development of the course. These outcomes encompass aspects of attitude, general skills, specific skills, and knowledge.*

42. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

Course Learning Outcomes (CLOs) are specific abilities derived from the PLOs assigned to a course and are directly related to the subject matter or learning content of the course.

43. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

Sub-Course Learning Outcomes (Sub-CLOs) are more specific capabilities derived from the CLOs, measurable and observable, representing the final learning abilities expected at each stage of the learning process, and specific to the course content.

44. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

Assessment Indicators are specific and measurable statements that identify student learning abilities or performance, along with the evidence supporting them, used to assess both the process and outcomes of learning.

45. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

Assessment Criteria are the standards used to measure the achievement of learning outcomes, based on predetermined indicators. These criteria serve as a guide for evaluators to ensure consistent and unbiased assessment. Criteria may be quantitative or qualitative.

46. **Bentuk penilaian:** tes dan non-tes.

Form of Assessment: tests and non-test assessments.

47. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.



Form of Learning: Lectures, Response Sessions, Tutorials, Seminars (or equivalent), Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other equivalent forms of learning.

48. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.

Learning Methods: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.

49. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.

Learning Materials are detailed topics or descriptions of subject matter, which can be presented as main topics and subtopics.

50. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.

Assessment Weight is the percentage assigned to the achievement of each Sub-CLO, proportionally reflecting the difficulty level of each Sub-CLO, with a total weight of 100%.

51. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

TM = Face-to-Face, PT = Structured Assignments, BM = Independent Learning.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>UNDERGRADUATE PROGRAM OF MECHANICAL ENGINEERING DEPARTMENT</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEM ENGINEERING</i>					Kode Dokumen <i>Document Code</i>
RENCANA PEMBELAJARAN SEMESTER <i>Semester Learning Plan</i>						
MATA KULIAH (MK) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>CREDIT</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date</i>
TERMODINAMIKA II <i>THERMODYNAMICS II</i>	TM234405	Rekayasa Termal dan Sistem Energi <i>Thermal Engineering and Energy System</i>	T=3	P=0	IV (4)	7 November 2023
OTORISASI <i>Autorization</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Undergraduate Program</i>	
	Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng		Prof. Dr. Ir. Djatmiko Ichani, MEng, IPU, AEng		Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng	
	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>					



Capaian Pembelajaran (CP) <i>Learning Outcome</i>	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif. <i>Able to study and utilize science and technology in order to apply them in the field of mechanical engineering, and able to make appropriate decisions based on the results of individual or group work, presented in the form of a final project report or other learning activities equivalent to a final project, through logical, critical, systematic, and innovative thinking</i>
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>
	CPL 8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>	
	CPMK-1	Mampu memahami, menalar dan menganalisis sistem pembangkit daya tenaga uap (siklus Rankine) <i>Able to comprehend, reason, and analyze Rankine cycle (steam power plant)</i>
	CPMK-2	Mampu memahami, menalar dan menganalisis sistem pembangkit daya tenaga gas (siklus Otto, siklus Diesel, siklus Brayton/turbin gas). <i>Able to comprehend, reason, and analyze Otto, Diesel, Brayton cycle (gas power plant)</i>
	CPMK-3	Mampu memahami, menalar dan menganalisis sistem refrigerasi dan pompa termal. <i>Able to comprehend, reason, and analyze Refrigeration and Heat Pump cycle</i>
	CPMK-4	Mampu memahami, menalar dan menganalisis prinsip campuran gas ideal dan konsep psikrometrik pada udara lembab (moist air). <i>Able to comprehend, reason, and analyze ideal gas mixture and Psychrometric for moist air</i>
	CPMK-5	Mampu memahami, menalar dan menganalisis prinsip campuran reaktif dan tak reaktif, serta dasar-dasar pembakaran. <i>Able to comprehend, reason, and analyze reacting mixture and combustion</i>
	Matrik CPL – CPMK	



		Matrix of CPL -CPMK				
		CPMK	CPL-2	CPL-4	CPL-8	Bobot (%)
		CPMK-1	v	v	v	25
		CPMK-2	v	v	v	25
		CPMK-3	v	v	v	15
		CPMK-4	v	v	v	20
		CPMK-5	v	v	v	15
		Total bobot (%)	33.33	33.33	33.33	100
Deskripsi Singkat MK <i>Short Description of Course</i>	Mata kuliah ini akan mempelajari pokok-pokok bahasan, yaitu siklus pembangkit daya tenaga uap (siklus Rankine), siklus pembangkit daya tenaga gas (siklus Otto, Diesel, Brayton), siklus pembangkit daya tenaga gabungan gas dan uap, siklus refrigerasi dan pompa panas, campuran gas ideal tidak berreaksi dan Psikrometrik, dasar-dasar pembakaran. <i>This course will study the main topics, namely the steam power generation cycle (Rankine cycle), gas power generation cycle (Otto, Diesel, Brayton cycle), combined gas and steam power generation cycle, refrigeration and heat pump cycles, unreacted ideal gas mixtures and Psychrometrics, basics of combustion.</i>					
Bahan Kajian: Materi Pembelajaran <i>Course Materials</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Daur pembangkit daya tenaga uap: daur Rankine - Daur pembangkit daya tenaga gas: daur Otto, Diesel, Brayton - Daur pembangkit daya tenaga gabungan gas dan uap. - Daur refrigerasi dan pompa termal: refrigeran, daur refrigerasi kompresi uap sederhana, daur refrigerasi bertingkat, dan refrigerasi absorpsi. - Campuran gas tidak berreaksi dan Psikrometrik. - Dasar-dasar pembakaran: kekekalan energi, sistem reaksi dan perhitungan suhu flame adiabatik. <i>In this course, the following topics will be studied:</i>					



	- Steam power generation cycle: Rankine cycle - Gas power generation cycle: Otto, Diesel, Brayton cycle - Combined gas and steam power generation cycle. - Refrigeration cycle and thermal pumps: refrigerants, simple vapor compression refrigeration cycle, multistage refrigeration cycle, and absorption refrigeration. - Unreacted gas mixtures and Psychrometrics. - Combustion basics: conservation of energy, reaction systems and calculation of adiabatic flame temperature. -				
Pustaka References	Utama :				
	Main				
	[1]. M. J. Moran , H.N. Shapiro, D.D. Boettner & M.B. Bailey, “Fundamental of Engineering Thermodynamics”, 9th edition, Willey, 2020.				
	Pendukung :				
	Supplementary				
		[2]. Yunus A. Cengel and Michael A. Boles, “Thermodynamics, An Engineering Approach”, 9th edition, McGraw-Hill.2019			
		[3]. William C. Reynold & Henry J. Perkins, “Engineering Thermodynamics”, 2nd edition, McGraw-Hill.1977			
Dosen Pengampu Lecturers	Djarmiko Ichsani, Bambang Sudarmanta, Prabowo, Atok Setiyawan, Ary Bachtiar Krisna Putra, , Bambang Arip Dwiyanoro, Is Bunyamin Suryo, Tri Vicca				
Matakuliah syarat Prerequisites	TERMODINAMIKA I THERMODYNAMICS I				
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian Assesment	Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, Learning Model, Learning Method, DStudent Assignment	Materi Pembelajaran Learning Materials	Bobot Penilaian (%) Assesment Credits (%)



	<i>Final Ability of Each Learning Stage</i>	<i>Indikator Indicator</i>	<i>Kriteria & Bentuk Criteria & Model</i>	<i>Luring Offline</i>	<i>Daring Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu mengerti dan memahami: definisi, terminology termodinamika, sistem satuan. <i>Students are able to understand and comprehend: definitions, thermodynamic terminology, and unit systems.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan definisi, terminology termodinamika, sistem satuan <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in explaining definitions, thermodynamic terminology, and unit systems</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Dokumen RPS di MyITS Classroom - <i>Learning plan document in My ITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Kontrak Kuliah - <i>Course contract</i> - Definisi dan terminology - <i>Definition and terminology</i> - Contoh sistem dan aplikasi termodinamika - <i>Example of thermodynamics system & applications</i> - Sistem Satuan - <i>Unit system</i> - Tekanan dan Temperatur - <i>Pressure and Temperature</i> Bab 1 [1], 3 [3] dan 5 [2] <i>Chapter 1 [1], chapter 3 [3] and chapter 5 [2]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	-
2	Mahasiswa mampu menganalisa energi dan Hukum Termodinamika I	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming	- Latihan soal & Homework di MyITS Classroom	- Hukum Termodinamika I: Kekekalan energy - <i>Thermodynamics 1 law: energy conservation</i>	



	<i>Students are able to analyze energy and the First Law of Thermodynamic</i>	menyelesaikan permasalahan kekekalan energy dalam system tertutup <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in complete the problem of energy conservation in the closed system</i>	Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	<i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- konsep dan jenis-jenis energy - <i>concepts and types of energy</i> - analisa serta perhitungan kekekalan energy pada sistem termodinamika tertutup - <i>analysis and calculation the conservation of energy in a closed thermodynamic system</i> Bab 2 [1] <i>Chapter 2 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
3	Mahasiswa mampu menganalisa energi dan Hukum Termodinamika I <i>Students are able to analyze energy and the First Law of Thermodynamic</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan kekekalan energy dalam system tertutup <i>Assessment is based on the completeness, clarity, accuracy (in</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas)	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture</i>	- Hukum Termodinamika I: Kekekalan energy - <i>Thermodynamics 1 law: energy conservation</i> - konsep dan jenis-jenis energy - <i>concepts and types of energy</i> - analisa serta perhitungan kekekalan energy pada	



		<i>terms of content and time management), and originality in complete the problem of energy conservation in the closed system</i>	<i>Non-test (assignment)</i>	Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	<i>Presentations on MyITS Classroom</i>	sistem termodinamika tertutup - <i>analysis and calculation the conservation of energy in a closed thermodynamic system</i> Bab 2 [1] <i>Chapter 2 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
4	Mahasiswa mampu memahami dan mencari sifat-sifat termodinamika dengan cara melihat tabel, grafik dan persamaan matematik <i>Students are able to understand and determine thermodynamic properties by referring to tables, graphs, and mathematical equations</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mendapatkan nilai dari sifat-sifat termodinamika untuk zat cair, campuran, uap dan gas denga cara melihat tabel, grafik dan persamaan matematika <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> test (Quiz 1) <i>test (Quiz 1)</i>	Bentuk: <i>Model:</i> kuliah <i>Learning</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian Quiz <i>Problem solving quiz</i> Analisa studi kasus <i>Case study analysis</i>	-	- sifat-sifat termodinamika dari zat cair, uap dan gas - <i>the thermodynamic properties of liquids, vapors, and gases using graph, tables and mathematical equations</i> Bab 3 [1] <i>Chapter 3 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	25%



		<i>originality in obtaining values for thermodynamic properties of liquids, mixtures, vapors, and gases by referring to tables, graphs, and mathematical equations</i>		(TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")			
5	Mahasiswa mampu memahami dan mencari sifat-sifat termodinamika dengan cara melihat tabel, grafik dan persamaan matematik <i>Students are able to understand and determine thermodynamic properties by referring to tables, graphs, and mathematical equations</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mendapatkan nilai dari sifat-sifat termodinamika untuk zat cair, campuran, uap dan gas denga cara melihat tabel, grafik dan persamaan matematika <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in obtaining values for thermodynamic properties of liquids, mixtures, vapors, and gases by referring to tables, graphs, and</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- sifat-sifat termodinamika dari zat cair, uap dan gas - <i>the thermodynamic properties of liquids, vapors, and gases using graph, tables and mathematical equations</i> Bab 3 [1] <i>Chapter 3 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	



		<i>mathematical equations</i>					
6	Mahasiswa Mahasiswa mampu memahami dan menganalisa hukum I & II Termodinamika untuk system volume atur secara steady state dan transient <i>Students are able to understand and analyze the First and Second Laws of Thermodynamics for control volume systems in both steady-state and transient conditions</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum I & II Termodinamika untuk system volume atur secara steady state dan transient <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the First and Second Laws of Thermodynamics for control volume systems under steady-state and transient conditions</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Persamaan matematika hukum Termodinamika I untuk sistem-sistem volume atur secara steady state dan transient. - <i>Mathematical equations of the First Law of Thermodynamics for control volume systems in steady-state and transient conditions</i> - Analisa hukum Termodinamika II secara steady state untuk Nozzle/Diffusere, Pompa/Kompresor, Turbin, penukar kalor dan katup - <i>Analysis of the first Law of Thermodynamics under steady-state conditions for nozzles/diffusers, pumps/compressors, turbines, heat exchangers, and valves.</i>	Bab 4 [1]



						Chapter 4 [1] Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
7	Mahasiswa Mahasiswa mampu memahami dan menganalisa hukum I & II Termodinamika untuk system volume atur secara steady state dan transient <i>Students are able to understand and analyze the First and Second Laws of Thermodynamics for control volume systems in both steady-state and transient conditions</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum I & II Termodinamika untuk system volume atur secara steady state dan transient <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the First and Second Laws of Thermodynamics for control volume systems under steady-state and transient conditions</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Persamaan matematika hukum Termodinamika I untuk sistem-sistem volume atur secara steady state dan transient. - <i>Mathematical equations of the First Law of Thermodynamics for control volume systems in steady-state and transient conditions</i> Bab 4 [1] <i>Chapter 4 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
8	Evaluasi Tengah Semester / Ujian Tengan Semester <i>Midterm Examination</i>						25%



9	Mahasiswa mampu memahami, menganalisa dan menerapkan hukum II Termodinamika untuk system volume atur secara steady state dan transient (nozzle, diffuser, pompa, kompresor, turbin, penukar kalor dan katup) <i>Students are able to understand, analyze, and apply the Second Law of Thermodynamics to control volume systems under steady-state and transient conditions (including nozzles, diffusers, pumps, compressors, turbines, heat exchangers, and valves)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika untuk system volume atur secara steady state dan transient (nozzle, diffuser, pompa, kompresor, turbin, penukar kalor dan katup) <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the Second Law of Thermodynamics for control volume systems under both steady-state and transient conditions, covering components such as nozzles, diffusers, pumps, compressors, turbines,</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Analisa hukum Termodinamika II secara steady state untuk Nozzle/Diffusere, Pompa/Kompresor, Turbin, penukar kalor dan katup - <i>Analysis of the Second Law of Thermodynamics under steady-state conditions for nozzles/diffusers, pumps/compressors, turbines, heat exchangers, and valves.</i> - Analisa hukum Termodinamika II untuk sitem-sistem termodinamika yang transient - <i>Analysis of the Second Law of Thermodynamics for transient thermodynamic systems</i> Bab 4 [1] <i>Chapter 4 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	



		<i>heat exchangers, and valves</i>					
10	Mahasiswa mampu memahami dan menganalisa serta menerapkan hukum II Termodinamika untuk system volume atur secara steady state dan transient (nozzle, diffuser, pompa, kompresor, turbin, penukar kalor dan katup) <i>Students are able to understand, analyze, and apply the Second Law of Thermodynamics to control volume systems under steady-state and transient conditions (including nozzles, diffusers, pumps, compressors, turbines, heat exchangers, and valves)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika untuk system volume atur secara steady state dan transient (nozzle, diffuser, pompa, kompresor, turbin, penukar kalor dan katup) <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and time management), and originality in solving problems related to the Second Law of Thermodynamics for control volume systems under both steady-state and transient conditions, covering components such as nozzles, diffusers, pumps,</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Analisa hukum Termodinamika II secara steady state untuk Nozzle/Diffusere, Pompa/Kompresor, Turbin, penukar kalor dan katup - <i>Analysis of the Second Law of Thermodynamics under steady-state conditions for nozzles/diffusers, pumps/compressors, turbines, heat exchangers, and valves.</i> - Analisa hukum Termodinamika II untuk sitem-sistem termodinamika yang transient - <i>Analysis of the Second Law of Thermodynamics for transient thermodynamic systems</i> Bab 4 [1] <i>Chapter 4 [1]</i> Handout di myITS Calssroom	



		<i>compressors, turbines, heat exchangers, and valves</i>				<i>Handout in myITS Classroom</i>	
11	Mahasiswa mampu menganalisis dan menerapkan hukum Termodinamika II secara steady state pada system tertutup <i>Students are able to analyze and apply the Second Law of Thermodynamics under steady-state conditions for closed systems.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika untuk system tertutup secara steady state <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to the Second Law of Thermodynamics for closed systems under steady-state conditions</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Persamaan clausius dan pernyataan Kelvin Plank - <i>Clausius equation and the Kelvin-Planck statement</i> - Persamaan matematika hukum Termodinamika II - <i>Mathematical equations of the Second Law of Thermodynamics</i> - Analisa hukum Termodinamika II secara steady state pada system tertutup - <i>Analysis of the Second Law of Thermodynamics under steady-state conditions for closed systems</i> Bab 5 [1] <i>Chapter 5 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	
12	Mahasiswa mampu menganalisis dan	Kelengkapan, kejelasan, ketepatan	Kriteria: <i>Criteria:</i>	Bentuk: <i>Model:</i>		- Persamaan clausius dan pernyataan Kelvin Plank	25%



	menerapkan hukum Termodinamika II secara steady state pada system tertutup <i>Students are able to analyze and apply the Second Law of Thermodynamics under steady-state conditions for closed systems.</i>	(materi & waktu), dan originalitas dalam menyelesaikan permasalahan hukum II Termodinamika untuk system tertutup secara steady state <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to the Second Law of Thermodynamics for closed systems under steady-state conditions</i>	Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> test (Quiz 1) test (Quiz 1)	kuliah <i>Learning</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian Quiz <i>Problem solving quiz</i> Analisa studi kasus <i>Case study analysis</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")		- <i>Clausius equation and the Kelvin-Planck statement</i> - Persamaan matematika hukum Termodinamika II - <i>Mathematical equations of the Second Law of Thermodynamics</i> - Analisa hukum Termodinamika II secara steady state pada system tertutup - <i>Analysis of the Second Law of Thermodynamics under steady-state conditions for closed systems</i> Bab 5 [1] <i>Chapter 5 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
13	Mahasiswa mampu menganalisis dan menghitung entropi <i>Students are able to analyze and calculate entropy</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan entropi	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion,</i>	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i>	- Ketidaksamaan clausius - <i>Clausius inequality</i> - Hubungan antara entropi dan hukum Termodinamika II termasuk: perpindahan	



		<i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to entrophy</i>	Bentuk: Model: non-test (tugas) Non-test (assignment)	<i>Brainstorming</i> Metode: Method: Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	dan prinsip kenaikan entropi - <i>The relationship between entropy and the Second Law of Thermodynamics, including entropy transfer and the entropy generation principle</i> - Evaluasi entropi, analisa proses isentropika menggunakan data yang sesuai - <i>Entropy evaluation and analysis of isentropic processes using appropriate data</i> - Mengaplikasikan persamaan untuk keseimbangan entropi pada system tertutup dan volume atur - <i>Application of entropy balance equations for closed systems and control volumes</i> Bab 6 [1] <i>Chapter 6 [1]</i> Handout di myITS Calssroom	



						Handout in myITS Classroom	
14	Mahasiswa mampu menganalisa dan menerapkan proses isentropic dalam aplikasi termodinamika <i>Students are able to analyze and apply isentropic processes in thermodynamic applications</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan proses isentropic untuk nozzle, pompa, turbin, penukar kalor dan katup. Perubahan entropy pada proses reversible internal <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to isentropic processes in nozzles, pumps, turbines, heat exchangers, and valves, as well as</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan discovery learning <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Proses isentropic - <i>Isentropic process</i> - Evaluasi efisiensi - <i>Efficiency evaluation</i> - isentropik untuk nozzle, pompa, turbin, penukar kalor dan katup - <i>Isentropic processes in nozzles, pumps, turbines, heat exchangers, and valves</i> - Perubahan entropy pada proses reversible internal - <i>Entropy changes in internally reversible processes</i> - Laju neraca entropi dalam volume atur - <i>Rate of entropy balance in control volumes</i> Bab 6 [1] <i>Chapter 6 [1]</i> Handout di myITS Classroom <i>Handout in myITS Classroom</i>	



		<i>entropy changes in internally reversible processes</i>					
15	Mahasiswa mampu menganalisa dan menerapkan aliran exergy, neraca laju exergy untuk volume atur dalam aplikasi termodinamika <i>Students are able to analyze and apply exergy flow and the exergy rate balance for control volumes in thermodynamic applications</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan aliran exergy, neraca laju exergy untuk volume atur dalam aplikasi termodinamika <i>Assessment is based on the completeness, clarity, accuracy (in terms of content and timing), and originality in solving problems related to exergy flow and exergy rate balance for control volumes in thermodynamic applications</i>	Kriteria: <i>Criteria:</i> Rubrik <i>Rubric</i> Marking Scheme <i>Marking Scheme</i> Bentuk: <i>Model:</i> non-test (tugas) <i>Non-test (assignment)</i>	Bentuk: <i>Model:</i> kuliah & Diskusi, brainstorming <i>Teaching, learning & discussion, Brainstorming</i> Metode: <i>Method:</i> Ekspositori dan <i>discovery learning</i> <i>Expository & Discovery Learning</i> Penyelesaian latihan soal <i>Problem solving exercise</i> (TM: 2 x 50") (PT: 2 x 60") (BM: 2 x 60")	- Latihan soal & Homework di MyITS Classroom - <i>Exercise & homework in myITS Classroom</i> - Review & Summary PPT perkuliahan di MyITS Classroom - <i>Overview and Summary of Lecture Presentations on MyITS Classroom</i>	- Neraca exergy system tertutup - <i>Exergy balance for closed systems</i> - aliran exergy - <i>Exergy flow</i> - neraca laju exergy untuk volume atur - <i>Exergy rate balance for control volumes</i> - efisiensi exergetic - <i>Exergetic efficiency</i> Bab 7 [1] <i>Chapter 7 [1]</i> Handout di myITS Calssroom <i>Handout in myITS Classroom</i>	
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Examinations</i>						25%

Catatan :

Notes:



4. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
- Program Learning Outcomes (PLOs) are the competencies possessed by each graduate of the study program, which represent the internalization of attitudes and mastery of knowledge and skills according to the level of the program, acquired through the learning process*
52. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan. *PLOs assigned to a course refer to selected program learning outcomes that contribute to the development of the course. These outcomes encompass aspects of attitude, general skills, specific skills, and knowledge.*
53. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
- Course Learning Outcomes (CLOs) are specific abilities derived from the PLOs assigned to a course and are directly related to the subject matter or learning content of the course.*
54. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
- Sub-Course Learning Outcomes (Sub-CLOs) are more specific capabilities derived from the CLOs, measurable and observable, representing the final learning abilities expected at each stage of the learning process, and specific to the course content.*
55. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
- Assessment Indicators are specific and measurable statements that identify student learning abilities or performance, along with the evidence supporting them, used to assess both the process and outcomes of learning.*
56. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.



***Assessment Criteria** are the standards used to measure the achievement of learning outcomes, based on predetermined indicators. These criteria serve as a guide for evaluators to ensure consistent and unbiased assessment. Criteria may be quantitative or qualitative.*

57. **Bentuk penilaian:** tes dan non-tes.

***Form of Assessment:** tests and non-test assessments.*

58. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.

***Form of Learning:** Lectures, Response Sessions, Tutorials, Seminars (or equivalent), Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other equivalent forms of learning.*

59. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.

***Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-Based Learning, and other equivalent methods.*

60. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.

***Learning Materials** are detailed topics or descriptions of subject matter, which can be presented as main topics and subtopics.*

61. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.

***Assessment Weight** is the percentage assigned to the achievement of each Sub-CLO, proportionally reflecting the difficulty level of each Sub-CLO, with a total weight of 100%.*

62. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

TM = Face-to-Face, PT = Structured Assignments, BM = Independent Learning.



						RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM		Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER								
MATA KULIAH (MK)		KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
DINAMIKA PERMESINAN		TM234302	REKAYASA VIBRASI DAN SISTEM OTOMOTIF		T=3 P=0		3	20 November 2023
OTORISASI		Pengembang RPS		Koordinator RMK			Ketua PRODI	
		WIWIEK HENDROWATI		WIWIEK HENDROWATI			ATOK SETYAWAN	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK							
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika						
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan						
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik						
	Capaian Pembelajaran Mata Kuliah (CPMK)							
	CPMK-1	Mahasiswa mampu menggambar Free-Body Diagram dan menganalisa model matematik dari permasalahan kinematika : 1. Perpindahan dan kecepatan mekanisme 2. Percepatan mekanisme						
	CPMK-2	Mahasiswa mampu menganalisa model matematik dari permasalahan gaya statis dan gaya dinamis mekanisme						
	CPMK-3	Mahasiswa mampu menganalisa komponen-komponen kinematika dan dinamika permesinan untuk Balancing						
	CPMK-4	Mahasiswa mampu menganalisa komponen-komponen kinematika dan dinamika permesinan untuk Flywheel						



	CPMK-5	Mahasiswa mampu menganalisa komponen-komponen kinematika dan dinamika permesinan untuk Cam Follower				
		Matrik CPL – CPMK				
		CPMK	CPL-4	CPL-5	CPL-8	Bobot (%)
		CPMK-1	v		v	15
		CPMK-2	v		v	15
		CPMK-3	v	v	v	20
		CPMK-4	v	v	v	25
		CPMK-5	v	v	v	25
		Total Bobot (%)	40	20	40	100
Deskripsi Singkat MK	Konsep kinematika yang terdiri dari sistem koordinat gerak dan analisa posisi, kecepatan, percepatan untuk rigid body, fenomena gerak coriolis terjadi pada mekanisme yang dianalisa dengan menggunakan metode analitis. Jenis mekanisme yang lain dalam dinamika permesinan meliputi balancing, flywheel dan cam follower					
Bahan Kajian: Materi Pembelajaran	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: Konsep kinematika yang terdiri dari sistem koordinat gerak dan analisa posisi, kecepatan, percepatan untuk rigid body, fenomena gerak coriolis, komponen mekanisme dan degree of freedom mekanisme dengan menggunakan metode analitis. Konsep dinamika permesinan yang meliputi balancing, flywheel dan cam follower					
Pustaka	Utama :					
		1. David H. Myszka, Machines and Mechanism Applied Kinematic Analysis, 4th edition, Prentice Hall 2. A. R. Holowenko, Dinamika Permesinan, Penerbit Erlangga				
	Pendukung :					
		1. J. L. Meriam, L. G. Kraige, " Engineering Mechanics, Dynamics", 2nd Edition, John Wiley and Sons, Inc. 1987. 2. Ferdinand p. Beer, E. Russell Johnston Jr. "Vector Mechanics for Engineers, Dynamics", 9 th Edition, McGraw-Hill, 2010.				



Dosen Pengampu		Wiwiek Hendrowati, Moch. Solichin, Aida Annisa Amin Daman, I Nyoman Sutantra, Muh. Nur Yuniarto, Kafi Hanna Alhadi					
Matakuliah syarat		Kinematika Dinamika					
Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami dan menganalisa Konsep dasar Kinematika pada gerak mekanisme	Memahami permasalahan kinematika mekanisme	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah Pengantar & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Dokumen RPS di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Introduction Pengenalan Kinematika mekanisme [1] : Bab 1	
2	Mahasiswa mampu menentukan derajat kebebasan pada sebuah mekanisme	Mampu menghitung jumlah derajat kebebasan	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Diagram kinematika mekanisme Perhitungan derajat kebebasan (DOF) mekanisme [1]: Bab 1	
3	Mahasiswa mampu	Mampu menghitung dan menggambar perubahan	Kriteria: - Rubrik	- Kuliah & Brainstorming	- Review & Summary PPT	Prinsip vector	



	menentukan posisi dari semua link pada sebuah mekanisme	posisi masing-masing link pada mekanisme	- Marking Scheme Bentuk: non-test (tugas)	- Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	perkuliahan di MyITS Classroom	Analisa Posisi dan perpindahan dari mekanisme slider & four bar linkage [1]: Bab 4	
4	Mahasiswa mampu menghubungkan kecepatan linear dan kecepatan sudut dan mampu menggunakan metode kecepatan relative	Mampu menghitung dan menggambar kecepatan tiap titik pada mekanisme	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 1)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Analisa Kecepatan dari mekanisme slider & four bar linkage [1]: Bab 6	25
5 & 6	Mahasiswa mampu menggunakan metode percepatan relative dalam penyelesaian percepatan satu titik terhadap titik lain pada mekanisme slider-crank	Mampu menghitung dan menggambar diagram percepatan tiap titik pada mekanisme	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Analisa Percepatan dari mekanisme slider-crank [1]: Bab 7	
7	Mahasiswa mampu menganalisa percepatan pada mekanisme coriolis	Mampu menggambarkan diagram kecepatan dari bodi coriolis dan tepat menghitung nilai percepatan tiap titik pada mekanisme	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal - Video mekanisme dengan coriolis body	- Review & Summary PPT perkuliahan di MyITS Classroom	Kinematika Coriolis Body Diagram kecepatan mekanisme coriolis body [1]: Bab 7	



				TM: 3x50" PT: 3x60" BM: 3x60"			
8	Evaluasi Tengah Semester / Ujian Tengan Semester						25
9	Mahasiswa mampu menganalisa percepatan pada mekanisme coriolis	Mampu menggambarkan diagram percepatan dari bodi 777oriolis dan tepat menghitung nilai percepatan tiap titik pada mekanisme	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal - Video mekanisme dengan coriollis body TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Kinematika Coriolis Body Diagram percepatan mekanisme coriolis body [1]: Bab 7	
10	Mahasiswa mampu menggambarkan polygon gaya dan menganalisa gaya-gaya pada mekanisme kondisi statis	Mampu menggambar polygon gaya dan menganalisa gaya – gaya pada mekanisme pada kondisi statis	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Analisa gaya-gaya statis pada mekanisme slider & four bar linkage [2]: Bab 13	
11 & 12	Mahasiswa mampu menggambarkan polygon gaya dan menganalisa gaya-gaya pada mekanisme kondisi dinamis	Mampu menggambar polygon gaya dan menganalisa gaya – gaya pada mekanisme pada kondisi dinamis	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 2)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Analisa gaya-gaya dinamis pada mekanisme slider & four bar linkage [2]: Bab 14	25



13	Mahasiswa mampu menggunakan menganalisa dinamika massa-massa tidak seimbang	Mampu menganalisa dinamika massa tidak seimbang	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Analisa Dinamika Massa tidak seimbang [2]: Bab 7	
14	Mahasiswa mampu menganalisa dinamika flywheel	Mampu menganalisa dinamika Flywheel	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Analisa Dinamika Flywheel [2]: Bab 7	
15	Mahasiswa mampu menganalisa dinamika Cam Follower	Mampu menganalisa dinamika Cam Follower	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Review & Summary PPT perkuliahan di MyITS Classroom	Analisa Dinamika Cam Follower [2]: Bab 7	
16	Evaluasi Akhir Semester / Ujian Akhir Semester						25

Catatan :

17. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.



18. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
63. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
20. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
21. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
22. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
23. **Bentuk penilaian:** tes dan non-tes.
24. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
25. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
26. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
27. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
28. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING</i>				Kode Dokumen <i>Document Code</i>
RENCANA PEMBELAJARAN SEMESTER <i>SEMESTER LEARNING PLAN</i>						
MATA KULIAH (MK) <i>COURSE (Course)</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>LOAD (credits)</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date of Preparation</i>
GETARAN SISTEM MEKANIKAL <i>Vibration Of Mechanical Systems</i>	TM234710	REKAYASA VIBRASI DAN SISTEM OTOMOTIF <i>Vibration Engineering and Automotive Systems</i>	T=3	P=0	PILIHAN <i>Elective</i>	20 November 2023
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of the Undergraduate Program</i>	
	WIWIEK HENDROWATI		WIWIEK HENDROWATI		ATOK SETYAWAN	
Capaian Pembelajaran (CP) <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>					
	CPL-4 <i>PLO-4</i>	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>				



(LO)	CPL-5 <i>PLO-5</i>	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan <i>The ability to design mechanical components, systems and/or processes to meet expected needs with an engineering analytical approach based on the latest science & technology and considering technical standards, performance aspects, reliability, and convenience.</i>																						
	CPL-7 <i>PLO-7</i>	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika.																						
	CPL-8 <i>PLO-8</i>	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to apply modern methods, skills and technical tools required for the practice of mechanical systems.</i>																						
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>																							
	CPMK-1 <i>CLO-1</i>	Mampu menganalisa konsep getaran sistem dan karakteristiknya system getaran 2DOF beserta responnya <i>Able to analyze the concept of system vibration and its characteristics 2DOF vibration system and its response</i>																						
	CPMK-2 <i>CLO-2</i>	Mampu menganalisa getaran multi DOF beserta responnya dengan analisa Ortogonalitas dan Modal <i>Able to analyze multi DOF vibration and its response with Orthogonality and Modal analysis</i>																						
	CPMK-3 <i>CLO-3</i>	Mampu menganalisis getaran sistem kontinyu <i>Able to analyze continuous system vibration</i>																						
	CPMK-4 <i>CLO-4</i>	Mampu menganalisa sistem getaran diskrit (MDOF), getaran aksial pada batang <i>Able to analyze discrete vibration system (MDOF), axial vibration on bar</i>																						
	CPMK-5 <i>CLO-5</i>	Mampu menganalisa getaran pada struktur, truss dan beam <i>Able to analyze vibration on structure, truss and beam</i>																						
		Matrik CPL – CPMK <i>Matrix of PLO – CLO</i> <table><tr><th>CPMK <i>CLO</i></th><th>CPL-4 <i>PLO-4</i></th><th>CPL-5 <i>PLO-5</i></th><th>CPL-7 <i>PLO-7</i></th><th>CPL-8 <i>PLO-8</i></th><th>TOTAL <i>TOTAL</i></th></tr><tr><td>CPMK-1 <i>CLO-1</i></td><td>v</td><td>v</td><td></td><td>v</td><td>20%</td></tr><tr><td>CPMK-2 <i>CLO-2</i></td><td>v</td><td>v</td><td>v</td><td>v</td><td>20%</td></tr></table>					CPMK <i>CLO</i>	CPL-4 <i>PLO-4</i>	CPL-5 <i>PLO-5</i>	CPL-7 <i>PLO-7</i>	CPL-8 <i>PLO-8</i>	TOTAL <i>TOTAL</i>	CPMK-1 <i>CLO-1</i>	v	v		v	20%	CPMK-2 <i>CLO-2</i>	v	v	v	v	20%
CPMK <i>CLO</i>	CPL-4 <i>PLO-4</i>	CPL-5 <i>PLO-5</i>	CPL-7 <i>PLO-7</i>	CPL-8 <i>PLO-8</i>	TOTAL <i>TOTAL</i>																			
CPMK-1 <i>CLO-1</i>	v	v		v	20%																			
CPMK-2 <i>CLO-2</i>	v	v	v	v	20%																			



		CPMK-3 <i>CLO-3</i>	v	v	v	v	20%
		CPMK-4 <i>CLO-4</i>	v	v	v	v	20%
		CPMK-5 <i>CLO-5</i>	v	v	v	v	20%
		TOTAL <i>TOTAL</i>	26%	26%	21%	26%	100%
Deskripsi Singkat MK <i>Short Description of Course</i>	Mata kuliah ini mempelajari konsep getaran dan karakteristiknya pada sistem getaran 2DOF beserta responnya, getaran multi DOF, getaran sistem kontinyu, serta sistem getaran diskrit (MDOF), pada batang dan struktur <i>This course studies the concept of vibration and its characteristics in 2DOF vibration systems and their responses, multi DOF vibrations, continuous system vibrations, and discrete vibration systems (MDOF), in rods and structures</i> This course studies the concept of vibration and its characteristics in 2DOF vibration systems and their responses, multi DOF vibrations, continuous system vibrations, and discrete vibration systems (MDOF), in rods and structures <i>This course studies the concept of vibration and its characteristics in 2DOF vibration systems and their responses, multi DOF vibrations, continuous system vibrations, and discrete vibration systems (MDOF), in rods and structures</i>						
Bahan Kajian: Materi Pembelajaran <i>Course Material</i>	- Konsep getaran dan karakteristiknya pada sistem getaran 2DOF beserta responnya <i>Concept of vibration and its characteristics in 2DOF vibration system and its response</i> - Respon getaran multi DOF beserta responnya dengan analisa Ortogonalitas dan Modal <i>Multi DOF vibration response and its response with Orthogonality and Modal analysis</i> - Respon getaran sistem kontinyu. <i>Vibration response of continuous systems.</i> - Respon getaran sistem diskrit (MDOF), getaran aksial pada batang <i>Vibration response of discrete systems (MDOF), axial vibration of rods</i> - Respon getaran pada struktur, truss dan beam <i>Vibration response of structures, truss and beams</i>						
Pustaka <i>References</i>	Utama :	1. Rao, Singiresu S., “Mechanical Vibrations”, 5 th Edition, Prentice Hall, 2013.					



		Pendukung : 1. Kelly, S. Graham, “Mechanical Vibrations: Theory and Applications”, SI Edition, Cengage Learning, 2011. 2. Inman, D. J. “Engineering Vibration”, 3 rd Edition, Pearson Prentice Hall, 2008.					
Dosen Pengampu <i>Lecturer</i>		Wiwiek Hendrowati					
Matakuliah syarat <i>Prerequisite course</i>		Mekanika Getaran <i>Mechanics Of Vibration</i>					
Mg Ke- <i>Week</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] <i>Learning Model, Learning Method, Student Assignment, [Time Estimate]</i>		Materi Pembelajaran <i>Course Material</i> [Pustaka] <i>[Reference]</i>	Bobot Penilaian (%) <i>Assesment Load</i>
		Indikator <i>Indicators</i>	Kriteria & Bentuk <i>Criteria and Model</i>	Luring <i>offline</i>	Daring <i>online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menganalisa konsep getaran sistem dan karakteristiknya.	Mampu dan terampil menyelesaikan permasalahan getaran sistem dan karakteristiknya	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i>	- Kuliah & Brainstorming - Latihan soal - Video Jembatan Tacoma Runtuh karena getaran angin	- Dokumen RPS di MyITS Classroom Review & Summary PPT perkuliahan di MyITS Classroom	Pengenalan Kontrak kuliah – Pengenalan Getaran Sistem Mekanikal – Review Getaran Mekanik : SDOF, frekuensi natural dan pembebanan eksitasi	



	<i>Students are able to analyze the concept of system vibration and its characteristics.</i>	<i>Able and skillful in solving system vibration problems and their characteristics</i>	- Rubric - Marking Scheme Model: non-test (assignment)	- Lecture & Brainstorming - Practice questions - Video Tacoma Bridge Collapses due to wind vibrations TM: 3x50" PT: 3x60" BM: 3x60"	- Video Jembatan Tacoma Runtuh karena getaran angin - Kuliah Pengantar & Brainstorming - RPS Document in MyITS Classroom - Review & Summary PPT lecture in MyITS Classroom - Video of Tacoma Bridge Collapses due to Wind Vibrations - Introductory Lecture & Brainstorming	Prosedur analisa getaran [1: Rao Bab 5] <i>Introduction to Course Contract</i> – Introduction to Vibration of Mechanical Systems – Mechanical Vibration Review: SDOF, natural frequency and excitation loading - Vibration analysis procedure [1: Rao Chapter 5]	
2 &3	Mahasiswa mampu menganalisa getaran sistem 2DOF beserta responnya <i>Students are able to analyze 2DOF system vibrations and their responses</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem 2DOF beserta responnya <i>Able and skilled in solving 2DOF system vibration problems and their responses</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) Criteria: - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>Lecture & Brainstorming</i> <i>- Practice problems</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Analisa Sistem Diskrit – Sistem dengan 2DOF – Analisa fundamental Respon Getaran – Analisa dynamic vibration absorber [1: Rao Bab 5] <i>Discrete System Analysis</i> – Systems with 2DOF – Fundamental Analysis of Vibration Response – Analysis of dynamic vibration absorber	



						[1: Rao Chapter 5]	
4&5	Mahasiswa mampu menganalisa getaran sistem multi DOF beserta responnya <i>Students are able to analyze multi DOF system vibrations and their responses</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem multi DOF beserta responnya <i>Able and skilled in solving multi DOF system vibration problems and their responses</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 1) Criteria: - Rubric - Marking Scheme Model: test (test document, Quiz 1)	- Kuliah & Brainstorming - Latihan soal <i>Lecture & Brainstorming</i> - Practice problems TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem dengan multi-DOF Analisa fundamental Respon Getaran [1: Rao Bab 6] <i>Systems with multi-DOF Fundamental analysis of response Vibration</i> [1: Rao Chapter 6]	25%
6&7	Mahasiswa mampu menganalisa sistem getaran sistem multi DOF dengan analisa Ortogonalitas dan Moda <i>Students are able to analyze multi DOF system vibration systems with Orthogonality and Modal analysis</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem multi DOF dengan analisa Ortogonalitas dan Modal <i>Able and skilled in solving multi DOF system vibration problems with Orthogonality and Modal analysis</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) Criteria: - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>Lecture & Brainstorming</i> - Practice problems TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Analisa dan penyelesaian - Ortogonalitas - Analisa modal [1: Rao Bab 6] <i>Analysis and solution</i> - Orthogonality - Modal analysis [1: Rao Chapter 6]	



8	Evaluasi Tengah Semester / Ujian Tengan Semester <i>Mid Semester Evaluation / Mid Semester Exam</i>						25%
9 -10	Mahasiswa mampu menganalisa sistem Kontinyu <i>Students are able to analyze continuous systems</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem kontinyu <i>Able and skilled in solving continuous system vibration problems</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) Criteria: - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>Lecture & Brainstorming - Practice problems</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Analisa Sistem Kontinyu – Getaran transversal pada tali dan kabel – Getaran lateral pada batang – Getaran longitudinal pada batang [1: Rao Bab 8] <i>Analysis of Continuous Systems</i> – Transverse vibrations in ropes and cables – Lateral vibrations in rods – Longitudinal vibrations in rods <i>[1: Rao Chapter 8]</i>	-
11&12	Mahasiswa mampu menganalisa getaran aksial pada batang <i>Students are able to analyze axial vibration of the rod.</i>	Mampu dan terampil menyelesaikan permasalahan getaran aksial pada batang <i>Able and skillful in solving axial vibration problems in rods</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 2) Criteria: - Rubric - Marking Scheme Model: test (test document, Quiz 1)	- Kuliah & Brainstorming - Latihan soal <i>Lecture & Brainstorming - Practice problems</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem Kontinyu di Diskritisasi - Getaran aksial pada batang [1: Rao Bab 8] <i>Continuous Systems in Discretization</i> - Axial vibrations in rods <i>[1: Rao Chapter 8]</i>	25%



13&14	Mahasiswa mampu menganalisa getaran pada struktur <i>Students are able to analyze vibrations in structures</i>	Mampu dan terampil menyelesaikan permasalahan getaran pada struktur truss <i>Able and skilled in solving vibration problems in truss structures</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>Lecture & Brainstorming</i> <i>- Practice problems</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Getaran Struktur - Analisa getaran pada trus [1: Rao Bab 12] <i>Vibration of Structures</i> - Vibration analysis of trus <i>[1: Rao Chapter 12]</i>	
15	Mahasiswa mampu menganalisa getaran pada struktur <i>Students are able to analyze vibrations in structures</i>	Mampu dan terampil menyelesaikan permasalahan getaran pada struktur beam <i>Able and skilled in solving vibration problems in beam structures</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>Lecture & Brainstorming</i> <i>- Practice problems</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Getaran Struktur - Analisa getaran pada beam [1: Rao Bab 12] <i>Vibration of Structures</i> - Vibration analysis of beams <i>[1: Rao Chapter 12]</i>	
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Semester Evaluation / Final Semester Exam</i>						25%

Catatan :

18. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.



19. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
64. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
21. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
22. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
23. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
24. **Bentuk penilaian:** tes dan non-tes.
25. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
26. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
27. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
28. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
29. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM				Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER						
MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
KINEMATIKA DINAMIKA TEKNIK	TM234202	REKAYASA VIBRASI DAN SISTEM OTOMOTIF	T=3	P=0	2	20 November 2023
OTORISASI	Pengembang RPS		Koordinator RMK		Ketua PRODI	
	WIWIEK HENDROWATI		WIWIEK HENDROWATI		ATOK SETYAWAN	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika				
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan				
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik				
	Capaian Pembelajaran Mata Kuliah (CPMK)					
	CPMK-1	Mahasiswa mampu menggambar Free-Body Diagram dan menganalisa model matematik dari permasalahan kinematika dan dinamika (gaya, kerja dan energi, impuls dan momentum) partikel				
	CPMK-2	Mahasiswa mampu menggambar Free-Body Diagram dan menganalisa model matematik dari permasalahan kinematika rigid body untuk 2D				
	CPMK-3	Mahasiswa mampu menggambar Free-Body Diagram dan menganalisa model matematik dari permasalahan dinamika (gaya, kerja dan energi, impuls dan momentum) rigid body untuk 2D				



	CPMK-4	Mahasiswa mampu menggambar Free-Body Diagram dan menganalisa model matematik dari permasalahan kinematika dan dinamika (gaya, kerja dan energi, impuls dan momentum) rigid body untuk 3D				
		Matrik CPL – CPMK				
		CPMK	CPL-4	CPL-5	CPL-8	TOTAL
		CPMK-1	v	v	v	25%
		CPMK-2	v	v	v	25%
		CPMK-3	v	v	v	25%
		CPMK-4	v	v	v	25%
		TOTAL	30%	30%	40%	100%
Deskripsi Singkat MK	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: Konsep kinematika yang terdiri dari sistem koordinat gerak dan analisa posisi, kecepatan, percepatan untuk partikel dan benda kaku, 2D dan 3D Konsep dinamika yang meliputi persamaan gerak untuk partikel dan benda kaku dengan menggunakan hukum Newton, prinsip kerja dan energi, prinsip impuls dan momentum, tumbukan untuk 2D dan 3D					
Bahan Kajian: Materi Pembelajaran	Kinematika pada gerak partikel Prinsip Newton II pada gerak Rectilinear, curvilinear dan gerak dependen pada partikel Prinsip kerja dan energi pada partikel Prinsip impuls dan momentum pada partikel Prinsip kinematika pada rigid body untuk 2D Prinsip hukum newton pada rigid body untuk 2D Prinsip kerja dan energi pada rigid body untuk 2D Prinsip impulse dan momentum pada rigid body untuk 2D Prinsip kinematika pada rigid body untuk 3D Prinsip kinetika, Newton pada rigid body untuk 3D					



Prinsip kinetika, kerja dan energi pada rigid body untuk 3D							
Pustaka	Utama :						
	3. R. C. Hibbeler, "Engineering Mechanics: Dynamics", 13 th Edition, Prentice Hall Inc. 1997						
	Pendukung :						
	4. J. L. Meriam, L. G. Kraige, " Engineering Mechanics, Dynamics", 2nd Edition, John Wiley and Sons, Inc. 1987. 5. Ferdinand p. Beer, E. Russell Johnston Jr. "Vector Mechanics for Engineers, Dynamics", 9 th Edition, McGraw-Hill, 2010.						
Dosen Pengampu		Wiwiek Hendrowati, Moch. Solichin, Aida Annisa Amin Daman, I Nyoman Sutantra, Muh. Nur Yuniarto, Kafi Hannan Alhadi					
Matakuliah syarat		Fisika Statika Minimal D					
Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
(1)	(2)	Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)	(7)	(8)
1	Mahasiswa mampu memahami dan menganalisa Konsep dasar Kinematika pada gerak partikel	Mampu menyelesaikan permasalahan kinematika partikel sesuai dengan lintasan Mampu membedakan & menganalisa gerakan partikel	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	- Dokumen RPS di MyITS Classroom Review & Summary PPT perkuliahan di MyITS Classroom	Introduction Partikel 2D - Review Kinematika partikel 2D - Contoh kinematika partikel Rectilinear dan curvilinear motion [1] : Bab 12	
2	Mahasiswa mampu menganalisa Prinsip Newton II pada gerak Rectilinear, curvilinear, dan gerak dependen pada partikel	Mampu dan terampil menyelesaikan permasalahan dinamika teknik dengan menggunakan	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Newton II, Partikel 2D : - Kinetika partikel untuk gerak dependen - Hukum Newton II, kinetika gaya dan percepatan [1] : Bab 13	



		prinsip Newton pada gerak partikel		BM: 3x60"			
3	Mahasiswa mampu menganalisa prinsip kerja dan energi pada partikel	Mampu dan terampil menyelesaikan permasalahan dinamika teknik dengan menggunakan prinsip kerja energi pada gerak partikel	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Kerja dan Energi, Partikel 2D : - Kerja oleh gaya luar, gaya berat, gaya pegas dan gaya gesek - Energi kinetik pada gerak translasi dan gerak rotasi - Konsep gaya konservatif dan non konservatif - Energi potensial gravitasi dan pegas	
4	Mahasiswa mampu menganalisa prinsip impuls dan momentum pada partikel	Mampu dan terampil menyelesaikan permasalahan dinamika teknik dengan menggunakan prinsip Impuls momentum pada partikel	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 1)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Impuls Momentum, Partikel 2D - Prinsip impuls dan momentum untuk gerak translasi - Prinsip konservasi momentum - Tumbukan partikel sejaris (central impact) - Tumbukan partikel membentuk sudut (oblique impact) [1] : Bab 15	25 %
5	Mahasiswa mampu menganalisa dan menggunakan prinsip kinematika pada rigid body untuk 2D	Mampu dan terampil menyelesaikan permasalahan kinematika rigid body sesuai dengan lintasan	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	- Introduction, Rigid Body 2D - Kinematika Rigid Body 2D, Gerak translasi, rotasi dan gerak umum - Contoh kinematika Rigid body 2D [1] : Bab 12	



6 & 7	Mahasiswa mampu menganalisa dan menggunakan prinsip hukum newton pada rigid body untuk 2D	Mampu dan trampil menyelesaikan permasalahan kinematika rigid body sesuai dengan lintasan	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Newton II, Rigid Body 2D: - Konsep inersia pada benda kaku - Kinetika benda kaku : Gerak translasi, rotasi dan gerak general [1] : Bab 17	
8	Evaluasi Tengah Semester / Ujian Tengan Semester						25%
9 & 10	Mahasiswa mampu menganalisa prinsip kerja dan energi pada rigid body untuk 2D	Mampu dan terampil menyelesaikan permasalahan dinamika dengan menggunakan prinsip kerja dan energy pada benda kaku	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Kerja dan energy, Rigid Body 2D - Kerja oleh momen kopel - Energi kinetik pada gerak translasi, gerak rotasi dan gerak general - Hukum kekekalan energi benda kaku [1] : Bab 18	-
11	Mahasiswa mampu menganalisa prinsip impulse dan momentum pada rigid body untuk 2D	Mampu dan terampil menyelesaikan permasalahan dinamika dengan menggunakan prinsip impuls dan momentum pada rigid body	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Impuls Momentum, Rigid Body 2D - Linear dan angular momentum - Prinsip impuls dan momentum untuk gerak translasi, rotasi, dan umum - Konservasi momentum [1] : Bab 19	-
12	Mahasiswa mampu menganalisa kinematika rigid body untuk 3D	Mampu dan trampil menyelesaikan permasalahan kinematika rigid body 3D	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Introduction, Rigid Body 3D - Review Kinematika Rigid Body 3D - Contoh kinematika Rigid Body 3D [1] : Bab 20	



				BM: 3x60"			
13	Mahasiswa mampu menganalisa kinematika pada rigid body untuk 3D	Mampu dan trampil menyelesaikan permasalahan kinematika rigid body 3D	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 2)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	- Kinematika Rigid Body 3D - Contoh kinematika rigid body 3D Rectilinear dan curvilinear motion [1] : Bab 20	25%
14	Mahasiswa mampu menganalisa kinetika rigid body 3D	Mampu dan terampil menyelesaikan permasalahan dinamika Rigid Body 3D	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Newton II, Rigid Body 3D Gaya dan percepatan pada benda kaku 3D [1] : Bab 20	-
15	Mahasiswa mampu menganalisa prinsip kerja dan energi pada rigid body untuk 3D	Mampu dan terampil menyelesaikan permasalahan dinamika dengan menggunakan prinsip kerja dan energy 3D untuk gerak gyroskopik	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas)	- Kuliah & Brainstorming - Latihan soal TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom	Prinsip Kerja dan energy, Rigid Body 3D - Energi kinetik pada benda kaku 3D - Gerak Gyroskopik [1] : Bab 20	-
16	Evaluasi Akhir Semester / Ujian Akhir Semester						25%

Catatan :

19. Capaian Pembelajaran Lulusan PRODI (CPL-PRODI) adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.



20. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
65. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
22. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
23. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
24. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
25. **Bentuk penilaian:** tes dan non-tes.
26. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
27. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
28. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
29. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
30. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM <i>SEMESTER LEARNING PLAN</i> <i>BACHELOR STUDY PROGRAM DEPARTMENT OF MECHANICAL ENGINEERING</i> <i>FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING</i>				Kode Dokumen <i>Document Code</i>
RENCANA PEMBELAJARAN SEMESTER <i>SEMESTER LEARNING PLAN</i>						
MATA KULIAH (MK) <i>COURSE (Course)</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>LOAD (credits)</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date of Preparation</i>
MEKANIKA GETARAN <i>Mechanics Of Vibration</i>	TM234507	REKAYASA VIBRASI DAN SISTEM OTOMOTIF <i>Vibration Engineering and Automotive Systems</i>	T=3	P=0	5	20 November 2023
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of the Undergraduate Program</i>	
	WIWIEK HENDROWATI		WIWIEK HENDROWATI		ATOK SETYAWAN	
Capaian Pembelajaran (CP) <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>					
	CPL-4 <i>PLO-4</i>	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>				



(LO)	CPL-5 <i>PLO-5</i>	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan <i>Ability to design mechanical components, systems and/or processes to meet expected needs with an analytical engineering approach based on cutting-edge science & technology and considering technical standards, performance aspects, reliability, and ease</i>				
	CPL-8 <i>PLO-8</i>	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze and solve engineering problems</i>				
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO)</i>					
	CPMK-1 <i>CLO-1</i>	Mahasiswa mampu menjelaskan konsep dasar getaran, membuat free body diagram dan memodelkan matematik sistem getaran <i>Students can explain the basic concept of vibration, create free body diagrams and mathematically model vibration systems</i>				
	CPMK-2 <i>CLO-2</i>	Mahasiswa mampu merumuskan persamaan gerak dan menganalisa respon getaran bebas pada sistem getaran yang tidak teredam dan teredam <i>Students can formulate equations of motion and analyze the response of free vibrations in undamped and damped vibration systems</i>				
	CPMK-3 <i>CLO-3</i>	Mahasiswa mampu merumuskan persamaan gerak dan menganalisa respon getaran paksa/ gaya eksitasi pada system getaran yang tidak teredam dan teredam <i>Students can formulate equations of motion and analyze the response of forced vibrations/excitation forces in undamped and damped vibration systems</i>				
	CPMK-4 <i>CLO-4</i>	Mahasiswa mampu menganalisa respon getaran akibat bentuk gaya eksitasi yang general dan sistem getaran 2 dof <i>Students can analyze the vibration response due to general forms of excitation forces and 2 dof vibration systems</i>				
		Matrik CPL – CPMK <i>Matrix of PLO – CLO</i>				
		CPMK <i>CLO</i>	CPL-4 <i>PLO-4</i>	CPL-5 <i>PLO-5</i>	CPL-8 <i>PLO-8</i>	TOTAL <i>TOTAL</i>
		CPMK-1 <i>CLO-1</i>	v	v	v	25%
		CPMK-2 <i>CLO-2</i>	v	v	v	25%
		CPMK-3 <i>CLO-3</i>	v	v	v	25%



		CPMK-4 CLO-4	v	v	v	25%
		TOTAL TOTAL	30%	40%	30%	100%
Deskripsi Singkat MK <i>Short Description of Course</i>	Mata kuliah ini mempelajari konsep getaran mekanik, pengertian derajat kebebasan, persamaan gerak. Selanjutnya menganalisa respon getaran bebas pada sistem getaran tanpa redaman dan dengan redaman, Demikian juga respon getaran paksa pada sistem getaran tanpa redaman dan dengan redaman, base motion, transmissibility, ketidakseimbangan rotasi. Analisa juga dilakukan pada gaya eksitasi harmonik, impuls, eksitasi periodik. Mata kuliah ini juga mempelajari respon getaran pada sistem getaran 2DoF <i>This course studies the concept of mechanical vibration, the definition of degrees of freedom, equations of motion. Furthermore, analyzing the response of free vibration systems without damping and with damping, as well as the response of forced vibrations on vibration systems without damping and with damping, base motion, transmissibility, rotational imbalance. Analysis is also carried out on harmonic excitation forces, impulses, periodic excitations. This course also studies the vibration response on 2DoF vibration systems</i>					
Bahan Kajian: Materi Pembelajaran <i>Course Material</i>	- Konsep getaran mekanik, pengertian derajat kebebasan, persamaan gerak, <i>The concept of mechanical vibration, understanding degrees of freedom, equations of motion</i> - Respon getaran bebas pada sistem getaran tanpa redaman dan dengan redaman <i>Free vibration response in vibration systems without damping and with damping</i> - Respon getaran paksa pada sistem getaran tanpa redaman dan dengan redaman, <i>Forced vibration response in vibration systems without damping and with damping</i> - Base motion, transmissibility, ketidakseimbangan rotasi, <i>Base motion, transmissibility, rotational imbalance</i> - Eksitasi harmonik, Impuls, Eksitasi Periodik. <i>Harmonic excitation, Impulse, Periodic Excitation</i> - Respon getaran pada sistem getaran 2DoF <i>Vibration response in 2DoF vibration systems</i>					
Pustaka <i>References</i>	Utama :					
	1. Rao, Singiresu S., “Mechanical Vibrations”, 5 th Edition, Prentice Hall, 2013.					
	Pendukung :					
	3. Kelly, S. Graham, “Mechanical Vibrations: Theory and Applications”, SI Edition, Cengage Learning, 2011. 4. Inman, D. J. “Engineering Vibration”, 3 rd Edition, Pearson Prentice Hall, 2008.					



Dosen Pengampu <i>Lecturer</i>		Wiwiek Hendrowati, Moch. Solichin, Aida Annisa Amin Daman, Harus Laksana Guntur, Muh. Nur Yuniarto, Kafi Hannan Alhadi					
Matakuliah syarat <i>Prerequisite course</i>		Kinematika dan Dinamika Teknik (minimal D) <i>Engineering Kinematics and Dynamics (minimum D)</i>					
Mg Ke- <i>Week</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Indikator <i>Indicators</i>		Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] <i>Learning Form, Learning Method, Student Assignment, [Time Estimate]</i>		Materi Pembelajaran <i>Course Material</i> [Pustaka] <i>[Reference]</i>	Bobot Penilaian (%) <i>Assesment Load</i>
		Indikator <i>Indicators</i>	Kriteria & Bentuk <i>Criteria and Model</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menganalisa konsep getaran dan karakteristiknya. <i>Students can analyze the concept of vibration and its characteristics</i>	Mampu dan terampil menyelesaikan permasalahan permasalahan getaran dan karakteristiknya <i>Able and skilled in solving vibration problems and their characteristics</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal - Video Jembatan Tacoma Runtuh karena getaran angin - Lecture & Brainstorming - Practice questions	- Dokumen RPS di MyITS Classroom Review & Summary PPT perkuliahan di MyITS Classroom - Video Jembatan Tacoma Runtuh karena getaran angin	Pengenalan Kontrak kuliah – Pengenalan mekanika getaran – Konsep getaran – Klasifikasi getaran – Prosedur analisa getaran – Elemen spring <i>Introduction</i>	



				- Video Tacoma Bridge Collapses due to wind vibrations TM: 3x50" PT: 3x60" BM: 3x60"	- Kuliah Pengantar & Brainstorming - RPS Document in MyITS Classroom Review & Summary PPT lecture in MyITS Classroom - Video of Tacoma Bridge Collapses due to Wind Vibrations - Introductory Lecture & Brainstorming	Course contract - Introduction to vibration mechanics - Concept of vibration - Classification of vibration - Vibration analysis procedure - Spring elements [1: Rao Bab 1] [1: Rao Chapter 1]	
2	Mahasiswa mampu menganalisa setiap elemen pada getaran beserta dof-nya, mampu membuat free body diagram beserta persamaan gerakanya dengan menggunakan hukum Newton <i>Students can analyze each element in vibration along with its DOF, and are able to create a free body diagram along with</i>	Mampu dan terampil menyelesaikan permasalahan getaran pada setiap elemen dan dof-nya, mampu dan terampil menyusun sistem resultan gaya dan menyelesaikan permasalahan free body diagram beserta persamaan gerakanya dengan menggunakan hukum Newton <i>Able and skilled in solving vibration problems on each element and its DOF, able and skilled in compiling</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme <i>Model non-test (assignment)</i>	- Kuliah & Brainstorming - Latihan soal - Lecture & Brainstorming - Practice questions TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	- Elemen massa dan inersia, damping - Derajat Kebebasan Sistem - Membuat free body diagram - Persamaan gerak sistem dengan menggunakan hukum newton - Mass and inertia elements, damping - Degrees of Freedom of the System - Making a free body diagram - Equations of motion of the system using Newton's laws	



	<i>its motion equations using Newton's laws</i>	<i>resultant force systems and solving free body diagram problems and their motion equations using Newton's laws.</i>				[1: Rao Bab 1] [1: Rao Chapter 1]	
3	Mahasiswa mampu menganalisa sistem getaran bebas SDOF tidak teredam <i>Students can analyze the undamped SDOF free vibration system</i>	Mampu menjelaskan dengan tepat bermacam tipe struktur. <i>Able to explain various types of structures accurately.</i> Mampu menganalisa dan menyelesaikan permasalahan SDOF tidak teredam <i>Able to analyze and solve undamped SDOF problems</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme <i>Model: non-test (assignment)</i>	- Kuliah & Brainstorming - Latihan soal <i>- Lecture & Brainstorming</i> <i>- Practice questions</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Gerak Harmonik Sistem getaran bebas SDOF tidak teredam Analisa dan penyelesaian <i>Harmonic Motion Undamped SDOF free vibration system Analysis and solution</i> [1: Rao Bab 2] [1: Rao Chapter 2]	
4-6	Mahasiswa mampu menganalisa sistem getaran bebas SDOF teredam <i>Students can analyze the damped SDOF free vibration system</i>	Mampu dan terampil menganalisa dan menyelesaikan permasalahan sistem getaran SDOF teredam <i>Able and skilled in analyzing and solving damped SDOF vibration system problems</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 1) <i>Criteria:</i> - Rubric - Marking Scheme <i>Model: test (test document, Quiz 1)</i>	- Kuliah & Brainstorming - Latihan soal <i>- Lecture & Brainstorming</i> <i>- Practice questions</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem getaran bebas SDOF teredam – Getaran bebas dengan redaman viskos : analisa dan penyelesaian – Konstanta redaman kritis dan faktor peredam – Gerak over damped, under damped dan critical damped – Penurunan logaritmik – Getaran bebas dengan redaman coulomb : analisa dan penyelesaian	25 %



						<i>Damped SDOF free vibration system</i> - <i>Free vibration with viscous damping: analysis and solution</i> - <i>Critical damping constant and damping factor</i> - <i>Over damped, under damped and critical damped motion</i> - <i>Logarithmic derivation</i> - <i>Free vibration with coulomb damping: analysis and solution</i> [1: Rao Bab 2] [1: Rao Chapter 2]	
7	Mahasiswa mampu menganalisa dan membandingkan sistem getaran paksa harmonik SDOF <i>Students can analyze and compare SDOF harmonic forced vibration systems.</i>	Mampu menganalisa , membandingkan dan menyelesaikan permasalahan getaran paksa harmonik SDOF <i>Able to analyze, compare and solve SDOF harmonic forced vibration problems.</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>- Lecture & Brainstorming</i> <i>- Practice questions</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem getaran paksa harmonik SDOF - Getaran paksa tak teredam - Getaran paksa teredam <i>Harmonic forced vibration system SDOF</i> - <i>Undamped forced vibration</i> - <i>Damped forced vibration</i> [1: Rao Bab 3] [1: Rao Chapter 3]	



8	Evaluasi Tengah Semester / Ujian Tengah Semester <i>Mid Semester Evaluation / Mid Semester Exam</i>						25%	
9 -10	Mahasiswa mampu menganalisa ketidakseimbangan rotasi dan memahami transmisi gaya <i>Students are able to analyze rotational imbalance and understand force transmission.</i>	Mampu menyusun persamaan gerak dan mampu menganalisa respon ketidakseimbangan rotasi <i>Able to compile motion equations and are able to analyze rotational imbalance responses.</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>- Lecture & Brainstorming - Practice questions</i> TM: 3x50” PT: 3x60” BM: 3x60”	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem getaran paksa harmonik SDOF - Respon terhadap eksitasi harmonis - Ketidakseimbangan rotasi - Transmisi gaya dan isolasi - Gerak landasan <i>Harmonic forced vibration system SDOF</i> - Response to harmonic excitation - Rotational unbalance - Force transmission and isolation - Anvil motion [1: Rao Bab 3] <i>[1: Rao Chapter 3]</i>	-	
11	Mahasiswa mampu menganalisa sistem getaran paksa periodik <i>Students are able to analyze periodic forced vibration systems.</i>	Mampu menganalisa dan menyelesaikan permasalahan sistem getaran paksa periodik <i>Able to analyze and solve problems with periodic forced vibration systems.</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>- Lecture & Brainstorming - Practice questions</i> TM: 3x50”	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem getaran paksa periodik - Deret fourier dan analisa respon <i>Periodic forced vibration system</i> - Fourier series and response analysis	-	



				PT: 3x60" BM: 3x60"		[1:Rao Bab 3] <i>[1: Rao Chapter 3]</i>	
12	Mahasiswa mampu menganalisa Sistem getaran paksa general <i>Students are able to analyze general forced vibration systems.</i>	Mampu menganalisa Sistem getaran paksa general <i>Able to analyze general forced vibration systemsvibration systems.</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal - Lecture & Brainstorming - Practice questions TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem getaran paksa general Integral Duhamel dan analisa respon <i>General forced vibration system Duhamel integral and response analysis</i> [1: Rao Bab 4] <i>[1: Rao Chapter 4]</i>	
13	Mahasiswa mampu menganalisa dan menunjukkan Sistem getaran paksa dengan pembebanan khusus <i>Students are able to analyze and demonstrate forced vibration systems with special loading.</i>	Mampu menganalisa dan menunjukkan Sistem getaran paksa dengan pembebanan khusus <i>Able to analyze and demonstrate forced vibration systems with special loading</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: test (dokumen tes, Quiz 2) <i>Criteria:</i> - Rubric - Marking Scheme Model: test (test document, Quiz 2)	- Kuliah & Brainstorming - Latihan soal - Lecture & Brainstorming - Practice questions TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem getaran paksa dengan pembebanan khusus - Step function - Ramp function - Impuls function - Analisa respon <i>Forced vibration system with special loading</i> - Step function - Ramp function - Impulse function - Response analysis [1: Rao Bab 4] <i>[1: Rao Chapter 4]</i>	25%



14-15	Mahasiswa mampu menunjukkan dan menganalisa Sistem getaran bebas MDOF tidak teredam <i>Students are able to demonstrate and analyze the undamped MDOF free vibration system</i>	Mampu menganalisa dan menunjukkan Sistem getaran bebas MDOF tidak teredam <i>Able to analyze and demonstrate the undamped MDOF free vibration system</i>	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (tugas) <i>Criteria:</i> - Rubric - Marking Scheme Model: non-test (assignment)	- Kuliah & Brainstorming - Latihan soal <i>- Lecture & Brainstorming</i> <i>- Practice questions</i> TM: 3x50" PT: 3x60" BM: 3x60"	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of PPT lectures in MyITS Classroom</i>	Sistem getaran bebas MDOF tidak teredam - Persamaan gerak - Analisa eigenvalue dan eigenvector <i>Undamped MDOF free vibration system</i> - <i>Equations of motion</i> - <i>Eigenvalue and eigenvector analysis</i> [1:Rao Bab 5,6] <i>[1: Rao Chapter 5,6]</i>	-
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Semester Evaluation / Final Semester Exam</i>						25%

Catatan :

20. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
21. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
66. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
23. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.



24. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
25. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
26. **Bentuk penilaian:** tes dan non-tes.
27. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
28. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
29. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
30. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
31. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen
	RENCANA PEMBELAJARAN SEMESTER					
MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)		SEME STER	Tgl Penyusunan
CAPSTONE # 1	TM234503	REKAYASA VIBRASI DAN SISTEM OTOMOTIF	T=2	P=0	5	22 November 2023
OTORISASI		Pengembang RPS	Koordinator RMK		Ketua PRODI	
		MOCH. SOLICHIN	MOCH. SOLICHIN		ATOK SETYAWAN	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK					
	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif.				
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan				



		masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi.																											
CPL-4		Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika.																											
CPL-5		Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan.																											
CPL-7		Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika.																											
CPL-8		Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik.																											
CPL-9		Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi.																											
Capaian Pembelajaran Mata Kuliah (CPMK)																													
CPMK-1		Mahasiswa mampu mendeskripsikan prinsip kerja dan spesifikasi mekanisme atau struktur mesin yang dirancang																											
CPMK-2		Mahasiswa mampu merancang mesin, menemukan geometri, memilih material dan proses permesinan/pembuatan, dan menganalisa kekuatan komponen mesin lalu mereka mampu menyampaikan dengan jelas																											
CPMK-3		Mahasiswa mampu membuat gambar 3D assembly, gambar teknik seluruh komponen, dan FEA komponen kritis																											
CPMK-4		Mahasiswa mampu membuat shop drawing dan general assembly serta menyusun laporan perancangan mesin dan menyampaikan dalam presentasi secara berkelompok.																											
		Matrik CPL – CPMK																											
		<table><tr><th>CPMK</th><th>CPL-2</th><th>CPL-3</th><th>CPL-4</th><th>CPL-5</th><th>CPL-7</th><th>CPL-8</th><th>CPL-9</th><th>Bobot (%)</th></tr><tr><td>CPMK-1</td><td>v</td><td>v</td><td>v</td><td></td><td></td><td></td><td></td><td>25</td></tr><tr><td>CPMK-2</td><td>v</td><td></td><td>v</td><td>v</td><td>v</td><td></td><td></td><td>25</td></tr></table>	CPMK	CPL-2	CPL-3	CPL-4	CPL-5	CPL-7	CPL-8	CPL-9	Bobot (%)	CPMK-1	v	v	v					25	CPMK-2	v		v	v	v			25
CPMK	CPL-2	CPL-3	CPL-4	CPL-5	CPL-7	CPL-8	CPL-9	Bobot (%)																					
CPMK-1	v	v	v					25																					
CPMK-2	v		v	v	v			25																					



		CPMK-3	v	v	v	v	v	v		25
		CPMK-4	v	v	v		v	v	v	25
		Total Bobot (%)	21	16	21	11	16	11	5	100
Deskripsi Singkat MK	Mata kuliah ini mempelajari gambar teknik dari hasil perancangan secara detail 2D, proses manufaktur, perakitan komponen, mempresentasikan prototipe hasil perancangan, memahami seluruh materi dasar dari Teknik Mesin secara komprehensif serta menyusun dan mempresentasikan laporan.									
Bahan Kajian: Materi Pembelajaran	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Metode perancangan suatu mekanisme atau elemen mesin - Cara menganalisa kekuatan komponen suatu mekanisme atau elemen mesin - Cara menggambar mekanisme atau elemen mesin - Cara menyusun laporan hasil perancangan mekanisme atau elemen mesin - Cara presentasi laporan hasil perancangan mekanisme atau elemen mesin									
Pustaka	Utama :									
	1. Bahram Nassersharif, “Engineering Capstone Design”, 1 st Edition, CRC Press, 2022. 2. Richard G Budynas, “Shigley's Mechanical Engineering Design”, 9th Edition, McGraw-Hill Education, 2014.									
	Pendukung :									
	6. Robert L. Norton, “Machine Design” Pearson, 5th edition, 2013 7. Aaron D. Deutschman, “Machine Design, Theory and Practice,”Macmillan Publishing Co, New York, 1975 8. J.H Faupel, “Engineering Design A Synthesis of Stress Analysis and Material Engineering,” A Wiley-Interscience, New York, 1981									
Dosen Pengampu	Wiwiek Hendrowati, Moch. Solichin, Aida Annisa Amin Daman, I Nyoman Sutantra, Muh. Nur Yuniarto, Kafi Hanan.									
Matakuliah syarat	Dinamika permesinan									



Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami gambaran umum tentang Capstone 1	Memahami sistem dan mekanisme sebagai acuan perancangan dan memahami metode evaluasi perkuliahan	Kriteria: - Rubrik Bentuk: presentasi	- Kuliah - Diskusi TM: 2x50" PT: 2x60" BM: 2x60"	-Dokumen RPS di MyITS Classroom	Pengenalan objek-objek sistem mekanik yang akan dirancang dan dianalisa, metode evaluasi dan format progress dan laporan akhir	5
2	Mahasiswa mampu membentuk kelompok/ tim untuk mengerjakan tugas Capstone 1 serta menentukan judul tugas	Dapat menetapkan yang akan dirancang serta cara kerjanya	Kriteria: - Rubrik Bentuk: non-test (tugas)	- Penjelasan - Pengelompokan - Diskusi rancangan TM: 2x50" PT: 2x60" BM: 2x60"	-Review & summary diskusi di MyITS Classroom	Pengelompokan dan pemilihan sistem yang akan dirancang dan dianalisa	5



	yang akan di kerjakan						
3	Mahasiswa mampu memahami strategi perancangan, menentukan metode analisis dan spesifikasi dasar alat yang dirancang	Memahami metode analisis untuk perancangan fungsi dan kualitasnya Mampu merancang dan mempresentasikan hasil rancangan	Kriteria: - Rubrik Bentuk: non-test (tugas)	- Kuliah - Diskusi - Presentasi TM: 2x50" PT: 2x60" BM: 2x60"	-Review & Summary hasil diskusi di MyITS Classroom	Penjelasan strategi perancangan dan metode analisisnya Presentasi rancangan dasar sistem dan cara kerjanya serta spesifikasi dasar (daya, torsi, dan putaran yang ditransmisikan)	10
4	Evaluasi 1, Progress penentuan topik dan mekanisme rancangan						
5-6	Mahasiswa mampu menganalisis, menghitung dan menentukan dimensi dan material komponen utama alat yang dirancang	Mampu menganalisis kekuatan komponen utama dan mempresentasikan hasilnya	Kriteria: - Rubrik Bentuk: presentasi progress perancangan	- Presentasi - Diskusi - Umpan Balik TM: 2x50" PT: 2x60" BM: 2x60"	-Review & Summary hasil diskusi di MyITS Classroom	- Menghitung dimensi dan memilih material untuk komponen utama (poros, pasak, roda gigi, kopling, dll.) - Memilih dimensi (sizing) berdasarkan katalog atau tabel tertentu (bantalan, belt, rantai, dll.) - Presentasi hasil analisis komponen pokok system dan diskusi hasil analisis	10



7	Mahasiswa mampu menganalisis, menghitung dan menentukan dimensi dan material komponen pendukung alat yang di rancang	Mampu menganalisa komponen pendukung dan mempresentasikan hasilnya	Kriteria: - Rubrik Bentuk: presentasi progress	- Presentasi - Diskusi TM: 2x50" PT: 2x60" BM: 2x60"	-Review & Summary hasil diskusi di MyITS Classroom	Menghitung dimensi dan memilih material untuk komponen pendukung (struktur penyangga, body,dudukan, dll.) - Presentasi hasil analisis komponen pendukung system dan diskusi hasil analisis	10
8	Evaluasi ke-2, Evaluasi Tengah Semester, Presentasi system transmisi						
9-11	Mahasiswa mampu membuat gambar 3D assembly dan menganalisa komponen kritis sesuai standar yang di pakai	Mampu menggambarkan susunan dari sistem yang dirancang, memahami kekurangannya dan memperbaiki gambar susunan yang telah dibuat	Kriteria: - Rubrik - Marking Scheme Bentuk: non-test (progress report perancangan)	- Pelatihan TM: 2x50" PT: 2x60" BM: 2x60"	- Review & Summary pokok bahasan perkuliahan di MyITS Classroom	Pelatihan 3D assembly	20
12	Evaluasi ke-3 – 3D assembly dan gambar teknik						



13-15	Mahasiswa mampu menggambar shop drawing komponen kritis dan Analisa perkiraan biaya	Mampu menggambar shop drawing	Kriteria: - Rubrik - Marking Scheme Bentuk: test (Dokumen shop drawing)	- Diskusi TM: 2x50” PT: 2x60” BM: 2x60”	- Review & Summary PPT perkuliahan di MyITS Classroom	Review macam toleransi dan proses manufaktur. Review standar gambar teknik. Mencari referensi harga bahan.	40
16	Evaluasi Ke-4 – Presentasi Akhir Dan Penyerahan Laporan						



					RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM		Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER							
MATA KULIAH (MK)		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
CAPSTONE # 2		TM234602	REKAYASA VIBRASI DAN SISTEM OTOMOTIF	T=2	P=0	6	22 November 2023
OTORISASI		Pengembang RPS		Koordinator RMK		Ketua PRODI	
		MOCH. SOLICHIN		MOCH. SOLICHIN		ATOK SETYAWAN	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK						
	CPL-2	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik mesin, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis dan inovatif.					
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi.					



	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika.								
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan.								
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika.								
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik.								
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi.								
	Capaian Pembelajaran Mata Kuliah (CPMK)									
	CPMK-1	Mahasiswa mampu mendeskripsikan ide kreatif tentang alat yang dirancang secara fungsi dan keterbaruannya.								
	CPMK-2	Mahasiswa mampu membuat detail gambar teknik setiap komponen yang dirancang sesuai standar yang nantinya siap untuk dilakukan proses manufaktur.								
	CPMK-3	Mahasiswa mengetahui proses manufaktur dari setiap komponen yang dirancang.								
	CPMK-4	Mahasiswa mampu merakit semua komponen yang telah dibuat secara benar.								
	CPMK-5	Mahasiswa mampu mempresentasikan produk yang telah selesai dibuat berupa prototipe.								
	CPMK-6	Mahasiswa memahami ilmu-ilmu dasar mekanika dari seluruh proses perancangan dan pembuatan prototipe secara komprehensif.								
		Matrik CPL – CPMK								
		CPMK	CPL-2	CPL-3	CPL-4	CPL-5	CPL-7	CPL-8	CPL-9	Bobot (%)
		CPMK-1	v	v	v					10
		CPMK-2	v		v	v	v			10



			CPMK-3	v	v	v	v	v	v		10
			CPMK-4	v	v	v		v	v	v	20
			CPMK-5					v	v	v	20
			CPMK-6	v	v	v	v	v	v	v	30
			Total Bobot (%)	17	14	17	10	17	14	10	100
Deskripsi Singkat MK	Mata kuliah ini mempelajari gambar teknik dari hasil perancangan secara detail 2D, proses manufaktur, perakitan komponen, mempresentasikan prototipe hasil perancangan, memahami seluruh materi dasar dari Teknik Mesin secara komprehensif serta menyusun dan mempresentasikan laporan.										
Bahan Kajian: Materi Pembelajaran	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Gambar teknik dari hasil perhitungan setiap komponen pada perancangan secara standar - Pemrosesan suatu komponen sebagai proses manufaktur - Merakit seluruh komponen menjadi satu kesatuan peralatan yang didesain sampai dengan menjadi satu prototipe - Mempresentasikan prototipe untuk menunjukkan cara kerja dari peralatan yang didesain - Menyusun laporan hasil perancangan dan Analisa - Memahami dan menjawab ujian komprehensif dari semua mata kuliah dasar pada bidang Teknik Mesin - Presentasi laporan hasil perancangan.										
Pustaka	Utama :										
	1. Bahram Nassersharif, “Engineering Capstone Design”, 1 st Edition, CRC Press, 2022.										
	Pendukung :										
	1. Richard G Budynas, “Shigley's Mechanical Engineering Design”, 9th Edition, McGraw-Hill Education, 2014 2. Robert L. Norton, “Machine Design” Pearson, 5th edition, 2013 3. Aaron D. Deutschman, “Machine Design, Theory and Practice,”Macmillan Publishing Co, New York, 1975										



	4. J.H Faupel, “Engineering Design A Synthesis of Stress Analysis and Material Engineering,” A Wiley-Interscience, New York, 1981						
Dosen Pengampu	Wiwiek Hendrowati, Moch. Solichin, Aida Annisa Amin Daman, I Nyoman Sutantra, Muh. Nur Yuniarto, Kafi Hanan.						
Mata kuliah syarat	Capstone 1						
Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
11	Mahasiswa mampu memahami gambaran umum dari capstone design 2	Memahami gambaran umum capstone design 2	Kriteria: Non-tes Bentuk: Presentasi	- Kuliah - Diskusi TM: 2x50” PT: 2x60” BM: 2x60”	- Dokumen RPS di MyITS Classroom - Review & Summary PPT perkuliahan di MyITS Classroom	Pengenalan tentang detail dari technical drawing, proses manufaktur, membuat prototipe, design showcase, metode evaluasi, format progress dan laporan akhir, dan ujian komprehensif	5



2 2	Mahasiswa mampu memahami detail desain 2 dimensi sesuai dengan standard ISO	Dapat memahami dan menggambar Teknik sesuai dengan standar	Kriteria: Non-tes Bentuk: Progress report	- - Kuliah - - Diskusi TM: 2x50" PT: 2x60" BM: 2x60"	-	Penjelasan tentang standard gambar termasuk proyeksi 2 dimensi secara detail kedalam lembar kerja	5
3 3	Mahasiswa mampu menyelesaikan semua gambar teknik yang diperlukan untuk proses manufaktur setiap komponennya	Mampu menyajikan seluruh gambar setiap komponen dalam lembar kerja dan siap dilakukan proses manufaktur	Kriteria: Non-tes Bentuk: tugas	- Kuliah - Diskusi - Presentasi TM: 2x50" PT: 2x60" BM: 2x60"	-	Penjelasan tentang finalisasi seluruh gambar komponen yang telah diberikan detail ukuran, keterangan gambar, standar ukuran kertas agar gambar Teknik sebagai dasar proses manufaktur setiap komponennya	5
44	Evaluasi 1 – presentasi detail gambar teknik						15
5	Mahasiswa mampu memahami dan melakukan proses manufaktur pada setiap	Mampu memahami proses manufaktur dari setiap kompoenen yang dirancang	Kriteria: Non-tes Bentuk: presentasi progress perancangan	- Kuliah - Presentasi - Diskusi TM: 2x50"	-	Menjelaskan proses manufaktur pada setiap komponen yang dirancang dan proses pemilihan materilnya	5



	komponen yang telah dirancang dan digambar detail 2D serta cara memilih material			PT: 2x60" BM: 2x60"			
6	Mahasiswa mampu menentukan jenis proses manufaktur pada setiap komponen yang didesain	Mampu menentukan jenis proses manufaktur pada setiap komponen yang didesain	Kriteria: Non-tes Bentuk: presentasi progress perancangan	- Kuliah - Presentasi - Diskusi TM: 2x50" PT: 2x60" BM: 2x60" -	-	Penjelasan tentang jenis-jenis proses pemesinan	5
7	Mahasiswa mampu mengetahui cara pengoperasian proses permesinan beserta keselamatan kerjanya	Mampu mengetahui cara pengoperasian proses pemesinan	Kriteria: Non-tes Bentuk: presentasi progress perancangan	- Presentasi - Diskusi TM: 2x50" PT: 2x60" BM: 2x60"	-	Penjelasan tentang cara pengoperasian dan safety dari cara pengoperasian pada setiap proses pemesinan	5



8	Mahasiswa mampu melakukan proses finishing dari komponen yang telah selesai dikerjakan pada proses pemesinan	Mampu melakukan proses finishing dari komponen yang telah selesai dikerjakan pada proses pemesinan	Kriteria: Non-tes Bentuk: presentasi progress perancangan	- Presentasi - Diskusi TM: 2x50" PT: 2x60" BM: 2x60" -	-	Penjelasan tentang proses finishing beberapa komponen dengan proses pemesinan yang berbeda-beda	5
8 9	Evaluasi 2 – presentasi progress proses manufaktur						20
9 10	Mahasiswa mampu merakit setiap komponen yang telah dibuat	Mampu menggambarkan susunan dari sistem yang dirancang, memahami kekurangannya dan memperbaiki gambar susunan yang telah dibuat	Kriteria: Non-tes Bentuk: Progress report perancangan	- Kuliah - Pelatihan TM: 2x50" PT: 2x60" BM: 2x60"		Memberikan materi tentang proses perakitan komponen untuk membuat satu prototipe	15
111	Mahasiswa mampu mengoperasikan dan	Mampu mengoperasikan dan mengevaluasi	Kriteria: Non-tes Bentuk: Progress	- Presentasi - Diskusi		Cara kerja dari prototipe yang dirakit bisa bekerja sesuai dengan desainnya	10



	mengevaluasi rancangan yang telah dirakit	rancangan yang telah dirakit	report perancangan	TM: 2x50" PT: 2x60" BM: 2x60"			
12	Evaluasi ke-3 – presentasi hasil assembly dari prototipe						25
13-15	Mahasiswa mampu mempresentasikan prototipe, dan menjawab ujian komprehensif	Mampu menampilkan prototipe dan menjelaskan cara kerjanya serta mampu menjawab pertanyaan ujian komprehensif	Kriteria: Ttes Bentuk: - Progress report dan presentasi progress perancangan final dan ujian komprehensif	- Presentasi - Diskusi TM: 2x50" PT: 2x60" BM: 2x60"		Menjelaskan cara mekanisme kerja dari suatu rancangan dalam bentuk prototipe dan memberikan review dari materi-materi Capstone 2 secara komprehensif	40
16	Evaluasi ke-4 – Presentasi akhir, ujian komprehensif, dan penyerahan laporan						40

 RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI-REKAYASA SISTEM ITS						
MATA KULIAH		KODE	Rumpun MK	BOBOT (sks)		SEMESTER
TEKNOLOGI PEMULIHAN ENERGI		TM234715	REKAYASA VIBRASI & SISTEM OTOMOTIF	T=3	P=0	PILIHAN
OTORISASI		Pengembang RP		Koordinator RMK		KETUA PRODI
		Wiwiek Hendrowati		Wiwiek Hendrowati		Is Bunyamin



Capaian Pembelajaran MK	Program Studi A. Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika. B. Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. C. Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. D. Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik.
	Mata Kuliah Mahasiswa mampu menganalisa konsep kekekalan energi dan metode pemulihan energi. Mahasiswa mampu menganalisa sistem mekanik dengan metode elektromekanik dan piezoelektrik. Mahasiswa mampu menganalisa sistem dinamis mekanik translasi dan rotasi. Mahasiswa mampu memodelkan sistem elektromagnetik. Mahasiswa mampu mensimulasikan Sistem dinamis, menganalisa dan mensimulasikan teknologi pemulihan energi.
Diskripsi Bahan Kajian & Pokok Bahasan	Bahan Kajian Teknik Pemulihan Energi : teknik yang diterapkan untuk menganalisa dan mendapatkan kembali energi yang terbuang
	Pokok Bahasan Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Prinsip dasar energi dan kekekalan energi, sumber sumber energi, macam-macam metode pemulihan energi : electromagnetik& piezoelectric. - Pemodelan sistem dinamis mekanik translasi dan rotasi, pemodelan sistem elektromagnetik dan piezoelectric, metode variabel keadaan & fungsi transfer, simulasi.
Pustaka	Utama : 1. Law,A.M.Kelton W.D., <u>Simulation Modeling dan Analysis</u> , Mc Graw Hill,2rd edition,1991.



	Pendukung :	
	2. Robert, N;Anderson,R.Deal, <u>Introduction Computer Simulation</u> , Addison Wisley,1983.	
Media Pembelajaran	Software :	Hardware :
	MATLAB	PC & LCD Projector
Team Teaching	Wiwiek Hendrowati	
Assessment	Latihan Soal Homework (<i>Case-Study</i>) Evaluasi tertulis (Quiz, ETS dan EAS)	
Mata kuliah Syarat	Mekanika Getaran	

Mg Ke-	Sub-Capaian Pembelajaran MK	Materi Pembelajaran [Pustaka]	Metode / Strategi Pembelajaran [Estimasi Waktu]	Assessment		
				Indikator	Bentuk	Bobot
(1)	Mahasiswa mampu menganalisa konsep kekekalan energi	Pengenalan Kontrak kuliah – Pengenalan Prinsip Dasar Energi, Sumber Sumber Energi – Review Dinamika Teknik : Kerja & energi, Kekekalan energi [1: Law]	- Video Gerakan Sistem Dinamis - Kuliah Pengantar & Brainstorming [TM: 1x(3x50’)]	Mampu dan terampil menyelesaikan permasalahan kekekalan energi pada sistem dinamis rigid body	Latihan soal	5 %



(2&3)	Mahasiswa mampu menganalisa metode pemulihan energi	Macam-Macam Metode Pemulihan Energi : - Electromagnetik - Piezoelectric. [1: Law]	- Kuliah - Latihan soal [TM: 2x(3x50'')]	Mampu dan terampil menyelesaikan permasalahan metode pemulihan energi	Latihan Soal Homework	5 %
(4&5)	Mahasiswa mampu menganalisa sistem mekanik dengan metode elektromekanik	Electromechanical System Dan Teknologinya [1: Law]	- Kuliah - Latihan soal [TM: 2x(3x50'')]	Mampu dan terampil menyelesaikan permasalahan teknologi elektromekanik	Latihan Soal Homework	10 %
(6&7)	Mahasiswa mampu menganalisa sistem mekanik dengan metode piezoelektrik	Piezoelectric System Dan Teknologinya [1: Law]	- Kuliah - Latihan soal [TM: 2x(3x50'')]	Mampu dan terampil menyelesaikan permasalahan teknologi piezoelectric	Latihan Soal Homework	10 %
(8)	Evaluasi Tengah Semester					
(9&10)	Mahasiswa mampu menganalisa Sistem Dinamis Mekanik Translasi Dan Rotasi	Pemodelan Sistem Dinamis Mekanik Translasi Dan Rotasi [1: Law]	- Kuliah - Latihan soal [TM: 2x(3x50'')]	Mampu dan terampil menyelesaikan permasalahan sistem dinamis translasi dan rotasi	latihan soal Homework	15 %
(11&12)	Mahasiswa mampu memodelkan Sistem Elektromagnetik Dan Piezoelectric	Pemodelan Sistem Elektromagnetik Dan Piezoelectric [1: Law]	- Kuliah - Latihan soal [TM: 2x(3x50'')]	Mampu dan terampil menyelesaikan permasalahan model Sistem	Latihan Soal	15 %



				elektromagnetik & Piezoelectric		
(13, 14)	Mahasiswa mampu mensimulasikan Sistem dinamis	Metode Variabel Keadaan & Fungsi Transfer, Simulasi.	- Kuliah - Latihan soal [TM: 2x(3x50")]	Mampu dan terampil menyelesaikan permasalahan simulasi sistem dinamis	Latihan Soal Quis	15 %
(15)	Mahasiswa mampu menganalisa dan mensimulasikan teknologi pemulihan energi	Review Paper Energy Harvesting Technology	- Kuliah - Latihan soal [TM: 1x(3x50")]	Mampu dan terampil menyelesaikan permasalahan simulasi teknologi pemulihan energi	Latihan Soal	5 %
(16)	Evaluasi Akhir Semester					



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER						
(Semester Learning Plan)						
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
AERODINAMIKA Aerodynamics	TM234718	MEKANIKA FLUIDA & MESIN FLUIDA	T = 3	P = 0	PILIHAN	5 Mei 2023
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)	
	Herman Sasongko	Sutardi			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems				
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan				



		<i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources.</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau pemodelan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik <i>Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)	
	CPMK-1	Mahasiswa mampu menerapkan dasar dasar mekanika fluida dalam melakukan pemodelan matematis singularitas dan pemodelan numerik panel terkait aliran inviscid incompressible 2 Dimensi yang melintasi bluff body dan airfoil dengan bantuan perangkat lunak. <i>Students are able to apply the basic principles of fluid mechanics for mathematical modeling of singularities and numerical modeling of panels related to 2-dimensional incompressible inviscid flow across bluff bodies and airfoils with the aid of software.</i>
	CPMK-2	Mahasiswa mampu menginterpretasikan pengaruh geometri obyek terhadap medan aliran inviscid incompressible 2 Dimensi (medan kecepatan dan medan tekanan) yang menyelimutinya. <i>Students are able to interpret the influence of an object's geometry on the 2-dimensional incompressible inviscid velocity field and pressure fields around the objects.</i>
	CPMK-3	Mahasiswa mampu menguasai dasar-dasar perancangan geometri airfoil untuk menghasilkan gaya lift <i>Students are able to have better understanding the basics of designing airfoil geometry to produce lift force</i>



	CPMK-4	Mahasiswa mampu menjelaskan dasar perhitungan skin friction drag dengan persamaan boundary layer berdasarkan informasi medan kecepatan dan medan tekanan yang diperoleh dari pemodelan aliran 2D inviscid incompressible. <i>Students are able to explain the basics of skin friction drag calculations using the boundary layer equation based on velocity field and pressure field information obtained from 2D inviscid incompressible flow modeling</i>				
		Matrik CPL – CPMK				
		CPMK	CPL-4	CPL-5	CPL-6	CPL-8
		CPMK-1	√	√	√	√
		CPMK-2	√	√	√	√
		CPMK-3	√	√	√	√
		CPMK-4	√	√	√	√
Deskripsi Singkat MK <i>(Short Description of Course)</i>	Mata kuliah ini membahas metode perancangan produk, baik dari aspek desain, ergonomi, manufaktur, dan perakitan serta membahas pengembangan produk berdasarkan kebutuhan konsumen melalui metode Quality Function Deployment (QFD).					
Bahan Kajian: Materi Pembelajaran <i>(Course Materials)</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: 1. Proses desain: proses desain kognitif, persuatif, deduktif 2. Fungsi produk: struktur fungsi, fungsi utama, fungsi tambahan sebuah produk 3. Pengembangan konsep : daftar kebutuhan, pembuatan dan pemilihan konsep 4. Perancangan komponen: perwujudan desain, perancangan komponen yang ekonomis, perancangan untuk manufaktur dan perakitan 5. Ergonomi Produk: metode RULA, manfaat dan aplikasinya dalam perancangan dan pengembangan produk 6. Pengembangan produk: konsep pengembangan berbasis fungsi produk, quality function deployment (QFD)					
Pustaka <i>(References)</i> C	Utama : <i>(Main)</i>					
	Batan, I Made Londen, Desain Produk Edisi 1, Guna Widya, 2012, Surabaya					
	Pendukung : <i>(Supplementary)</i>					



		Bralla, James G., Design for Manufacturability Handbook, Mc Graw-Hill, 1999. Mc-Atamney, Lynn and Corlett, E Nigel; RULA: a survey method for investigation of work-related upper limb disorders, Institute for Occupational Ergonomics, University of Nottingham. Otto, Kevin N. and Wood, Kristin L., Product Design – Techniques in Reverse Engineering and New Product Development, Printice Hall, 2000. Ulrich, Karl T.; Eppinger, Steven D., Product Design and Development. Mc Graw-Hill, Inc., 2000. Boothroyd, Geoffrey; Peter, Dewhurst and Winston, Knight, Product Design For Manufacture and Assembly, 2nd edition, 2002.					
Dosen Pengampu (Lecturers)		I Made Londen Batan					
Matakuliah syarat (Prerequisites)		Tidak ada mata kuliah prasyarat					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami esensi teori airfoil. <i>Students are able to understand the</i>	Mampu memahami aliran 2D melintasi airfoil, dan mampu membedakannya dengan wing teori <i>Students are able to understand two-dimensional flow over an</i>	Diskusi <i>Discussion</i>	• Video: Contoh struktur streamline melintasi airfoil & wing • Kuliah		2D flow & 3D flow Inviscid & viscous flow, incompressible flow & compressible flow. [3]	



	<i>essence of airfoil theory</i>	<i>airfoil and distinguish it from three-dimensional wing theory</i>		• Video: Example of streamline structures over an airfoil and a wing • Lecture [TM: 1 x (3x50")]			
2	Mahasiswa mampu memahami dan menganalisa persamaan differential konservasi massa, stream function, rotasi fluida dan potential function. <i>Students are able to understand and analyze the</i>	Mampu menganalisa dan memahami korelasi PD konservasi massa dengan stream function, korelasi rotasi fluida dengan potential function serta posisi relative antara streamline Dengan potential line <i>Able to analyze and understand the correlation between the</i>	Diskusi <i>Discussion</i>	Kuliah Lecture [TM: 1 x (3x50")]		PD konsevasi massa, stream function, rotasi fluida dan potential function. [3]	



	<i>differential equations of mass conservation, stream function, fluid rotation, and potential function</i>	<i>differential equation of mass conservation and the stream function, the correlation between fluid rotation and the potential function, as well as the relative position between streamlines and potential lines.</i>					
3	Mahasiswa mampu memahami & menganalisa beberapa aliran singular. <i>Students are able to understand and analyze various types of singular flows.</i>	Mampu menganalisa dan memahami struktur streamline, medan kecepatan dan medan tekanan aliran singular. <i>Able to analyze and understand the streamline structure, velocity field, and pressure field of singular flows</i>	Tugas : literature review terkait materi kuliah minggu 1 & 2 <i>Assignment: Literature review related to the course material of Week 1 & 2.</i>	• Kuliah • Diskusi • <i>Lecture</i> • <i>Discussion</i> [TM: 1 x (3 x 50")]		Horizontal free stream flow, inclined free stream flow, source / sink flow, doublet flow, vortex flow [1]	5
4	Mahasiswa mampu memahami proses superposisi	Mampu melaksanakan proses superposisi membentuk aliran melintasi rankine	Tugas : literature review materi kuliah minggu ke 3	• Kuliah • Diskusi • <i>Lecture</i>		Flow around Rankine oval, ellips, circular cylinder, rotated circular cylinder	5



	terbentuknya combined flow <i>Students are able to understand the superposition process in the formation of combined flow.</i>	oval, ellips, circular cylinder dan rotated circular cylinder. <i>Able to perform the superposition process to form flow over a Rankine oval, ellipse, circular cylinder, and rotated circular cylinder.</i>	<i>Assignment: Literature review on the course material of Week 3.</i>	• <i>Discussion</i> [TM: 1 x (3 x 50")]		[1]	
5	Mahasiswa mampu menganalisa medan aliran combined flow <i>Students are able to analyze the flow field of combined flow.</i>	Mampu menganalisa struktur streamline, medan kecepatan dan medan tekanan combined flow. <i>Able to analyze the streamline structure, velocity field, and pressure field of combined flow.</i>	Diskusi <i>Discussion</i>	• Kuliah • Diskusi • <i>Lecture</i> • <i>Discussion</i> [TM: 1 x (3 x 50")]		Flow around Rankine oval, ellips, circular cylinder, rotated circular cylinder [1]	
6	Mahasiswa memahami Kutta Joukowski theorem.	Memahami keterkaitan harga sirkulasi (total vortex strength) dengan terjadinya gaya lift.	Diskusi <i>Discussion</i>	• Kuliah • Video • <i>Lecture</i> • <i>Video</i>		Lifting Flow over unsymmetrical body [1]	



	<i>Students understand the Kutta-Joukowski theorem</i>	<i>Students will understand the relationship between circulation (total vortex strength) and the generation of lift</i>		[TM: 1 x (3 x 50")]			
7	Mahasiswa mampu memahami dasar pemodelan airfoil <i>Students are able to understand the fundamentals of airfoil modeling</i>	Mampu memahami keterkaitan ketidak simetrisan body dengan kekuatan sirkulasi, memahami kelvin theorem, starting vortex, syarat kutta pada trailing edge dan syarat Kinematis pada kontur. <i>Able to understand the relationship between the asymmetry of the body and the circulation strength, comprehend Kelvin's theorem, the starting vortex, the Kutta condition at the trailing</i>	Diskusi <i>Discussion</i>	• Kuliah • Video • <i>Lecture</i> • <i>Video</i> [TM: 1 x (3 x 50")]		Circulation (total vortex strength), kelvin theorem, starting vortex, syarat kutta pada trailing edge, syarat kinematis pada kontur. <i>Circulation (total vortex strength), Kelvin's theorem, starting vortex, the Kutta condition at the trailing edge, and the kinematic condition on the contour.</i> [1]	



		<i>edge, and the kinematic condition on the contour.</i>					
8	Evaluasi Tengah Semester (Midterm Exam)						35
9	Mahasiswa mampu memahami & melaksanakan pemodelan airfoil simetris tipis dengan angle of attack kecil. <i>Students are able to understand and perform the modeling of a thin symmetric airfoil with a small angle of attack</i>	Mampu memahami prosedur matematis pemodelan, dan mampu menganalisa pengaruh peningkatan angle of attack terhadap gaya lift. <i>Able to understand the mathematical modeling procedure and analyze the effect of an increased angle of attack on lift force</i>	Diskusi <i>Discussion</i>	• Kuliah • Diskusi • <i>Lecture</i> • <i>Discussion</i> [TM: 1 x (3 x 50")]		Pemodelan airfoil simetris tipis dengan angle of attack. <i>Modeling of a thin symmetric airfoil with an angle of attack.</i> [1]	
10	Mahasiswa mampu memahami & melaksanakan pemodelan airfoil simetris tipis tanpa angle	Mampu memahami prosedur matematis pemodelan, dan mampu menganalisa pengaruh ketebalan kontur terhadap	Diskusi <i>Discussion</i>	• Kuliah • Diskusi • <i>Lecture</i> • <i>Discussion</i>		Pemodelan airfoil simetris tipis tanpa angle of attack (Tropfen Model) <i>Modeling of a thin symmetric airfoil</i>	



	of attack (droplet modelling) <i>Students are able to understand and perform the modeling of a thin symmetric airfoil without an angle of attack (droplet modeling).</i>	kecepatan aliran pada kontur <i>Able to understand the mathematical modeling procedure and analyze the effect of contour thickness on the flow velocity along the contour.</i>		[TM: 1 x (3 x 50")]		<i>without an angle of attack (Tropfen Model)</i> [2]	
11	Evaluasi Sisipan : Presentasi project pemodelan materi minggu ke 10 <i>Evaluation: Project presentation on the material of Week 10</i>						10
12	Mahasiswa mampu memahami & melaksanakan pemodelan airfoil tidak simetris tipis kelengkungan lemah dengan angle of attack kecil. <i>Students are able to understand and perform the</i>	Mampu memahami prosedur matematis pemodelan, dan mampu menganalisa pengaruh peningkatan kelengkungan & angle of attack terhadap gaya lift. <i>Able to understand the mathematical modeling procedure and analyze the effect of increased</i>	Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> [TM: 1 x (3 x 50")]		Pemodelan airfoil tidak simetris tipis lengkung lemah dengan angle of attack. <i>Modeling of a thin asymmetric airfoil with weak curvature and an angle of attack.</i> [1] & [2]	



	<i>modeling of a thin asymmetric airfoil with weak curvature and a small angle of attack.</i>	<i>curvature and angle of attack on lift force</i>					
13	Mahasiswa mampu memahami & melaksanakan pemodelan numerik source / sink panel <i>Students are able to understand and perform the numerical modeling of a source/sink panel</i>	Mampu melaksanakan pemodelan numerik panel source untuk bluff body <i>Able to perform the numerical modeling of a source panel for a bluff body</i>	Tugas : Project pemodelan materi minggu ke 12 <i>Assignment: Modeling project on the material of Week 12</i>	Kuliah Lecture [TM: 1 x (3 x 50")]		Pemodelan numerik source panel <i>Numerical modeling of a source panel.</i> [1]	10
14	Mahasiswa mampu memahami & melaksanakan pemodelan numerik panel vortex	Mampu melaksanakan pemodelan numerik panel vortex untuk camber line	Diskusi <i>Discussion</i>	Kuliah Lecture [TM: 1 x (3 x 50")]		Pemodelan numerik panel vortex <i>Numerical modeling of a vortex panel</i>	



	<i>Students are able to understand and perform the numerical modeling of a vortex panel</i>	<i>Able to perform the numerical modeling of a vortex panel for the camber line</i>				[1]	
15	Mahasiswa mampu memahami perhitungan skinfriction drag menggunakan persamaan momentum dalam boundary layer <i>Students are able to understand the calculation of skin friction drag using the momentum equation within the boundary layer.</i>	Mampu melakukan perhitungan skin friction drag pada airfoil simetris tipis yang diasumsikan sebagai pelat datar. <i>Able to calculate skin friction drag on a thin symmetric airfoil assumed to be a flat plate</i>	Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> [TM: 1 x (3 x 50'')]		Momentum integral equation inner boundary layer. [3]	
16	Evaluasi Akhir Semester (Final Exam)						35



						RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM		Kode Dokumen	
RENCANA PEMBELAJARAN SEMESTER									
MATA KULIAH (MK)		KODE		Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
Mekanika Fluida/ <i>Fluid Mechanics</i>		TM234704				T=3 P=0		PILIHAN	22 Nopember 2023
OTORISASI		Pengembang RPS			Koordinator RMK			Ketua PRODI	
		Tri Yogi Yuwono			Sutardi				
Capaian Pembelajaran (CP) <i>Learning Outcomes (LO)</i>	CPL-PRODI yang dibebankan pada MK								
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (mechanical system) <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>							
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu dan teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>The ability to design mechanical components, systems and/or processes to meet expected needs with an analytical engineering approach based on the latest science and technology and considering technical standards, performance aspects, reliability, and ease of implementation, and/or utilizing the potential of local and national resources with a global perspective.</i>							
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems</i>							



CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>Ability to identify, formulate, analyze and solve engineering problems.</i>				
Capaian Pembelajaran Mata Kuliah (CPMK) / <i>Course Learning Outcomes (CLO)</i>					
CPMK-1	Mahasiswa mampu memahami akibat kompresibilitas aliran terhadap perubahan kondisi termodinamik aliran sehingga perlu mengingat kembali persamaan dasar termodinamika, serta mampu memahami perambatan gelombang suara, kondisi stagnasi sebagai referensi dan kondisi kritis. <i>Students understand the effects of flow compressibility on changes in the flow's thermodynamic conditions, so they need to remember the basic thermodynamics equations. They also understand the propagation of sound waves, stagnation conditions as a reference, and critical conditions.</i>				
CPMK-2	Mahasiswa mampu menganalisa aliran kompresibel satu-dimensi yang meliputi; aliran isentropik, aliran adiabatik dalam saluran berpenampang konstan dengan gesekan, aliran dalam saluran berpenampang konstan tanpa gesekan dengan perpindahan panas. <i>Students can analyze one-dimensional compressible flow, including isentropic flow, adiabatic flow in constant cross-section channels with friction, and flow in constant cross-section channels without friction with heat transfer.</i>				
CPMK-3	Mahasiswa mampu menganalisa serta mampu menunjukkan terjadinya normal shocks, oblique shocks dan expansion wave. <i>Students can analyze and demonstrate the occurrence of normal shocks, oblique shocks and expansion waves.</i>				
CPMK-4	Mahasiswa mampu memahami aplikasi aliran kompresibel maupun fenomena aliran berbasis mekanika fluida di industri. <i>Students can understand the application of compressible flow and fluid mechanics-based flow phenomena in industry.</i>				
CPMK-4	Matrik CPL – CPMK				
	CPMK	CPL-4	CPL-5	CPL-7	CPL-8
	CPMK-1	V	V	-	-
	CPMK-2	V	-	V	V
	CPMK-3	V	-	V	V
	CPMK-4	V	V	V	V



Deskripsi Singkat MK <i>Brief Description of Course</i>	Untuk melengkapi matakuliah mekanika fluida, perlu dipelajari juga aliran kompresibel. Hal ini karena aliran kompresibel sangat penting dalam banyak aplikasi teknik. Perubahan densitas fluida yang merupakan karakter dari aliran kompresibel, perlu dipelajari akibatnya terhadap property fluida lainnya, khususnya tekanan dan temperatur. Hubungan ini mengharuskan mempelajari persamaan tingkat keadaan serta persamaan dasar mekanika fluida lainnya. Begitu juga variasi temperatur pada aliran kompresibel sangat signifikan, sehingga persamaan energy perlu didalami. Fenomena menarik dapat terjadi pada aliran kompresibel, seperti perubahan kecepatan aliran fluida karena gesekan, perubahan kecepatan aliran fluida pada saluran converging, penurunan temperatur fluida akibat pemanasan, serta diskontinuitas property fluida akibat gangguan shock, baik norma shock, oblique shock maupun juga expansion wave dlsb. <i>To complete the fluid mechanics course, studying compressible flow is necessary. This is because compressible flow is very important in many engineering applications. Changes in fluid density, which are the characteristics of compressible flow, need to be studied for their effects on other fluid properties, especially pressure and temperature. This relationship requires studying the state-level equations and other basic equations of fluid mechanics. Likewise, temperature variations in the compressible flow are very significant, so the energy equations must be studied in depth. Interesting phenomena can occur in the compressible flow, such as changes in fluid flow velocity due to friction, changes in fluid flow velocity in converging channels, decreases in fluid temperature due to heating, and discontinuities in fluid properties due to shock disturbances, both norm shock, oblique shock and expansion wave etc.</i>
Bahan Kajian: Materi Pembelajaran <i>Course Material</i>	Dalam mata kuliah ini akan dipelajari pokok-pokok bahasan sebagai berikut: <i>In this course, the following main topics will be studied:</i> 1. Pengenalan tentang aliran kompresibel : 1. <i>Introduction to compressible flow:</i> ● Tinjauan termodinamika: persamaan umum gas ideal; rasio panas spesifik; perubahan energi internal dan entalpi sebagai fungsi suhu; perubahan entropi; ● <i>Thermodynamics review; general equation of ideal gas; specific heat ratio; change in internal energy & enthalpy as a function of temperature; change in entropy;</i> ● Propagasi gelombang suara; ● <i>Propagation of sound waves;</i> ● Tipe-tipe aliran-the mach cone ● <i>Flow types-the Mach cone</i> ● Kondisi Refensi: berupa property-property titik stagnasi lokal;



	• <i>Reference State: local stagnation point properties;</i> • Kondisi kritis. • <i>Critical conditions</i> 2. Aliran kompresibel: <i>Compressible flow</i> • persamaan dasar untuk aliran kompresibel satu-dimensi; • <i>basic equations for one-dimensional compressible flow;</i> • aliran isentropik dari gas ideal – variasi luas saluran; • <i>isentropic flow of an ideal gas – variation of channel area.</i> • aliran isentropik melalui Converging Nozzle dan Converging-Diverging Nozzle; • <i>isentropic flow through Converging Nozzle and Converging-Diverging Nozzle;</i> • aliran dalam saluran berpenampang konstan yang meliputi: • <i>flow in a constant-area duct, which includes:</i> - aliran isentropik (tanpa gesekan & tanpa perpindahan panas); - <i>isentropic flow (no friction and no heat transfer);</i> - aliran dengan gesekan tetapi tanpa perpindahan panas (Fanno); - <i>flow in a constant area duct with friction, no heat transfer (Fanno).</i> - aliran dengan perpindahan panas tetapi tanpa gesekan (Rayleigh); - <i>frictionless flow in a constant area duct with heat exchange.</i> • normal shocks; • <i>normal shocks;</i> • aliran dalam saluran supersonik dengan shock; • <i>supersonic channel flow with shocks.</i> • oblique shocks dan expansion waves. • <i>oblique shocks and expansion waves</i>	
Pustaka	Utama/ <i>Main</i> :	



References		- John W. Mitchell, Fox and Alan T. McDonald, Introduction to Fluid Mechanics , 10 th Edition, John Wiley & Sons Inc., New York, 2020.			
		Pendukung/Supporting			
		1. Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Alric P. Rothmayer, Fundamentals of Fluid Mechanics , 9 th edition, John Wiley & Sons Inc., New York, 2016. 2. John D. Anderson, Jr., “Modern Compressible Flow”, 3 rd Edition, McGraw-Hill Publishing Company, 2012.			
Dosen Pengampu Lecturer		Tri Yogi Yuwono			
Matakuliah prasyarat/Prerequisite		Mekanika Fluida I & II/ <i>Fluid Mechanics I and II</i>			
Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Indikator Indicators	Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] Learning Form, Learning Method, Student Assignment, [Time Estimate]	Materi Pembelajaran Course Material [Pustaka] [Reference]	Bobot Penilaian Assessment Weight (%)



	<i>Sub-Learning Outcomes</i>	Indikator Indicator	Kriteria & Bentuk <i>Criteria and Forms</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami karakteristik aliran kompresibel. <i>Students can understand the characteristic s of compressible flow.</i>	Mampu menjelaskan dengan tepat efek kompresibilitas aliran kompresibel satu-dimensi, steady, serta mampu menentukan kondisi referensi aliran : property stagnasi isentropic local dan kondisi kritis. <i>Able to explain precisely the compressibility effects and one-dimensional steady</i>	Latihan soal 12.59 sd 12.62 (Reff. Utama) <i>Excercise 12.29-12.62</i> <i>[Main Reff.]</i>	Kuliah Pengantar & Brainstorming - Latihan soal [TM: 1x(3x50”)] <i>Introductory Lecture & Brainstorming Exercise</i> <i>[TM: 1x(3x50”)]</i>	-	Pengenalan Aliran Kompresibel Review termodinamika Propagasi Gelombang Suara Kondisi Referensi: Properti Stagnasi Insentropik Lokal Kondisi Kritis [1: Robert W.Fox et al., Bab 12] <i>Introduction to Compressible Flow</i> <i>- Thermodynamics Review</i> <i>- Sound Wave Propagation</i> <i>- Reference Conditions: Local</i> <i>Insentropic Stagnation Properties</i>	5



		<i>compressible flow, and able to determine flow reference conditions: local isentropic stagnation properties and critical conditions.</i>				<i>- Critical Conditions</i> <i>[1: Robert W.Fox et al., Bab 12]</i>	
2	Mahasiswa mampu menganalisa aliran isentropic satu-dimensi untuk gas ideal dan menentukan pengaruh perubahan luasan terhadap property fluida dalam aliran isentropic.	Mampu dan terampil menyelesaikan permasalahan perubahan luasan saluran pada property fluida dalam aliran isentropik. Mampu membuat) Tabel Aliran Isentropik berdasarkan Persamaan	Kerja Mandiri: Pembuatan Tabel Isentropik Latihan soal (pilih 2 soal diantara soal 13.2 sd 13.13 (Ref. 1) <i>Exercise (choose two questions from questions 13.2 to 13.13 (Reff. main)</i>	- Kuliah - Kerja Mandiri terstruktur - Latihan soal [TM: 1x(3x50'')] - Lecture - Structured Independent Work - Exercise <i>[TM: 1x(3x50'')]</i>		<i>Aliran Kompresibel Satu-Dimensi: Persamaan Dasar untuk Aliran Kompresibel Satu-dimensi</i> - <i>Persamaan Dasar untuk Aliran Isentropik</i> - <i>Pengaruh perubahan luasan pada property dalam aliran isentropik</i> - <i>Aliran isentropik untuk gas ideal</i> - <i>Persamaan dasar</i>	5



	<i>Students can analyze one-dimensional isentropic flow for ideal gases and determine the effect of changes in area on fluid properties in isentropic flow.</i>	Dasar Aliran Isentropik. <i>Able and skilled in solving problems of channel area changes in fluid properties in isentropic flow. Able to create an Isentropic Flow Table based on the Basic Equation of Isentropic Flow.</i>				- <i>Kondisi referensi untuk aliran isentropik-gas ideal</i> [1: Robert W.Fox et al., Bab 13] One-Dimensional Compressible Flow: Basic Equations for One-Dimensional Compressible Flow - <i>Basic Equations for Isentropic Flow</i> - <i>Effect of area changes on properties in isentropic flow</i> - <i>Isentropic flow for an ideal gas</i> - <i>Basic equations for isentropic flow</i> - <i>Reference conditions for isentropic flow-ideal gas</i> [1: Robert W. Fox et al., Chapter 13].	



3-4	Mahasiswa mampu menganalisa kasus aliran isentropik pada Converging dan Converging-Diverging Nozzle. <i>Students are able to analyze isentropic flow cases in Converging and Converging-Diverging Nozzles.</i>	Mampu menjelaskan dengan tepat tentang fenomena aliran isentropik pada Converging maupun Converging-Diverging Nozzle; termasuk kapan terjadinya choked pada kedua type Nozzle tsb dan menentukan kondisi desainnya. <i>Able to explain precisely the isentropic flow phenomenon in Converging and Converging-</i>	Pembahasan Contoh Soal 13.2 dan 13.3 Latihan Soal (pilih 4 soal diantara soal 13.14 sd 13.59 (Ref.1) dan soal 11.38 (Ref.Pendukung 1) <i>Discussion of Example problems 13.2 and 13.3 Exercises (choose 4 questions between questions 13.14 to 13.59 (Ref 1) and question 11.38).</i>	- Kuliah - Latihan soal [TM: 2x(3x50'')] <i>- Lecture - Exercise [TM: 2x(3x50'')]</i>		- Aliran isentropik pada Converging Nozzle - Aliran isentropik pada Converging-Diverging Nozzle [1: Robert W.Fox et al., Bab 13] <i>- Isentropic flow in Converging Nozzle - Isentropic flow in Converging-Diverging Nozzle. [1: Robert W. Fox et al., Chapter 13].</i>	10



		<i>Diverging Nozzles, including when choked occurs in both types of Nozzles and determining their design conditions.</i>					
5	Evaluasi-1 (Quis-1)/First Evaluation (Quiz-1)						10
6-7	Mahasiswa mampu menganalisa kasus aliran kompresibel dengan gesekan tanpa perpindahan panas. <i>Students can analyze cases of compressible flow with friction</i>	Mampu dan terampil menyelesaikan permasalahan aliran kompresibel dalam saluran berpenampang konstan dengan gesekan tetapi tanpa perpindahan panas. <i>Able and skilled in solving compressible flow problems</i>	Pembahasan Contoh Soal 13.6 dan 13.7 Latihan Soal (pilih 4 soal diantara soal 13.60 sd 13.72 (Ref.1) <i>Discussion of Example problems 13.6 and 13.7 Exercises (choose 4 questions between questions 13.60 to 13.72 (Ref 1) and question 11.38).</i>	- Kuliah - Kerja Mandiri terstruktur - Latihan soal [TM: 2x(3x50'')] - Lecture - Structured Independent Work - Exercise [TM: 1x(3x50'')]		- Aliran kompresibel melalui saluran berpenampang konstan dengan gesekan tetapi tanpa perpindahan panas - Fungsi Aliran Garis-Fanno untuk Aliran Gas Ideal satu-dimensi [1: Robert W.Fox et al., Bab 13] - Compressible flow through a constant cross-sectional	10



	<i>without heat transfer</i>	<i>in constant cross-section channels with friction but without heat transfer.</i> <i>Mampu membangun Tabel FANNO berdasarkan Persamaan aliran kompresibel dengan gesekan tetapi tanpa perpindahan panas.</i> <i>Able to construct the FANNO Table based on the compressible flow equation with friction, but without heat transfer.</i>				<i>channel with friction but no heat transfer</i> <i>- Fanno-Line Flow Function for One-Dimensional Ideal Gas Flow.</i> <i>[1: Robert W. Fox et al., Chapter 13].</i>	



8	Mahasiswa mampu mengetahui Aplikasi Aliran Kompresibel di Lapangan Kerja. <i>Students can understand the Application of Compressible Flow in the Workplace.</i>	Mampu mengetahui aplikasi aliran kompresibel di Industri. <i>Able to know the application of compressible flow in industry.</i>	<i>Membuat Laporan Kunjungan Pabrik. Making a Factory Visit Report.</i>	- Kunjungan Industri/Lapangan [TM: 1x(3x50")] - Visit Industry [TM: 1x(3x50")]		Studi Kasus di Industri Cases study in industry.	5
9	Evaluasi Tengah Semester / Ujian Tengah Semester /=/ Mid Semester Evaluation						10
10-11	Mahasiswa mampu menganalisa kasus aliran kompresibel tanpa gesekan tetapi dengan	Mampu dan terampil menyelesaikan permasalahan aliran kompresibel dalam saluran berpenampang konstan tanpa	Pembahasan Contoh Soal 13.8 dan 13.9 <i>Discussion of Example problems 13.8 & 13.9</i>	- Kuliah - Kerja Mandiri terstruktur - Latihan soal. [TM: 2x(3x50")] - Lecture - Structured Independent Work		- Aliran kompresibel melalui saluran berpenampang konstan tanpa gesekan tetapi tetapi dengan perpindahan panas - Fungsi Aliran Garis-Rayleigh	10



	perpindahan panas <i>Students can analyze cases of compressible flow without friction but with heat transfer.</i>	gesekan tetapi dengan perpindahan panas. <i>Able and skilled to solve compressible flow problems in constant cross-section channels without friction, but with heat transfer.</i> Mampu membangun Tabel RALEIGH berdasarkan Persamaan aliran kompresibel tanpa gesekan tetapi dengan perpindahan panas.		- <i>Exercise [TM: 2x(3x50")]</i>		untuk Aliran Gas Ideal satu-dimensi. [1: Robert W.Fox et al., Bab 13] - <i>Compressible flow through a constant cross-sectional channel without friction but with heat transfer</i> - <i>Rayleigh-Line Flow Function for One-Dimensional Ideal Gas Flow.</i> [1: Robert W. Fox et al., Chapter 13].	



		<i>Able to construct the Rayleigh Table based on the compressible flow equation without friction, but with heat transfer.</i>					
12	Mahasiswa mampu menganalisa kasus aliran kompresibel dengan shock normal dan kasus aliran dalam saluran supersonic dengan Shock <i>Students can analyze compressible flow cases with normal</i>	Mampu dan terampil menyelesaikan permasalahan aliran kompresibel dengan Shock Normal. <i>Able and skilled in solving compressible flow problems with Normal Shock.</i> Mampu membangun Tabel Normal	Pembahasan Contoh Soal 13.10 Latihan Soal (pilih 4 soal diantara soal 13.100 sd 13.137 (Ref.1) dan soal 11.74 & 11.76 (Ref.Pendukung 1) <i>Discussion of Example problems 13.10</i> <i>Exercises (choose 4 questions between questions 13.100 to 13.137 (Ref 1)</i>	- Kuliah - Kerja Mandiri terstruktur - Latihan soal. [TM: 1x(3x50'')] <i>- Lecture</i> <i>- Structured Independent Work</i> <i>- Exercise</i> [TM: 2x(3x50'')]		- Aliran kompresibel dengan Shock Normal - Fungsi Aliran Normal Shock untuk Aliran Gas Ideal satu-dimensi - Aliran gabungan Fanno-Shock-Fanno dalam saluran berpenampang konstan - Aliran gabungan Rayleigh-Shock-Rayleigh dalam saluran	5



	<i>shock and cases of flow in supersonic channels with shock.</i>	Shock berdasarkan Persamaan aliran kompresibel dengan Shock Normal. <i>Able to build a Normal Shock Table based on the Compressible flow equation with a Normal Shock.</i>				berpenampang konstan - Aliran dalam Nosel Converging-Diverging dengan Shock [1: Robert W.Fox et al., Bab 13] - <i>Compressible Flow with Normal Shock</i> - <i>Normal Shock Flow Function for One-Dimensional Ideal Gas Flow</i> - <i>Combined Fanno-Shock-Fanno Flow in a Constant-Cross-Dimensional Channel</i> - <i>Combined Rayleigh-Shock-Rayleigh Flow in a Constant-Cross-Dimensional Channel</i> - <i>Flow in a Converging-</i>	



						<i>Diverging Nozzle with Shock</i> <i>[1: Robert W. Fox et al., Chapter 13]</i>	
13	Evaluasi-3 (Quis-II) – The third Evaluation (Quiz-II)						10
14-15	Mahasiswa mampu menganalisa kasus aliran kompresibel dua-dimensi: Oblique shocks dan expansion waves. <i>Students can analyze two-dimensional compressible flow cases: Oblique shocks and expansion waves.</i>	Mampu membedakan aliran antara dengan oblique shock dan expansion waves, serta terampil menyelesaikan permasalahan aliran kompresibel dengan oblique shock dan expansion waves. <i>Able to differentiate between flow with oblique</i>	Pembahasan Contoh Soal 13.11 sd 13.14 Latihan Soal (pilih 4 soal diantara soal 13.138 sd 13.159 (Ref.1) dan soal 11.74. <i>Discussion of Example problems 13.11 to 13.14 Exercises (choose 4 questions between questions 13.138 to 13.159 (Ref 1)</i>	- Kuliah - Kerja Mandiri terstruktur - Latihan soal. [TM: 1x(3x50”)] - Lecture - Structured Independent Work - Exercise [TM: 2x(3x50”)]		- Aliran dengan <i>Oblique Shocks</i> - Aliran dengan <i>Expansion waves</i> [1: Robert W.Fox et al., Bab 13] - Aliran dengan <i>Oblique Shocks</i> - Aliran dengan <i>Expansion waves</i> <i>[1: Robert W. Fox et al., Bab 13].</i> Ref: [1: Robert W.Fox et al., Bab 13]	10



		<i>shock and expansion waves, and skilled in solving compressible flow problems with oblique shock and expansion waves.</i> Mampu membangun Tabel Oblique Shock dan Expansion Waves berdasarkan Persamaan terkait. <i>Able to construct Oblique Shock and Expansion Waves Tables based on</i>					



		<i>related Equations.</i>					
16	Evaluasi Akhir Semester – Final semester exam (Final Evaluation)						10

Catatan :

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
7. **Bentuk penilaian:** tes dan non-tes.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.



11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen	
RENCANA PEMBELAJARAN SEMESTER								
MATA KULIAH (MK)		KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
Mekanika Fluida Dasar I/ <i>Basic Fluid Mechanics-I</i>		TM234303			T=2	P=0	3	22 Nopember 2023
OTORISASI		Pengembang RPS			Koordinator RMK		Ketua PRODI	
		Tri Yogi Yuwono			Sutardi		Suwarno	
Capaian Pembelajaran (CP) <i>Learning Outcomes (LO)</i>	CPL-PRODI yang dibebankan pada MK							
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (mechanical system) <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>						
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian Teknik <i>Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment</i>						
	CPL-7	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>Ability to apply the methodology, skills, and modern devices/tools which are needed for the practice of mechanical systems.</i>						



Capaian Pembelajaran Mata Kuliah (CPMK) / <i>Courses Learning Outcomes (LO)</i>																													
CPMK-1	Mampu memahami konsep dasar tentang mekanika fluida (4,6) <i>Able to analyse mathematical models and applications related to fluid statics (manometry, hydrostatic force on submerged objects, buoyancy force and stability)</i>																												
CPMK-2	Mampu menganalisa model matematika dan aplikasi yang berkaitan statika fluida (manometri, gaya hidrostatis pada benda terendam, gaya apung dan kestabilan) (4, 7) <i>Able to analyse mathematical models and applications related to fluid statics (manometry, hydrostatic force on submerged objects, buoyancy force and stability) [4,7]</i>																												
CPMK-3	Mampu menganalisa model matematika dan aplikasi yang berkaitan aliran dengan menerapkan persamaan-persamaan dasar dalam bentuk integral untuk volume atur (4, 7) <i>Able to analyse mathematical models and applications related to flow by applying basic equations in integral form for control volume.</i>																												
CPMK-4	Mampu menyusun dan menganalisis parameter dimensi menjadi tidak berdimensi untuk data eksperimen terkait keserupaan aliran antara model dan prototipe. (4, 7) <i>Able to compile and analyse dimensional parameters into dimensionless ones for experimental data related to the flow similarity between model and prototype.</i>																												
	Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-4</td><td>CPL-6</td><td>CPL-7</td><td></td></tr><tr><td>CPMK-1</td><td>V</td><td>V</td><td>-</td><td></td></tr><tr><td>CPMK-2</td><td>V</td><td>-</td><td>V</td><td></td></tr><tr><td>CPMK-3</td><td>V</td><td>-</td><td>V</td><td></td></tr><tr><td>CPMK-4</td><td>V</td><td>-</td><td>V</td><td></td></tr></table>				CPMK	CPL-4	CPL-6	CPL-7		CPMK-1	V	V	-		CPMK-2	V	-	V		CPMK-3	V	-	V		CPMK-4	V	-	V	
CPMK	CPL-4	CPL-6	CPL-7																										
CPMK-1	V	V	-																										
CPMK-2	V	-	V																										
CPMK-3	V	-	V																										
CPMK-4	V	-	V																										



Deskripsi Singkat MK <i>Brief Course Description</i>	Matakuliah mekanika fluida merupakan matakuliah wajib dalam kurikulum Program Studi Teknik Mesin. Matakuliah ini mempelajari sifat dan perilaku fluida yang berinteraksi dengan wadahnya, baik dalam kondisi diam maupun bergerak. Matakuliah ini memegang peranan penting dalam bidang rekayasa keteknikan, khususnya Teknik mesin. Secara keseluruhan matakuliah ini menyajikan dasar-dasar teoritis dan Analisa perhitungan yang komprehensif meliputi statika fluida, kinematika fluida, dinamika fluida serta konsep studi keserupaan dan analisa dimensi. <i>The fluid mechanics course is compulsory in the curriculum of the Mechanical Engineering Study Program. This course studies the properties and behaviour of fluids interacting with their containers in stationary and moving conditions. This course plays an important role in engineering, especially mechanical engineering. Overall, this course presents theoretical foundations and comprehensive calculation analysis covering fluid statics, fluid kinematics, fluid dynamics and the concept of similarity studies and dimensional analysis.</i>		
Bahan Kajian: Materi Pembelajaran <i>Course Material</i>	- Pendahuluan tentang definisi fluida, lingkup mekanika fluida, konsep fundamental, dan dilanjutkan dengan tentang statika fluida - <i>An introduction that discusses the definition of fluid, the scope of fluid mechanics, and basic concepts and continues with fluid statics.</i> - Pengembangan dan aplikasi bentuk-bentuk dari lima persamaan dasar dalam bentuk integral untuk volume atur yang meliputi persamaan konservasi massa, momentum linier, momentum angular, kekekalan energi, dan entropi. - <i>Development and application of the five basic equations in integral form for control volumes, which include the conservation equations of mass, linear momentum, angular momentum, conservation of energy, and entropy.</i> - Analisa dimensional dan kaitannya dengan data eksperimental (Buckingham Pi, protipe dan model, kesamaan aliran yang tidak lengkap, serta skala dengan beberapa parameter dependen) - <i>Analysis of dimensions and their relationship to experimental data (Buckingham Pi, prototypes and models, incomplete flow similarity, and scaling with multiple dependent parameters)</i>		
Pustaka <i>References</i>	<table border="1" data-bbox="304 1107 2036 1187"> <tr> <td data-bbox="304 1107 622 1187"> Utama/Main Reference : </td><td data-bbox="622 1107 2036 1187"></td></tr> </table> - John W. Mitchell, Fox and Alan T. McDonald, Introduction to Fluid Mechanics, 10th Edition, John Wiley & Sons Inc., New York, 2020.	Utama/Main Reference :	
Utama/Main Reference :			



		Pendukung/ <i>Supporting</i> :		1. Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Alric P. Rothmayer, Fundamentals of Fluid Mechanics , 9 th edition, John Wiley & Sons Inc., New York, 2016. 2. Frank M. White, Fluid mechanics , 9 th edition, McGraw-Hill, New York, 2020. 3. Irving Herman Shames, Mechanics of Fluid , 4 th edition, McGraw-Hill, New York, 2002.			
Dosen Pengampu <i>Lecturer</i>		1. Tri Yogi Yuwono 2. Herman Sasongko 3. Sutardi 4. Wawan Aries Widodo 5. Nur Ikhwan 6. Vivien Suphandani					
Matakuliah syarat / <i>Prerequisite</i>		Fisika Dasar I & II/Physics I & II					
Mg Ke- <i>Week-</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Sub-Learning Outcomes</i>	Penilaian <i>Evaluation</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [<i>Estimasi Waktu</i>] <i>Learning Form, Learning Method, Student Assignment, [Time Estimate]</i>		Materi Pembelajaran [<i>Pustaka</i>] <i>Learning Materials [References]</i>	Bobot Penilaian (%) <i>Assessment Weight (%)</i>
		Indikator <i>Indicators</i>	Kriteria & Bentuk	Luring (<i>offline</i>)	Daring (<i>online</i>)		



			<i>Criteria and Forms</i>				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami definisi fluida, lingkup mekanika fluida, persamaan dasar, metode analisa, serta dimensi dan unit <i>Students can understand the definition of fluid, the scope of fluid mechanics, basic equations, analysis methods, and dimensions and units.</i>	Mampu dan memahami fenomena mekanika fluida yang terkait dengan lingkup, persamaan dasar, metode menganalisa, serta dimensi dan unit. <i>Able to understand fluid mechanics phenomena related to scope, basic equations, analysis methods, as well as</i>	Diskusi <i>Discussion</i>	-Menyajikan video tentang aplikasi fenomena mekanika fluida dalam kehidupan di sekitar kita, misal: Failure of Tacoma Narrow Bridges, mobil formula-1, balap sepeda, putting beliung dlsb -Kuliah Pengantar & Brainstorming -Latihan soal [TM: 1x(2x50”)] <i>-Presenting videos about applying fluid mechanics phenomena in life around us, for example, The failure of Tacoma Narrow Bridges, formula-1 cars,</i>	-	Definisi dan Ruang Lingkup Mekanika Fluida, Persamaan Dasar, Metode Analisa, Review Dimensi dan Unit [1:Fox dkk, Bab 1] <i>Definition and Scope of Fluid Mechanics, Basic Equations, Analysis Methods, Review of Dimensions and Units.</i> [1:Fox et. Al., Chapter 1]	3



		<i>dimensions and units.</i>		<i>bicycle racing, tornadoes, etc.</i> <i>-Introductory Lecture & Brainstorming</i> <i>-Exercises</i> <i>[TM: 1x(2x50'')]</i>			
2-4	Mahasiswa mampu memahami konsep dasar mekanika fluida, medan kecepatan, medan tegangan, viskositas fluida, tegangan permukaan, serta deskripsi dan klasifikasi gerakan fluida. <i>Students can understand the basic</i>	Mampu dan memahami konsep dasar fluida tentang medan kecepatan, medan tegangan, viskositas fluida, tegangan permukaan, serta deskripsi dan klasifikasi gerakan fluida. <i>Able to understand the basic</i>	Diskusi Tugas Praktikum <i>Discussion Assignment Practical work in the Laboratory</i>	- Kuliah tatap muka - Latihan soal - Menyajikan video tentang aliran fluida [TM: 2x(2x50'')] <i>- Classroom lectures</i> <i>- Exercise</i> <i>- Video presentation on fluid flow</i>		- Konsep-konsep dasar mekanika fluida: fluida Sebagai Suatu Kontinum - Medan Kecepatan, Medan Tegangan, Viskositas, Tegangan Permukaan - Deskripsi dan Klasifikasi Gerakan Fluida [1:Fox dkk, Bab 2] <i>- Basic concepts of fluid mechanics: fluid as a continuum</i> <i>- Velocity field, stress field, viscosity, surface tension</i>	9



	concepts of fluid mechanics, velocity fields, stress fields, fluid viscosity, surface tension, and descriptions.	concepts of fluids regarding velocity fields, stress fields, fluid viscosity, and surface tension, as well as descriptions and classifications of fluid motion.				- Description and classification of fluid motion [1:Fox et al., Chapter 2]	
5	Evaluasi-1 (Quiz-1) Evaluation-1 (Quiz-1)						10
6	Mahasiswa mampu menganalisa problema statika fluida yang terkait dengan manometri, gaya hidrostatik, gaya apung,	Mampu menyelesaikan an problema statika fluida yang terkait dengan manometri, gaya hidrostatik, gaya apung,	Diskusi Tugas Praktikum Discussion Assignment Practical work in the Laboratory	- Kuliah tatap muka - Latihan soal - Praktikum [TM: 1x(2x50”)] - Classroom lectures - Exercise - Video presentation on fluid flow -		- Persamaan Dasar dari Statika Fluida, Variasi Tekanan d Fluida Statis - Gaya-gaya Hidrostatik pada Permukaan Terendam Berben-tuk	3



	dan kestabilan. <i>Students can analyze fluid statics problems related to manometry, hydrostatic forces, buoyancy forces, and stability.</i>	<i>dan kestabilan. Able to solve fluid statics problems related to manometry, hydrostatic forces, buoyancy forces, and stability.</i>				Bidang datar & Kurva - Gaya Apung dan Kestabilan [1:Fox dkk, Bab 3] - <i>Basic Equations of Fluid Statics, Pressure Variation in Static Fluids</i> - <i>Hydrostatic Forces on Submerged Surfaces in the Form of Planes & Curves</i> - <i>Buoyancy and Stability</i>	
7	Mahasiswa mampu menggunakan lima persamaan dasar untuk diubah menjadi persamaan transportasi Reynolds, dan	Mampu menggunakan persamaan dasar dalam bentuk integral untuk volume atur untuk menyelesaikan problem kekekalan massa.	Diskusi Tugas <i>Discussion Assignment</i>	- Kuliah tatap muka - Latihan soal [TM: 1x(2x50'')] - <i>Classroom lectures</i> - <i>Exercise</i> [TM: 1x(2x50'')]		Persamaan- Persamaan Dasar dalam Bentuk Integral untuk Sebuah Volume Atur: Persamaan konservasi massa [1:Fox dkk, Bab 4] - <i>Basic Equations in Integral Form for a Control Volume:</i>	5



	menggunakan persamaan konservasi massa untuk menganalisa problema mekanika fluida terkait volume atur. <i>Students can use five basic equations to be converted into Reynolds transport equations and use the mass conservation equation to analyze fluid mechanics problems related to control volumes.</i>	Able to use basic equations in integral form for control volumes to solve mass conservation problems. <i>Able to use basic equations in integral form for control volumes to solve mass conservation problems.</i>				<i>Conservation of mass equation.</i> [1:Fox et al., Chapter 4]	
8	Evaluasi Tengah Semester (Evaluasi-2) / Mid-Semester Evaluation/Exam (Evaluation-2) -						20



9-10	Mahasiswa mampu menggunakan persamaan momentum untuk menganalisa problema mekanika fluida terkait volume atur. <i>Students can use the momentum equation to analyze fluid mechanics problems related to control volumes.</i>	<i>Mampu menggunakan persamaan dasar dalam bentuk integral untuk volume atur untuk menyelesaikan problem persamaan momentum linier, baik untuk volume atur diam maupun bergerak dengan kecepatan konstan.</i> <i>Able to use basic equations in</i>	Diskusi Tugas <i>Discussion Assignment</i>	- Kuliah tatap muka - Latihan soal [TM: 2x(2x50”)] <i>- Classroom lectures - Exercise [TM: 2x(2x50”)]</i>		Persamaan Momentum untuk Volume Atur yang Diam dan Bergerak dengan Kecepatan Konstan [1:Fox dkk, Bab 4] <i>Momentum Equation for Control Volumes at Inertial and Moving with Constant Velocity.</i> [1:Fox et al., Chapter 4]	6



		<i>integral form for control volumes to solve linear momentum equation problems, both for control volumes at rest and moving at constant velocity.</i>					
11	Mahasiswa mampu menggunakan persamaan momentum angular dalam bentuk control volume untuk menganalisa problema mekanika fluida	Mampu menggunakan persamaan momentum sudut dalam bentuk integral untuk volume kontrol tetap dan memecahkan masalah	Diskusi <i>Discussion</i>	- Kuliah tatap muka - Latihan soal [TM: 1x(2x50")] - <i>Classroom lectures</i> - <i>Exercise</i> [TM: 1x(2x50")]		Prinsip Momentum Angular untuk Volume Atur yang Diam [1:Fox dkk, Bab 4] <i>Angular Momentum Principle for Fixed Control Volume</i> [1:Fox et al., Chapter 4]	4



	<i>Students can use the angular momentum equation in control volume form to analyze fluid mechanics problems.</i>	momentum sudut. <i>Able to use the angular momentum equation in integral form for a fixed control volume and solve angular momentum problems.</i>					
12	Evaluasi-3 (Quis-II)/ <i>Evaluation-3 (Quiz-II)</i>						10
13	Mahasiswa dapat menggunakan persamaan konservasi energi dan entropi dasar dalam bentuk kontrol volume untuk	Mampu menggunakan persamaan dasar dalam bentuk integral kontrol volume untuk	Diskusi Tugas <i>Discussion Assignment</i>	- Kuliah tatap muka - Latihan soal [TM: 1x(2x50”)] <i>- Classroom lectures</i> <i>- Exercise</i> [TM: 1x(2x50”)]		- Hukum Termodinamika I (Energi) - Hukum Termodinamika II (Entropy) [1:Fox dkk, Bab 4]	4



	menganalisis masalah mekanika fluida. <i>Students can use basic energy and entropy conservation equations in control volume form to analyze fluid mechanics problems.</i>	menyelesaikan problem kekekalan energi dan entropi. <i>Able to use basic equations in the form of control volume integrals to solve energy conservation and entropy problems.</i>				- <i>First Law of Thermodynamics (Energy)</i> - <i>Second Law of Thermodynamics (Entropy)</i> [1:Fox et al., Chapter 4]	
14-15	Mahasiswa mampu menganalisa persamaan tak berdimensi, kesamaan aliran dan studi model, serta skala		Diskusi Tugas <i>Discussion Assignment</i>	- Kuliah tatap muka - Latihan soal - Menyajikan video tentang eksperimental model di terowongan angin [TM: 2x(2x50")]		- Analisa Bilangan tak berdimensi - Teori Buckingham Pi - Kelompok-Kelompok Tanpa Dimensi didalam Mekanika Fluida - Kesamaan Aliran dan Studi Model	6



	untuk parameter dependen lebih dari satu <i>Students can analyze non-dimensional equations, flow similarities and model studies, as well as scales for more than one dependent parameter.</i>			<i>- Classroom lectures</i> <i>- Exercise</i> <i>- Presenting a video about experimental models in a wind tunnel</i> [TM: 2x(2x50")]		[1:Fox dkk, Bab 7] <i>- Dimensionless Analysis</i> <i>- Buckingham Pi Theory</i> <i>- Dimensionless Groups in Fluid Mechanics</i> <i>- Flow Similarities and Model Studies</i> [1:Fox et al. Chapter 7]	
16	Evaluasi Akhir Semester / Final-Semester Evaluation/Exam (Evaluation-4)						20

Catatan :

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.



3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
7. **Bentuk penilaian:** tes dan non-tes.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



					RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM			Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER								
MATA KULIAH (MK)		KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
Aliran Multifase untuk Sistem Aerasi		TM234745	Mekanika Fluida		T=3 P=0		6	22 Mei 2025
OTORISASI		Pengembang RPS		Koordinator RMK			Ketua PRODI	
		Nur Ikhwan		Sutardi			Is Bunyamin Suryo	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK							
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (mechanical system)						
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu dan teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global.						
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika.						
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik.						
	Capaian Pembelajaran Mata Kuliah (CPMK)							
	CPMK-1	Mahasiswa mampu memahami konsep dasar aliran multifase						
	CPMK-2	Mahasiswa mampu memahami konsep dasar dan aplikasi sistem aerasi di sistem pengolahan air						



	CPMK-3	Mahasiswa mampu melakukan perhitungan peningkatan kadar Oksigen terlarut pada penggunaan alat aerasi				
	CPMK-4	Mahasiswa mampu melakukan simulasi numerik untuk aliran multifase air-udara				
	CPMK-5	Mahasiswa mampu melakukan simulasi numerik untuk gelembung udara dalam air				
		Matrik CPL – CPMK				
		CPMK	CPL-4	CPL-5	CPL-7	CPL-8
		CPMK-1	V			
		CPMK-2		V		
		CPMK-3		V		
		CPMK-4			V	V
		CPMK-5			V	V
Deskripsi Singkat MK	Kuliah ini merupakan topik khusus dari materi kuliah: Metode Komputasi Fluida (Analisa diferensial aliran fluida) untuk aliran multi fase udara-air. Analisa detail dilakukan dengan perangkat lunak CFD, ANSYS Fluent.					
Bahan Kajian: Materi Pembelajaran	1. Klasifikasi aliran multi fase 2. Proses aerasi dalam pengolahan air 3. Analisa empiris proses aerasi 4. Pemodelan CFD untuk aliran multi fase udara-air 5. Pemodelan CFD untuk gelembung udara di dalam air					
Pustaka	Utama :					
	[1]. James A. Mueller, W.C. Boyle, H.J. Popel, “AERATION: Principles and Practices					
	Pendukung :					
	[2]. Versteek Malalasakera, Computational Fluid Dynamics, Finite Volume Methods.					



	[3]. Anonim, Fluent Documentation, Theory Manual, Fluent. Inc., 1996.						
Dosen Pengampu	Nur Ikhwan, Triyogi Yuwono, Gunawan.						
Matakuliah syarat	Metode Komputasi Fluida						
Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1,2	Mahasiswa memahami mekanisme fisik aliran multi fase	mampu memahami konsep-konsep dasar CFD	Quiz	Perkuliahan [TM: 2x50"] Belajar Terstruktur [TM: 2x60"] Belajar Mandiri [TM: 2x60"]	SAP Hands out Quiz	- Pendahuluan - Klasifikasi aliran multi fase - Aplikasi Aliran multi fase di dunia industri - Konfigurasi aliran dua fase - Persamaan Monofase (review) - persamaan global (integral) persamaan lokal/diferensial (transformasi pers integral ke diferensial)	5%



						[1]: Bab 2 [1]: Bab 3	
3,4	Mahasiswa mampu memahami aplikasi aliran multi fase dalam proses aerasi di proses pengolahan air	memahami aplikasi aliran multi fase dalam proses aerasi di proses pengolahan air		Perkuliahan [TM: 2x50"] Belajar Terstruktur [TM: 2x60"] Belajar Mandiri [TM: 1x60"]		• Proses aerasi dalam pengolahan air minum • Monitoring kualitas air dalam proses aerasi • Perhitungan praktis kapasitas aerasi • Praktek di lapangan (IPAM PDAM) [1]: Bab 4 [1]: Bab 5	10%
5	Evaluasi Tengah Semester (Case study di lapangan tentang performa aerator, khususnya pada peningkatan kadar DO)						
6	Mahasiswa memahami pemodelan aliran multi fase	memahami pemodelan aliran multi fase Eulerian Model	Tugas Kelompok	- Perkuliahan [TM: 1x50"] - Belajar Terstruktur [TM: 1x60"] - Belajar Mandiri [TM: 1x60"] - Tugas simulasi dengan software CFD [TM: 1x60"]	Hands out Tugas	- Penggunaan metode Eulerian Model [3]: Bab 14	10%
7,8	Mahasiswa memahami pemodelan aliran multi fase	memahami pemodelan aliran multi fase	Tugas Kelompok	- Perkuliahan [TM: 1x50"] - Belajar Terstruktur [TM: 1x60"]	Hands out Tugas	- Penggunaan metode Volume of Fluid Model - Pengaruh pemakaian model turbulensi terhadap akurasi hasil	15%



				- Belajar Mandiri [TM: 1x60"] - Tugas simulasi dengan software CFD [TM: 1x60"]		[3]: Bab 14	
9, 10	Mahasiswa mampu melakukan simulasi CFD untuk memodelkan proses aerasi	mampu melakukan simulasi CFD untuk memodelkan proses aerasi	Tugas Mandiri	- Perkuliahan [TM: 3x50"] - Belajar Terstruktur [TM: 3x60"] - Belajar Mandiri [TM: 1x60"] - Tugas simulasi dengan software Gambit [TM: 3x60"]	Hands out Video tutorial Tugas	- Pengaturan dan set up simulasi multi fase - Add-on Population Bubble Method (PBM) dalam aliran multi fase	15%
11, 12	Mahasiswa mampu melakukan simulasi CFD untuk memodelkan proses aerasi	mampu melakukan simulasi CFD untuk memodelkan proses aerasi	Tugas Mandiri	- Perkuliahan [TM: 3x50"] - Belajar Terstruktur [TM: 3x60"] - Belajar Mandiri [TM: 1x60"] - Tugas simulasi dengan software Gambit [TM: 3x60"] -	Hands out Tugas	- Simulasi gelembung pada column flow - Simulasi Oxygen transfer pada column flow	15%



12,13	Mahasiswa mampu melakukan simulasi CFD untuk memodelkan proses aerasi	mampu melakukan simulasi CFD untuk memodelkan proses aerasi	Tugas Mandiri	- Perkuliahan [TM: 3x50"] - Belajar Terstruktur [TM: 3x60"] - Belajar Mandiri [TM: 1x60"] - Tugas simulasi dengan software Gambit [TM: 3x60"]	Hands out Tugas	- Simulasi gelembung pada open channel flow - Simulasi Oxygen transfer pada open channel flow flow [3]: Bab 14,15	15%
14,15	Mahasiswa mampu melakukan simulasi dan validasi untuk aliran gelembung dalam air	mampu melakukan simulasi dan validasi untuk aliran gelembung dalam air	Tugas Mandiri	- Perkuliahan [TM: 3x50"] - Belajar Terstruktur [TM: 3x60"] - Belajar Mandiri [TM: 2x60"] - Tugas simulasi dengan software CFD [TM: 2x60"]	Hands out Tugas	- Simulasi karakteristik gelembung dan oksigen transfer dalam aliran multi-fase. Studi kasus untuk variasi ukuran dan debit relatif gelembung [3]: Bab 14	15%
16	Evaluasi Akhir Semester / Ujian Akhir Semester						

Catatan :

21. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.



22. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
67. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
24. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
25. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
26. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
27. **Bentuk penilaian:** tes dan non-tes.
28. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
29. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
30. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
31. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
32. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



		INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)							
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)	
MESIN FLUIDA INKOMPRESIBEL Incompressible Fluid Machinery	TM234622	MEKANIKA FLUIDA & MESIN FLUIDA	T = 3	P = 0	PILIHAN	5 Mei 2023	
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)		
	Herman Sasongko	Sutardi			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.		
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)						
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)					



	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>(Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources)</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>(Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>(Ability to identify, formulate, analyze, and solve technical problems)</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)	
	CPMK-1	Mahasiswa mampu menjelaskan klasifikasi, komponen2, prinsip kerja serta aplikasi mesin fluida inkompresibel yang ada di lapangan/ industri <i>Students are able to explain the classification, components, working principles, and applications of incompressible fluid machines used in the field or industry.</i>
	CPMK-2	Mahasiswa mampu membedakan berbagai karakteristik serta melakukan pemilihan pompa & turbin sesuai dengan fungsi pada titik kerja dengan efisiensi optimum. <i>Students are able to differentiate various characteristics and select pumps and turbines according to their function at the operating point with optimal efficiency.</i>



	CPMK-3	Mahasiswa mampu melakukan dasar-dasar perancangan mesin fluida inkompresibel <i>Students are able to carry out the fundamentals of designing incompressible fluid machines.</i>																																		
	CPMK-4	Mahasiswa mampu mengukur & menghitung unjuk kerja mesin fluida inkompresibel (head, kapasitas, daya dan efisiensi). <i>Students are able to measure and calculate the performance of incompressible fluid machines (head, capacity, power, and efficiency).</i>																																		
	CPMK-5	Mahasiswa mampu menjelaskan operasi, dasar2 perawatan & trouble shooting mesin fluida inkompresibel. <i>Students are able to explain the operation, basic maintenance, and troubleshooting of incompressible fluid machines.</i>																																		
		Matrik CPL – CPMK <table><tr><td>CPMK</td><td>CPL-4</td><td>CPL-5</td><td>CPL-6</td><td>CPL-8</td></tr><tr><td>CPMK-1</td><td></td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-2</td><td>V</td><td></td><td></td><td></td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td></td><td></td></tr><tr><td>CPMK-4</td><td></td><td></td><td></td><td>V</td></tr><tr><td>CPMK-5</td><td></td><td></td><td>V</td><td>V</td></tr></table>					CPMK	CPL-4	CPL-5	CPL-6	CPL-8	CPMK-1		V	V		CPMK-2	V				CPMK-3	V	V			CPMK-4				V	CPMK-5			V	V
CPMK	CPL-4	CPL-5	CPL-6	CPL-8																																
CPMK-1		V	V																																	
CPMK-2	V																																			
CPMK-3	V	V																																		
CPMK-4				V																																
CPMK-5			V	V																																
Deskripsi Singkat MK <i>(Short Description of Course)</i>	Review mekanika fluida, prinsip kerja pompa positive displacement dan pompa roto dinamik, perhitungan kapasitas aliran dan kenaikan tekanan pompa reciprocating dan pompa rotary, dasar-dasar perencanaan impeller pompa, karakteristik dan operasi pompa, klasifikasi turbin air, dan dasar-dasar perencanaan impeller turbin air. <i>Review of fluid mechanics, working principles of positive displacement pumps and rotodynamic pumps, calculation of flow capacity and pressure rise in reciprocating and rotary pumps, fundamentals of pump impeller design, pump characteristics and operation, classification of water turbines, and fundamentals of water turbine impeller design.</i>																																			



Bahan Kajian: Materi Pembelajaran <i>(Course Materials)</i>	- Pendahuluan: Klasifikasi, komponen, prinsip kerja serta aplikasi mesin fluida incompressible di industri - Review mekanika fluida: Pers. energi, Pers. Euler dalam mesin fluida; Perhitungan performance: Head efektif pompa, kapasitas, daya dan efisiensi yang dihasilkan pompa, serta kecepatan spesifik. - Pompa positive displacement: Klasifikasi pompa (screw, vane, gear, reciprocating) dan prinsip kerja. Karakteristik kerja, komponen utama dan pendukung. - Pompa dinamik: Klasifikasi pompa (axial & sentrifugal) dan prinsip kerja, kecepatan spesifik, pemilihan pompa. - Dasar-dasar perencanaan impeller pompa: Segitiga kecepatan, Head yang dihasilkan pompa, pengaruh sudut sudu keluar terhadap head dan kurva head-kapasitas. - Karakteristik pompa: karakteristik utama, karakteristik kerja, karakteristik universal, gabungan seri & paralel, circuit kompleks. - Operasi pompa: Membalance gaya aksial, Unstable operation (surging), dasar-dasar perawatan pompa sentrifugal. - Turbin air: Klasifikasi (impuls & reaksi, Pelton, Francis, Kaplan), komponen, prinsip kerja serta aplikasi turbin. - Dasar-dasar perencanaan impeller turbin air: analisa segitiga kecepatan. • <i>Introduction: Classification, components, working principles, and applications of incompressible fluid machines in industry.</i> • <i>Review of Fluid Mechanics: Energy equation, Euler's equation in fluid machinery; performance calculations: effective pump head, capacity, power, efficiency produced by the pump, and specific speed.</i> • <i>Positive Displacement Pumps: Classification of pumps (screw, vane, gear, reciprocating) and their working principles. Performance characteristics, main and supporting components.</i> • <i>Dynamic Pumps: Classification of pumps (axial & centrifugal) and their working principles, specific speed, pump selection.</i> • <i>Fundamentals of Pump Impeller Design: Velocity triangle, pump-generated head, effect of outlet blade angle on head and head-capacity curve.</i> • <i>Pump Characteristics: Main characteristics, performance characteristics, universal characteristics, series & parallel combinations, complex circuits.</i> • <i>Pump Operation: Balancing axial force, unstable operation (surging), basic maintenance of centrifugal pumps.</i> • <i>Water Turbines: Classification (impulse & reaction, Pelton, Francis, Kaplan), components, working principles, and applications of turbines.</i> • <i>Fundamentals of Water Turbine Impeller Design: Analysis of velocity triangles.</i>
Pustaka	Utama :



(References)C	(Main)	1. M. Khetagurov, 1954, “Marine Auxiliary Machinery and Systems”, Peace Publishers Moscow. 2. Robert, W. Fox & Alan T. McDonald, 2010, ”Introduction to Fluid Mechanics”, 7 th ed., John Wiley & Sons, Inc, Asia. 3. Kothandaraman C.P, 2007, "Fluid Mechanics and Machinery", 2nd edition, New Age International Publisher, New Delhi Sularso dan H. Tahara, 2000, “Pompa dan Kompresor”, Pradnya Paramita, Jakarta					
	Pendukung :	Pendukung :					
	4. I. Karassik, J.P. Messina, P. Cooper, dan C. Heald, 2001, ”Pump Handbook”. 3rd ed, McGraw Hill, New York. 5. Lazarkiewicz, S. and Troskolanski, A.T.,1965, “Impeller Pump”, New York, Pergamon Press. 6. Nourbakhsh, Ahmad, 2008, ”Turbo Pumps and Pumping Systems”, Springer-Verlag. 7. Wagner, H.J. dan J. Mathur, 2011, ”Introduction to Hydro Energy Systems”, Springer-Verlag.						
	1.						
Dosen Pengampu (Lecturers)		Triyogi Yuwono, Herman Sasongko					
Matakuliah syarat (Prerequisites)		Mekanika Fluida Dasar 1, Mekanika Fluida Dasar 2, Mesin Konversi Energi Basic Fluid Mechanics 1, Basic Fluid Mechanics 2, Energy Conversion Machines					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami Klasifikasi, komponen, prinsip	Mampu memahami klasifikasi, komponen,	Diskusi Discussion	- Video: Contoh mesin- mesin fluida - Kuliah		Mesin Fluida inkompresibel: -. Klasifikasi -. komponen,	



	kerja serta aplikasi mesin fluida incompressible di industri <i>Students are able to understand the classification, components, working principles, and industrial applications of incompressible fluid machines.</i>	prinsip kerja serta aplikasi mesin fluida incompressible di industri. <i>Able to understand the classification, components, working principles, and industrial applications of incompressible fluid machines.</i>		Video: Examples of fluid machines Lecture [TM: 1 x (3x50'')]		-. prinsip kerja -. Aplikasi <i>Incompressible Fluid Machines:</i> • Classification • Components • Working Principles • Applications [3. Chp. 14-16]	
2	Mahasiswa mampu menganalisa dan memahami Pers. energi, Pers. Euler dalam mesin fluida <i>Students are able to analyze and understand the energy equation and</i>	Mampu menganalisa dan memahami Pers. energi, Pers. Euler dalam mesin fluida. <i>Able to analyze and understand the energy</i>	Diskusi <i>Discussion</i>	- Kuliah <i>Lecture</i> [TM: 1 x (3x50'')]		-. Pers. energi, -. Pers. Euler [2. Chp. 4 dan 10]	



	<i>Euler's equation in fluid machinery.</i>	<i>equation and Euler's equation in fluid machinery.</i>					
3	Mahasiswa mampu menganalisa dan memahami head efektif pompa, kapasitas, daya dan efisiensi yang dihasilkan pompa, serta kecepatan spesifik. <i>Students are able to analyze and understand the effective head of the pump, capacity, power, and efficiency generated by the pump, as well as specific speed.</i>	Mampu menganalisa dan memahami head efektif pompa, kapasitas, daya dan efisiensi yang dihasilkan pompa, serta kecepatan spesifik. <i>Able to analyze and understand the effective head of the pump, capacity, power, and efficiency generated by the pump, as well as the specific speed.</i>	Tugas : literature review terkait materi kuliah minggu 1 – 3 <i>Task: Literature Review Related to Lecture Material Week 1 - 3</i>	- Kuliah - diskusi <i>-Lecture -Discussion</i> [TM: 1 x (3 x 50'')]		- head efektif dan kapasitas pompa - daya dan efisiensi pompa - kecepatan spesifik. <i>Effective head and pump capacity</i> <i>Power and efficiency of pumps</i> <i>Specific speed</i> [1. Chp. 1]	5



4	Mahasiswa mampu memahami Klasifikasi dan prinsip kerja pompa positive displacement (screw, vane, gear, reciprocating) <i>Students are able to understand the classification and working principles of positive displacement pumps (screw, vane, gear, reciprocating).</i>	Mampu memahami Klasifikasi dan prinsip kerja pompa positive displacement (screw, vane, gear, reciprocating) <i>Able to understand the classification and working principles of positive displacement pumps (screw, vane, gear, reciprocating).</i>	Diskusi <i>Discussion</i>	- Kuliah - diskusi <i>-Lecture -Discussion</i> [TM: 1 x (3 x 50'')]		Klasifikasi dan prinsip kerja pompa positive displacement: - Screw pump - Vane pump - Gear pum - Reciprocating pump <i>Classification and working principles of positive displacement pumps:</i> <i>Screw pump</i> <i>Vane pump</i> <i>Gear pump</i> <i>Reciprocating pump</i> [1. Chp. 1]	
5	Mahasiswa mampu memahami Karakteristik kerja, komponen utama dan pendukung	Mampu memahami Karakteristik kerja, komponen utama dan	Diskusi <i>Discussion</i>	- Kuliah <i>-Lecture</i> [TM: 1 x (3 x 50'')]		- Karakteristik kerja - komponen utama dan pendukung pompa positive displacement.	



	pompa positive displacement. <i>Students are able to understand the working characteristics, main components, and supporting components of positive displacement pumps.</i>	pendukung pompa positive displacement. <i>Mampu memahami Karakteristik kerja, komponen utama dan pendukung pompa positive displacement.</i>				• <i>Working characteristics</i> • <i>Main components and supporting components of positive displacement pumps.</i> [1. Chp. 1]	
6	Mahasiswa mampu memahami komponen utama dan pendukung, klasifikasi dan prinsip kerja pompa roto dinamik (aksial & sentrifugal) <i>Students are able to understand the main and</i>	Mampu memahami komponen utama dan pendukung, klasifikasi dan prinsip kerja pompa dinamik (aksial & sentrifugal) <i>Able to understand the</i>	Tugas: literature review materi kuliah minggu 4 – 6 <i>Assignment: Literature review on the course material for weeks 4 - 6.</i>	- Kuliah - Video <i>-Lecture -Video</i> [TM: 1 x (3 x 50'')]		Pompa dinamik (aksial & sentrifugal) - komponen utama dan pendukung - klasifikasi dan prinsip kerja <i>Dynamic pumps (axial & centrifugal)</i> • <i>Main and supporting components</i>	5



	<i>supporting components, classification, and working principles of roto-dynamic pumps (axial & centrifugal).</i>	<i>main and supporting components, classification, and working principles of dynamic pumps (axial & centrifugal).</i>				• <i>Classification and working principles</i> [1. Chp. 1]	
7	Mahasiswa mampu memahami dan menganalisa Karakteristik kerja, kecepatan spesifik, dan pemilihan pompa roto dinamik. <i>Students are able to understand and analyze the working characteristics, specific speed, and selection of roto-dynamic pumps.</i>	Mampu memahami dan menganalisa Karakteristik kerja, kecepatan spesifik, dan pemilihan pompa dinamik. <i>Able to understand and analyze the working characteristics, specific speed, and selection of dynamic pumps.</i>	Diskusi <i>Discussion</i>	- Kuliah - Video <i>-Lecture -Video</i> [TM: 1 x (3 x 50'')]		Pompa dinamik: - Karakteristik kerja - kecepatan spesifik - pemilihan <i>Dynamic pumps:</i> • <i>Working characteristics</i> • <i>Specific speed</i> • <i>Selection</i> [1. Chp. 1]	



8	Evaluasi Tengah Semester / Ujian Tengan Semester : presentasi kelompok project design instalasi, pemilihan tipe pompa, dan prinsip transfer energi poros menjadi energi fluida pada pompa yang dipilih. <i>Group presentation on project design installation, pump type selection, and the principles of shaft energy transfer to fluid energy in the selected pump.</i> (Midterm Exam)					30
9	Mahasiswa mampu memahami dan menganalisa Segitiga kecepatan, Head yang dihasilkan pompa, pengaruh sudut sudu keluar terhadap head dan kurva head-kapasitas. <i>Students are able to understand and analyze the velocity triangle, the head produced by the pump, the effect of the exit blade angle on the head, and the head-capacity curve.</i>	Mampu memahami dan menganalisa Segitiga kecepatan, Head yang dihasilkan pompa, pengaruh sudut sudu keluar terhadap head dan kurva head-kapasitas. <i>Able to understand and analyze the velocity triangle, the head produced by the pump, the effect of the exit blade</i>	Diskusi <i>Discussion</i>	- Kuliah - diskusi <i>-Lecture -Discussion</i> [TM: 1 x (3 x 50")]	Pompa dinamik: -. Segitiga kecepatan -. Head yang dihasilkan -. pengaruh sudut sudu keluar terhadap head dan kurva head-kapasitas. <i>Dynamic pumps:</i> • <i>Velocity triangle</i> • <i>Head produced</i> • <i>Effect of the exit blade angle on the head and head-capacity curve.</i> [1. Chp. 1]	



		<i>angle on the head, and the head-capacity curve.</i>					
10	Mahasiswa mampu menganalisa karakteristik utama, karakteristik kerja, karakteristik universal, gabungan seri & paralel, circuit komplek. <i>Students are able to analyze the main characteristics, operating characteristics, universal characteristics, series & parallel combinations, and complex circuits.</i>	Mampu menganalisa karakteristik utama, karakteristik kerja, karakteristik universal, gabungan seri & paralel, circuit komplek. <i>Able to analyze the main characteristics, operating characteristics, universal characteristics, series & parallel combinations, and complex circuits.</i>	Praktikum <i>Practical session.</i>	- Kuliah Praktikum • <i>Lecture</i> • <i>Practical session</i>		Pompa dinamik: - karakteristik utama - karakteristik kerja - karakteristik universal - karakteristik gabungan pompa seri & paralel - karakteristik pompa pada circuit komplek. <i>Dynamic pumps:</i> <i>Main characteristics</i> <i>Operating characteristics</i> <i>Universal characteristics</i> <i>Characteristics of series & parallel pump combinations</i> <i>Characteristics of pumps in complex circuits.</i>	10



						[1. Chp. 1]	
11	Mahasiswa mampu memahami Operasi pompa: membalance gaya aksial dan operasi Unstable (surging) <i>Students are able to understand pump operation: balancing axial forces and unstable operation (surging).</i>	Mampu memahami Operasi pompa: membalance gaya aksial dan operasi Unstable (surging) <i>Able to understand pump operation: balancing axial forces and unstable operation (surging).</i>	Diskusi <i>Discussion</i>	- Kuliah - Video visualisasi pengukuran aliran internal <i>Lecture</i> <i>Video visualization of internal flow measurement</i> [TM: 1 x (3 x 50'')]		Operasi pompa dinamik: membalance gaya aksial dan operasi Unstable (surging) <i>Dynamic pump operation: balancing axial forces and unstable operation (surging).</i> [1. Chp. 1]	
12	Mahasiswa mampu memahami Operasi pompa: dasar-dasar perawatan pompa sentrifugal. <i>Students are able to understand pump</i>	Mampu memahami Operasi pompa: dasar-dasar perawatan pompa sentrifugal.	Diskusi <i>Discussion</i>	- Kuliah <i>Lecture</i> [TM: 1 x (3 x 50'')]		- Operasi pompa dinamik: dasar-dasar perawatan pompa sentrifugal <i>Dynamic pump operation: basic</i>	



	<i>operation: basic maintenance of centrifugal pumps.</i>	<i>Able to understand pump operation: basic maintenance of centrifugal pumps.</i>				<i>maintenance of centrifugal pumps.</i> [4. Chp. 7]	
13	Mahasiswa mampu memahami dan menganalisa klasifikasi dan prinsip kerja Turbin air: (impuls & reaksi, Pelton, Francis, Kaplan). <i>Students are able to understand and analyze the classification and working principles of water turbines: (impulse & reaction, Pelton, Francis, Kaplan).</i>	Mampu memahami dan menganalisa klasifikasi dan prinsip kerja Turbin air: (impuls & reaksi, Pelton, Francis, Kaplan). <i>Able to understand and analyze the classification and working principles of water turbines: (impulse & reaction, Pelton, Francis, Kaplan).</i>	Diskusi <i>Discussion</i>	- Kuliah - Video Turbin air • <i>Lecture</i> • <i>Water turbine video</i> [TM: 1 x (3 x 50'')]		- Klasifikasi dan prinsip kerja Turbin air: (impuls & reaksi, Pelton, Francis, Kaplan). • <i>Classification and working principles of water turbines: (impulse & reaction, Pelton, Francis, Kaplan).</i> [3. Chp. 14]	



14	Mahasiswa mampu memahami menganalisa komponen dan dasar-dasar perencanaan impeller turbin air: analisa segitiga kecepatan. <i>Students are able to understand and analyze the components and basic design of water turbine impellers: velocity triangle analysis.</i>	Mampu memahami menganalisa komponen dan dasar-dasar perencanaan impeller turbin air: analisa segitiga kecepatan. <i>Able to understand and analyze the components and basic design of water turbine impellers: velocity triangle analysis.</i>	Tugas <i>Assignment</i>	- Kuliah - Latihan soal • <i>Lecture</i> • <i>Practice exercises</i> [TM: 1 x (3 x 50'')]		- komponen dan dasar-dasar perencanaan impeller turbin air: analisa segitiga kecepatan. <i>Components and basic design of water turbine impellers: velocity triangle analysis.</i> [3. Chp. 14]	5
15	Mahasiswa mampu memahami aplikasi turbin air. <i>Students are able to understand the</i>	Mampu memahami aplikasi turbin air.	Diskusi Praktikum <i>Discussion Practical session</i>	- Kuliah - Video turbin air - praktikum • <i>Lecture</i> • <i>Water turbine video</i>		- Aplikasi turbin air • <i>Applications of water turbines</i> [8. Chp. 5]	10



	<i>applications of water turbines.</i>	<i>Able to understand the applications of water turbines.</i>		<i>Practical session</i> [TM: 1 x (3 x 50'')]			
16	Evaluasi Akhir Semester / Ujian Akhir Semester : presentasi kelompok project design instalasi, pemilihan tipe, prinsip transfer energi fluida menjadi energi poros dan perhitungan geometri utama rotor turbin air yang dipilih. <i>group presentation on project design installation, selection of type, principles of fluid energy transfer to shaft energy, and calculation of the main geometry of the selected water turbine rotor.</i> (Final Exam)						35



 RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM					Kode Dokumen	
RENCANA PEMBELAJARAN SEMESTER <i>SEMESTER COURSE PLAN</i>						
MATA KULIAH (MK) <i>COURSE NAME</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Group</i>	BOBOT (sks) <i>Credit</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>Date</i>
Mesin Konversi Energi <i>Energy Conversion</i>	TM234505 <i>TM234505</i>	MEKANIKA FLUIDA & MESIN FLUIDA <i>FLUID MECHANICS AND FLUID MACHINERY</i>	T = 3 <i>(Lecture = 3)</i>	P = 0 <i>(Lab = 0)</i>	5 (V)	5 Mei 2023 <i>May 5, 2023</i>
OTORISASI <i>AUTHORITATION</i>	Pengembang RPS <i>Course Plan Authority</i>		Koordinator RMK <i>Course Plan Coordinator</i>		Ketua PRODI <i>Head of Study Program</i>	
	Sutardi		Sutardi		Atok Setyawan	
Capaian Pembelajaran an (CP) <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>Study Program Learning Outcomes Assigned to Courses</i>					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>				



CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources</i>
CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment</i>
CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>Ability to identify, formulate, analyze, and solve technical problems</i>
Capaian Pembelajaran Mata Kuliah (CPMK)	
CPM K-1	Mahasiswa mengetahui dan memahami sumber energi tidak terbarukan dan energi terbarukan yang dapat dikonversi dalam bentuk energi thermal dan non-thermal <i>Students know and understand non-renewable energy and renewable energy sources that can be converted into thermal and non-thermal energy forms.</i>
CPM K-2	Mahasiswa mampu merumuskan dan menganalisa prinsip kerja dan unjuk kerja peralatan dalam bentuk konversi energi thermal <i>Students are able to formulate and analyze the working principles and performance of equipment in the form of thermal energy conversion.</i>
CPM K-3	Mahasiswa mampu merumuskan dan menganalisa prinsip kerja dan unjuk kerja peralatan dalam bentuk konversi energi non-thermal <i>Students are able to formulate and analyze the working principles and performance of equipment in the form of non-thermal energy conversion</i>



	CPM K-4	Mahasiswa mampu merumuskan dan menganalisa konversi sistem pembangkit daya thermal dengan beragam peralatan dan unjuk kerja sistem. studi kasus Pembangkit Listrik Tenaga Uap (PLTU), Pembangkit Listrik Gas dan Uap (PLTGU), dan Integrated Gasification Power Plant (IGCC) <i>Students are able to formulate and analyze the conversion of thermal power generation systems with various equipment and their performances. Case study: Steam Power Plants (PLTU), Gas and Steam Power Plants (PLTGU), and Integrated Gasification Power Plants (IGCC).</i>																													
		Matrik CPL – CPMK (<i>Study Program – Course Learning outcome Matrix</i>) <table><tr><td>CPMK</td><td>CPL-4</td><td>CPL-5</td><td>CPL-6</td><td>CPL-8</td></tr><tr><td>CPMK-1</td><td></td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-2</td><td>V</td><td></td><td></td><td></td></tr><tr><td>CPMK-3</td><td>V</td><td>V</td><td></td><td></td></tr><tr><td>CPMK-4</td><td></td><td></td><td>V</td><td>V</td></tr></table>					CPMK	CPL-4	CPL-5	CPL-6	CPL-8	CPMK-1		V	V		CPMK-2	V				CPMK-3	V	V			CPMK-4			V	V
CPMK	CPL-4	CPL-5	CPL-6	CPL-8																											
CPMK-1		V	V																												
CPMK-2	V																														
CPMK-3	V	V																													
CPMK-4			V	V																											
Deskripsi Singkat MK Course Brief Description	Macam energi dan sumber-sumber energi, cara kerja mesin-mesin konversi energi, baik konvensional maupun non-konvensional Analisa karakteristik dasar dan unjuk kerja mesin-mesin konversi energi <i>Types of energy and energy sources, how conventional and non-conventional energy conversion machines work.h</i> <i>Analysis of basic characteristics and performance of energy conversion machines</i>																														
Bahan Kajian: Materi	a). Pengantar Konversi Energi b). Mesin-Mesin Konversi Energi Konvensional 1. Motor Pembakaran Dalam: Motor Bensin, Motor Diesel, dan Turbin Gas 2. Motor Pembakaran Luar: Pembangkit Turbin uap																														



Pembelajaran an <i>Course</i> <i>Content</i>	3. Mesin-Mesin Fluida 4. Mesin Refrigerasi C). Mesin-Mesin Konversi Energi Non-konvensional: 1. Turbin Air 2. Turbin Angin 3. Photovaltaic Cell (Sel Surya) 4. Ocean Thermal energy conversion (OTEC) 5. Wave and Tidal Wave Energy conversion 6. Energi Nuklir 7. Sel bahan bakar (fuel cell) <i>a). Introduction to Energy Conversion</i> <i>b). Conventional Energy Conversion Machines</i> <i>1. Internal Combustion Engines: Gasoline Engines, Diesel Engines, and Gas Turbines</i> <i>2. External Combustion Engines: Steam Turbine</i> <i>3. Fluid Machinerics</i> <i>4. Refrigeration Systems</i> <i>C). Non-conventional Energy Conversion Machines:</i> <i>1. Water Turbines</i> <i>2. Wind Turbines</i> <i>3. Photovaltaic Cells (Solar Cells)</i> <i>4. Ocean Thermal energy conversion (OTEC)</i> <i>5. Wave and Tidal Wave Energy conversion</i> <i>6. Nuclear Energy</i> <i>7. Fuel cells</i>



Pustaka <i>ReferenceS</i>	Utama : Main:	
		1. Pudjanarsa, A. and Nursuhud, D., "Mesin Konversi Energi", Edisi kedua, Penerbit Andi, Yogyakarta, 2009, 2. A.K. Raja, Amit Prakash Srivastava, Manish Dwivedi, "Power Plant Engineering", New Age International, 2006. 3. D. Yogi Goswami and Frank Kreith, "Energy Conversion", 2 nd edition", CRC Press, Taylor and Francis, 2017
	Pendukung : Additional:	
		4. Schlager, N. and Weisblatt, J., "Alternative Energy", Thomson Gale, 2006. 5. Twidell, J. and Weir, T., "Renewable Energy Resources", Taylor & Francis, 2006. 6. Lawrence J. Shadle, Ronald W. Breault, James Bennet, "Gasification Technology", U. S. Department of Energy National Energy Technology Laboratory
Dosen Pengampu <i>Lecturers/Instructors</i>	Sutardi, Atok Setiyawan, Bambang Sudarmanta, Wawan Aries Widodo, Tri Vicca Kusumawardhani	
Matakuliah syarat <i>Course prerequisite</i>	Termodinamika I, Termodinamika II, Mekanika Fluida Dasar I, Mekanika Fluida Dasar II	



Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Expected sub-achievement</i>	Penilaian <i>Evaluation</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [<i>Estimasi Waktu</i>] <i>Learning Types,</i> <i>Learning Methods,</i> <i>Student Assignments</i> [<i>Duration</i>]		Materi Pembelajaran [<i>Pustaka</i>] <i>Learning Materials</i> [<i>Reference</i>]	Bobot Penilaian (%) <i>Grade</i> (%)
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criterion and type</i>	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami jenis energi dan sumber-sumber energi <i>Students are able to understand types of energy and energy sources</i>	Memahami jenis energi dan sumber-sumber energi <i>understand types of energy and energy sources</i>		- Video: Mekanisme kerja bbrp mesin pengkonversi energi - Kuliah Pengantar & Brainstorming - Video: some energy conversion machines - Introductory Lecture & Brainstorming		- Kontrak Kuliah - Jenis energi dan sumber-sumber energi - Kondisi bauran energy di Indonesia - Lecture Contract - Types of energy and energy sources - Conditions of energy sources and resources in Indonesia	



				[TM: 1 x (3 x 50'')]			
2	Mahasiswa mampu menganalisa penerapan persamaan dasar termodinamika dan mekanika fluida dalam konteks konversi energi <i>Students are able to analyze the application of basic equations of thermodynamics and fluid mechanics in the context of energy conversion</i>	Mampu menganalisa penerapan persamaan dasar termodinamika dan mekanika fluida dalam konteks konversi energi <i>able to analyze the application of basic equations of thermodynamics and fluid mechanics in the context of energy conversion</i>		- Kuliah - Tanya jawab - Video mekanisme kerja motor pembakaran dalam - <i>Lecture</i> - <i>Question & Answer</i> - <i>Video about internal combustion engine</i> [TM: 1 x (3 x 50'')]		- Persamaan dasar termodinamika - Sistim dan Volume atur - Persamaan Bernoulli - Persamaan momentum linier anguler - Persamaan energi [1: Ch. 2] - <i>Basic equation of thermodynamics</i> - <i>Control systems and volumes</i> - <i>Bernoulli equation</i> - <i>Angular linear momentum equation</i> - <i>Energy equation</i> [1: Ch. 2]	



3	Mahasiswa mampu menganalisa penerapan persamaan dasar termodinamika dan mekanika fluida dalam konteks konversi energi <i>Students are able to analyze the application of basic equations of thermodynamics and fluid mechanics in the context of energy conversion</i>	Mampu menganalisa penerapan persamaan dasar termodinamika dan mekanika fluida dalam konteks konversi energi <i>able to analyze the application of basic equations of thermodynamics and fluid mechanics in the context of energy conversion</i>		- Kuliah - Tanya jawab - Video mekanisme kerja motor pembakaran dalam - <i>Lecture</i> - <i>Question & Answer</i> - <i>Video about internal combustion engine</i> [TM: 1 x (3 x 50'')]		Persamaan dasar termodinamika - Sistim dan Volume atur - Persamaan Bernoulli - Persamaan momentum linier anguler - Persamaan energi [1: Ch. 2] - <i>Basic equation of thermodynamics</i> - <i>Control systems and volumes</i> - <i>Bernoulli equation</i> - <i>Angular linear momentum equation</i> - <i>Energy equation</i> [1: Ch. 2]	
4	Mahasiswa mampu memahami	Memahami dan menganalisa		- Kuliah - Tanya jawab		- Analisis Hukum Termodinamika Pertama untuk	



	dan menganalisa cara kerja dan unjuk kerja motor pembakaran dalam <i>Students are able to understand and analyze the working principles of internal combustion engines and their performances</i>	cara kerja dan unjuk kerja motor pembakaran dalam <i>understand and analyze the working principles of internal combustion engines and their performances</i>		- Video mekanisme kerja motor pembakaran dalam dan turbin gas - Presentasi beberapa jenis motor pembakaran dalam dan aplikasinya - Lecture - Q & A - Video about internal combustion engines and gas turbines - Presentation of several types of internal combustion engines and their applications [TM: 1 x (3 x 50'')]		Siklus Motor Pembakaran Dalam - Motor Pembakaran Dalam Jenis <i>Spark Ignition Engine</i> (SIE) dan <i>Compression Ignition Engine</i> (CIE) [1: Ch. 3] - <i>First Law of Thermodynamics Analysis for Internal Combustion Engine Cycles</i> - <i>Internal Combustion Engines Spark Ignition Engine (SIE) and Compression Ignition Engine (CIE)</i> [1: Ch. 3]	



5	Mahasiswa mampu memahami dan menganalisa cara kerja dan unjuk kerja motor pembakaran dalam <i>Students are able to understand and analyze the working principles of internal combustion engines and their performances</i>	Memahami dan cara kerja dan menganalisa unjuk kerja motor pembakaran dalam <i>understand and analyze the working principles of internal combustion engines and their performances</i>	Diskusi Tugas Kelompok	Kuliah - Tanya jawab - Video mekanisme kerja motor pembakaran dalam dan turbin gas - Presentasi beberapa jenis motor pembakaran dalam dan aplikasinya Tugas - Lecture - Q & A - Video about internal combustion engines and gas turbines - Presentation of several types of internal combustion engines and their applications Assignment		- Analisis Hukum Termodinamika Pertama untuk Siklus Motor Pembakaran Dalam - Motor Pembakaran Dalam Jenis <i>Spark Ignition Engine</i> (SIE) dan <i>Compression Ignition Engine</i> (CIE) [1: Ch. 3] - <i>First Law of Thermodynamics Analysis for Internal Combustion Engine Cycles</i> - <i>Internal Combustion Engines Spark Ignition Engine (SIE) and Compression</i>	10



				[TM: 1 x (3 x 50'')]		<i>Ignition Engine (CIE)</i> [1: Ch. 3]	
6	Mahasiswa mampu memahami dan menganalisa Turbin Gas Siklus Tertutup dan terbuka <i>Students are able to understand and analyze the closed and open Cycles of Gas Turbines</i>	Memahami dan menganalisa Turbin Gas Siklus Tertutup dan terbuka <i>able to understand and analyze the closed and open Cycles of Gas Turbines</i>		- Kuliah - Tanya jawab - Video mekanisme kerja turbin gas - <i>Lecture</i> - <i>Q & A</i> - <i>Video about internal combustion engines and gas turbines</i> [TM: 1 x (3 x 50'')]		- Turbin Gas - <i>Gas Turbines</i> [1: Ch. 3]	
7	Mahasiswa mampu memahami dan menganalisa Sistem Energi Uap dan	Memahami dan menganalisa Sistem Energi Uap dan sistem turbin uap	Diskusi Tugas Kelompok Presentasi	- Kuliah - Tanya jawab - Video mekanisme kerja turbin uap - <i>Lecture</i>		- Turbin Uap - <i>Steam turbines</i> [1: Ch.4]	10



	sistem turbin uap <i>Students are able to understand and analyze steam energy systems and steam turbine systems</i>	<i>able to understand and analyze steam energy systems and steam turbine systems</i>		- Q & A - Video about internal combustion engines and Steam turbines [TM: 1 x (3 x 50")]			
8	Evaluasi Tengah Semester / Ujian Tengan Semester/Midterm Exam						30
9	Mahasiswa mampu memahami dan menganalisa sistim turbin Air dan Pompa <i>Students are able to understand and analyze water turbine and pumping systems</i>	Memahami dan menganalisa sistim turbin Air dan Pompa <i>understand and analyze water turbine and pumping systems</i>		- Kuliah - Tanya jawab - Video mekanisme kerja turbin air dan pompa - Latihan soal - Lecture - Q & A - Video about water turbines and pumps - Problem solving [TM: 1 x (3 x 50")]		- Turbin Air - Pompa - Water turbines - Pumps [1: Ch. 5]	



10	Mahasiswa mampu memahami dan menganalisa unjuk kerja Fan, blower, dan kompresor <i>Students are able to understand and analyze the performance of fans, blowers and compressors</i>	Memahami dan menganalisa unjuk kerja Fan, blower, dan kompresor <i>understand and analyze the performance of fans, blowers and compressors</i>		- Kuliah - Tanya jawab - Video mekanisme kerja Fan, Blower, dan Kompresor - <i>Lecture</i> - <i>Q & A</i> - <i>Video about fan, blower, and compressor</i> [TM: 1 x (3 x 50'')]		-. Fan, blower, dan kompresor -. <i>Fan, blower, and compressor</i> [1: Ch. 5]	
11	Mahasiswa mampu memahami dan menganalisa unjuk kerja Fan, blower, dan kompresor	Memahami dan menganalisa unjuk kerja Fan, blower, dan kompresor <i>understand and analyze</i>		- Kuliah - Tanya jawab - Video mekanisme kerja Fan, Blower, dan Kompresor - Latihan soal - <i>Lecture</i> - <i>Q & A</i>		-. Fan, blower, dan kompresor -. <i>Fan, blower, and compressor</i> [1: Ch. 5]	



	<i>Students are able to understand and analyze the performance of fans, blowers and compressors</i>	<i>the performance of fans, blowers and compressors</i>		- Video about fan, blower, and compressor - Problem solving [TM: 1 x (3 x 50'')]			
12	Mahasiswa mampu memahami dan menganalisa termodinamika siklus pendingin, serta mampu mengenal komponen-komponen utama sistem pendingin dan unjuk kerjanya <i>Students are able to</i>	Mampu memahami dan menganalisa termodinamika siklus pendingin, serta mampu mengenal komponen-komponen utama sistem pendingin dan unjuk kerjanya <i>understand and analyze the</i>	Diskusi Tugas Kelompok	- Kuliah - Tanya jawab - Video mekanisme kerja sistem pendingin - Lecture - Q & A - Video about refrigeration [TM: 1 x (3 x 50'')]		- Refrigerasi Dan Pengkondisian Udara - Psychrometric chart - Komponen-komponen utama sistem pengkondisian udara - Refrigeration and Air Conditioning - Psychrometric chart	10



	<i>understand and analyze the thermodynamics of the refrigeration cycle, and are able to recognize the main components of the refrigeration system and their performances</i>	<i>thermodynamics of the refrigeration cycle, and are able to recognize the main components of the refrigeration system and their performances</i>				- The main components of the air conditioning system [1: Ch. 6]	
13	Mahasiswa mampu memahami dan menganalisa sistem pembangkit tenaga panas bumi (<i>geothermal</i>)	Mampu memahami dan menganalisa sistem pembangkit tenaga panas bumi (<i>geothermal</i>) dan energi surya		- Kuliah - Tanya jawab - Video mekanisme kerja sistem pembangkit <i>geothermal</i> dan energi surya - Lecture - Q&A		- Sistem pembangkit tenaga panas bumi (<i>geothermal</i>). - Energi surya - <i>Geothermal power generation system.</i> - <i>Solar energy</i> [1: Ch. 7]	



	dan energi surya <i>Students are able to understand and analyze geothermal and solar energy systems for power generation</i>	<i>understand and analyze geothermal and solar energy systems for power generation</i>		- Video about geothermal and solar power generation systems [TM: 1 x (3 x 50")]			
14	Mahasiswa mampu memahami dan menganalisa pesawat pengonversi tenaga angin, pesawat pengonversi energi termal samudra (<i>ocean thermal energy</i>)	Mampu memahami dan menganalisa pesawat pengonversi tenaga angin, pesawat pengonversi energi termal samudra (<i>ocean thermal energy conversion,</i>	Diskusi Tugas Kelompok Presentasi Lap. praktikum	- Kuliah - Tanya jawab - Video mekanisme kerja pesawat pengonversi tenaga angin, pesawat pengonversi energi termal samudra (OTEC), dan pesawat pengonversi energi pasang surut. - Lecture		- Pesawat pengonversi tenaga angin - Pesawat pengonversi energi termal samudra (<i>ocean thermal energy conversion, OTEC</i>) - Pesawat pengonversi energi pasang surut (<i>tidal</i>) - Wind power	10



	conversion, OTEC), dan pesawat pengonversi energi pasang surut (<i>tidal</i>) <i>Students are able to understand and analyze wind power, ocean thermal energy, and tidal energy for the needs of the power generation.</i>	OTEC), dan pesawat pengonversi energi pasang surut (<i>tidal</i>) <i>understand and analyze wind power, ocean thermal energy, and tidal energy for the needs of the power generation</i>		- Q&A - Video about wind power, ocean thermal energy conversion (OTEC), and tidal energy converters. [TM: 1 x (3 x 50'')]		- Ocean thermal energy conversion (OTEC) - Tidal energy conversion [1: Ch. 7]	
15	Mahasiswa mampu memahami dan menganalisa Konversi energi gelombang laut,	Mampu memahami dan menganalisa Konversi energi gelombang laut, pembangkit		- Kuliah - Tanya jawab - Video mekanisme kerja Konversi energi gelombang laut, pembangkit uap berbahan bakar nuklir, pesawat <i>magneto</i>		- Konversi energi gelombang laut. - Pembangkit uap berbahan bakar nuklir. - Pesawat <i>magneto hydro dynamics</i> (MHD).	



	pembangkit uap berbahan bakar nuklir, pesawat <i>magneto hydro dynamics</i> (MHD), dan sel bahan bakar (<i>fuel cell</i>) <i>Students are able to understand and analyze ocean wave energy conversion, nuclear energy system, magneto-hydro dynamics (MHD), and fuel cells.</i>	uap berbahan bakar nuklir, pesawat <i>magneto hydro dynamics</i> (MHD), dan sel bahan bakar (<i>fuel cell</i>) <i>understand and analyze ocean wave energy conversion, nuclear energy system, magneto-hydro dynamics (MHD), and fuel cells</i>		<i>hydro dynamics</i> (MHD), dan sel bahan bakar (<i>fuel cell</i>) - <i>Lecture</i> - <i>Q&A</i> - <i>Video about ocean wave energy conversion, nuclear-power generators, magneto hydro dynamics (MHD), and fuel cells</i> [TM: 1 x (3 x 50'')]		- Sel bahan bakar (<i>fuel cell</i>) - <i>Wave energy conversion.</i> - <i>Nuclear-power generator.</i> - <i>Magneto hydro dynamics (MHD).</i> - <i>Fuel cell</i> [1: Ch. 7]	
16	Evaluasi Akhir Semester / Ujian Akhir Semester / <i>Final Exam</i>						30



Catatan :

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
7. **Bentuk penilaian:** tes dan non-tes.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



 RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM						Kode Dokumen
RENCANA PEMBELAJARAN SEMESTER SEMESTER COURSE PLAN						
MATA KULIAH (MK) COURSE NAME	KODE CODE	Rumpun MK Course Group	BOBOT (sks) Credit		SEMESTER SEMESTER	Tgl Penyusunan Date
MEKANIKA FLUIDA DASAR II Basic Fluid Mechanics II	TM234402 TM234402	MEKANIKA FLUIDA & MESIN FLUIDA FLUID MECHANICS AND FLUID MACHINERY	T = 3 (Lecture = 3)	P = 0 (Lab = 0)	IV IV	5 Mei 2023 May 5, 2023
OTORISASI AUTHORITY	Pengembang RPS Course Plan Authority		Koordinator RMK Course Plan Coordinator		Ketua PRODI Head of Study Program	
	Sutardi		Sutardi		Atok Setiyawan	
Capaian Pembelajaran (CP) Learning Outcomes	CPL-PRODI yang dibebankan pada MK Study Program Learning Outcomes Assigned to Courses					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems				



	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources</i>				
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik <i>Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment</i>				
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik <i>Ability to identify, formulate, analyze, and solve technical problems</i>				
	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcomes</i>					
	CPMK-1	Mahasiswa mampu menganalisa dasar-dasar aliran fluida ideal, didalam maupun di luar saluran <i>The students are able to analyze basics of ideal fluid flow for internal and external flows</i>				
	CPMK-2	Mahasiswa mampu menyusun metode analisa aliran fluida viskos. <i>The students are able to synthesize method of analyze of viscous fluid flow</i>				
	CPMK-3	Mahasiswa mampu menganalisa komponen yang berkontribusi terhadap kerugian aliran <i>The students are able to analyze components that contribute to the flow losses</i>				
	CPMK-4	Mahasiswa mampu menunjukkan dan memilih komponen sistem distribusi fluida yang sesuai <i>The students are able to show and choose the appropriate components for fluid flow ssytems</i>				
		Matrik CPL – CPMK (Study Program – Course Learning outcome Matrix)				
		CPMK	CPL-4	CPL-5	CPL-6	CPL-8
		CPMK-1		V	V	



		CPMK-2	V			
		CPMK-3	V	V		
		CPMK-4				V
Deskripsi Singkat MK <i>Course Brief Description</i>	Mekanika Fluida: Dasar-dasar aliran fluida ideal dan fluida tak mampu mampat, viskos didalam saluran tertutup dan aliran luar (<i>external flows</i>) <i>Fluid Mechanics: Basics of ideal fluid flow and incompressible and viscous fluids in closed channels and external flows</i>					
Bahan Kajian: Materi Pembelajaran <i>Course Content</i>	- Analisa diferensial gerakan fluida - Rotasi dan deformasi fluida, stream function dan irrotational flow - Aliran tak mempunyai kekentalan (inviscid) dan tak termampatkan (incompressible), Persamaan Euler dan Persamaan Bernoulli - Analisa aliran viscous (kental) dan incompressible untuk aliran internal, termasuk analisa aliran didalam pipa-pipa seri. - Analisa aliran viscous (kental) dan incompressible untuk aliran eksternal - Konsep lapis batas - Pengaruh aliran terhadap benda-benda yang berada di dalam aliran: gaya lift dan drag - Pengukuran aliran. - <i>Differential analysis of fluid motion</i> - <i>Rotation and deformation of fluids, stream functions and irrotational flow</i> - <i>Inviscid and incompressible flow, Euler's equation and Bernoulli's equation</i> - <i>Analysis of viscous and incompressible flow for internal flow, including analysis of flow serie arrangement of pipes.</i> - <i>Analysis of viscous and incompressible flow for external flow</i> - <i>Boundary layer concept</i>					



	<i>- Effect of flow on objects in the fluid flow: lift and drag forces</i> <i>- Flow measurements</i>				
Pustaka <i>References</i>	Utama : <i>Main:</i>				
	1. P. J. Pritchard, John W. Mitchell, and John C. Leylegian, Fox and McDonald’s Introduction to Fluid Mechanics, 9th ed., John Wiley & Sons Inc., New York, 2015 (e-book).				
	Pendukung : <i>Additional:</i>				
	2. Robert W. Fox, Alan T. McDonald, and P. J. Pritchard, Introduction to Fluid Mechanics, 7th ed., John Wiley & Sons Inc., New York, 2010.				
	3. V. L. Streeter and E. B. Wylie, Fluid Mechanics, 7th ed., McGraw-Hill Inc, New York, 1981.				
	4. Bruce R. Munson, Donald F. Young, and Theodore H. Okiishi, Fundamentals of Fluid Mechanics, 8th ed., John Wiley & Sons Inc., New York, 2016.				
	5. Irving H. Shames, Mechanics of Fluids, 3rd ed., McGraw-Hill Inc, New York, 1992.				
Dosen Pengampu <i>Lecturers/</i> <i>Instructures</i>	Triyogi Yuwono, Herman Sasongko, Sutardi, Wawan Aries W., Vivien S.				
Matakuliah syarat <i>Course</i> <i>prerequisite</i>	<i>Mekanika Fluida Dasar 1</i> <i>Basic Fluid Mechanics 1</i>				
Mg Ke <i>Week</i>	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian <i>Evaluation</i>	Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]	Materi Pembelajaran [Pustaka] <i>Learning Materials</i>	Bobot Penilaian (%) <i>Grade</i> (%)



	<i>Expected sub-achievement</i>			Learning Types, Learning Methods, Student Assignments [Duration]		<i>[Reference]</i>	
		<i>Indikator Indicator</i>	<i>Kriteria & Bentuk Criterion and type</i>	<i>Luring (offline)</i>	<i>Daring (online)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menganalisa Dasar teori tentang persamaan diferensial untuk aliran fluida <i>Basics of Flow of Fluids - Differential analysis of fluid flows</i>	Mampu memahami persamaan diferensial didalam analisa aliran fluida. - <i>Able to understand the Basics of Flow of Fluids - Differential analysis of fluid flows</i>	Diskusi <i>Discussion</i>	- Video: Fund. of Fluid Flow - Kuliah - <i>Lecture</i> [TM: 1 x (3 x 50")]		- Analisa diferensial gerakan fluida <i>Differential analysis of fluid motion</i> [1: Pritchard dkk, Ch. 5] [1: Pritchard et al, Ch. 5]	
2	Mahasiswa mampu menganalisa Dasar teori tentang pers.	Mampu memahami persamaan diferensial utk konservasi massa.	Diskusi <i>Discussion</i>	- Video: Fund. of Fluid Flow - Kuliah - <i>Lecture</i> [TM: 1 x (3 x 50")]		- Analisa diferensial gerakan fluida <i>Differential analysis of fluid motion</i>	



	diferensial utk konservasi massa <i>Basics of Flow of Fluids - Differential analysis of fluid flows - Mass conservation</i>	<i>Able to understand the Basics of Flow of Fluids - Differential analysis of fluid flows - Mass conservation</i>				[1: Pritchard dkk, Ch. 5] [1: Pritchard et al, Ch. 5]	
3	Mahasiswa mampu menganalisa gerakan elemen fluida dan menganalisa pers. momentum. <i>Basics of Flow of Fluids - Differential analysis of fluid flows - Linear Momentum conservation</i>	Mampu dan terampil menyelesaikan persamaan-persamaan momentum <i>Able and mastering to solve Basics of Flow of Fluids - Differential analysis of fluid flows - Linear Momentum conservation</i>	Tugas Assignment	- Kuliah - Lecture - Latihan soal <i>Problem solving [TM: 1 x (3 x 50")]</i>		-. Persamaan Momentum linier dalam bentuk diferensial <i>Linear Momentum Equation in Differential Form</i> [1: Pritchard dkk, Ch. 5 dan 6] [1: Pritchard et al, Ch. 5 and 6]	2



4	Mahasiswa mampu menganalisa pers. Euler dan pers. Bernoulli <i>Euler and Bernoulli equations</i>	Mampu dan terampil menyelesaikan persamaan Euler dan persamaan Bernoulli -. <i>Able and mastering to solve Euler and Bernoulli equations</i>	Diskusi <i>Discussion</i>	- Kuliah - Latihan soal -. <i>Lecture</i> -. <i>Problem solving</i> [TM: 1 x (3 x 50")]		-. Persamaan Euler dan persamaan Bernoulli <i>Euler and Bernoulli equations</i> [1: Pritchard dkk, Ch. 5 dan 6] [1: Pritchard et al, Ch. 5 and 6]	
5	Mahasiswa mampu menganalisa persamaan Bernoulli dalam kaitannya dengan pengukuran tekanan statik, stagnasi, dan dinamik dan Hk. 1 Termodinamika <i>Bernoulli equation with</i>	Mampu dan terampil menerapkan persamaan Bernoulli dalam kaitannya dengan pengukuran tekanan statik, stagnasi, dan dinamik dan Hk. 1 Termodinamika -. <i>Able and mastering to</i>	Praktikum <i>Lab work</i>	- Kuliah -. <i>Lecture</i> - Praktikum -. <i>Lab work</i> [TM: 1 x (3 x 50")]		- Tekanan statis, stagnasi, dan dinamis - Hubungan antara hukum termodinamika I dengan persamaan Bernoulli -. <i>Static, stagnation and dynamic pressure</i> - <i>The relationship between the first law of</i>	5



	<i>relation with Static, stagnation, and dynamic pressures; Relation between the first law of thermodynamics and the Bernoulli equation</i>	<i>solve Bernoulli equation with relation with Static, stagnation, and dynamic pressures; Relation between the first law of thermodynamics and the Bernoulli equation</i>				<i>thermodynamics and Bernoulli's equation</i> [1: Pritchard dkk, Ch. 6] [1: Pritchard et al, Ch. 6]	
6	Mahasiswa mampu melakukan memahami dan menganalisa aliran internal kental dan tak termampatkan, utk aliran laminar berkembang penuh diantara pelat datar.	Mampu menjelaskan dengan tepat bermacam – macan aliran internal, viskos, dan tak mampu mampat (incompressible), aliran laminar didalam di antara dua pelat datar	Tugas Assignment	- Kuliah - Latihan soal - Video -. <i>Lecture</i> -. <i>Problem solving</i> -. <i>Video</i> [TM: 1 x (3 x 50”)]		-. Aliran internal kental dan tak termampatkan <i>Internal, viscous, incompressible flow</i> [1: Pritchard dkk, Ch. 8] [1: Pritchard et al, Ch. 8]	2



	<i>Internal, viscous, incompressible flow, laminar flow between two parallel flat plates</i>	<i>Able to explain correctly Internal, viscous, incompressible flow, laminar flow between two parallel flat plates</i>					
7	Mahasiswa mampu melakukan memahami dan menganalisa aliran internal kental dan tak termampatkan, utk. aliran laminar berkembang penuh didalam pipa. <i>Analysis of Internal viscous and incompressible internal flow - fully developed</i>	Mampu menjelaskan dengan tepat bermacam – macan aliran internal, viskos, dan tak mampu mampat (incompressible), aliran laminar didalam pipa <i>Able to explain correctly Analysis of Internal viscous and incompressible internal flow - fully developed</i>	Short quiz <i>Short quiz</i>	- Kuliah - Latihan soal - Video <i>-. Lecture</i> <i>-. Problem solving</i> <i>-. Video</i> [TM: 1 x (3 x 50”)]		-. Aliran internal kental dan tak termampatkan <i>Internal, viscous, incompressible flow</i> [1: Pritchard dkk, Ch. 8] [1: Pritchard et al, Ch. 8]	15



	<i>laminar flow inside the pipe</i>	<i>laminar flow inside the pipe</i>					
8	Evaluasi Tengah Semester / Ujian Tengan Semester <i>Midterm Exam</i>						20
9	Mahasiswa mampu memahami dan menganalisa profil kecepatan turbulen aliran berkembang penuh didalam pipa penerapan persamaan energi pada aliran didalam pipa untuk keperluan perhitungan head loss (major and minor losses) <i>Internal incompressible viscous flow - laminar and</i>	Mampu dan terampil membedakan aliran laminar dan aliran turbulen didalam saluran tertutup, seperti pipa atau sistem saluran dengan penampang tidak melingkar (non-circular ducts) <i>Able and mastering to differentiate Internal incompressible viscous flow - laminar and turbulent flows in closed</i>	Tugas <i>Assignment</i>	- Kuliah - Video aliran didalam pipa - Latihan soal -. <i>Lecture</i> -. <i>Video</i> -. <i>Problem solving</i> [TM: 1 x (3 x 50")]		-. Aliran internal kental dan tak termampatkan <i>Internal, viscous, incompressible flow</i> [1: Pritchard dkk, Ch. 8] [1: Pritchard et al, Ch. 8]	2



	turbulent flows in closed conduits, such as pipes or ducting systems with non-circular cross-sections (non-circular ducts)	conduits, such as pipes or ducting systems with non-circular cross-sections (non-circular ducts)					
10	Mahasiswa mampu menganalisa energy grade line (EGL) & hydraulic grade line (HGL) dan pipa-pipa parallel. <i>Internal incompressible viscous flow - EGL and HGL in flow analysis for parallel pipes</i>	Mampu membedakan dan menjelaskan tentang EGL dan HGL dan menerapkannya dalam analisa aliran untuk pipa paralel <i>Able to differentiate and explain Internal incompressible viscous flow - EGL and HGL in flow analysis for parallel pipes</i>	Praktikum <i>Lab work</i>	-. Kuliah -. Praktikum -. <i>Lecture</i> -. <i>Lab work</i>		-. Aliran internal kental dan tak termampatkan <i>Internal, viscous, incompressible flow</i> [1: Pritchard dkk, Ch. 6 & 8] [1: Pritchard et al, Ch. 6 and 8]	5



11	Mahasiswa mampu mengenal dasar pengukuran aliran fluida dan penggunaan Alat ukur aliran konvensional (orifice, flow nozzle, dan venturi) <i>Flow measurement - orifice, flow nozzle, dan venturi</i>	Mampu mengenal dasar pengukuran aliran fluida yang konvensional (orifice, flow nozzle, dan venturi) <i>Able to understand the basics Flow measurement - orifice, flow nozzle, dan venturi</i>	Tugas Assignment	- Kuliah - Video visualisasi pengukuran aliran internal - Latihan soal -. <i>Lecture</i> -. <i>Video</i> -. <i>Problem solving</i> [TM: 1 x (3 x 50")]		-. Pengukuran Aliran <i>Flow measurement</i> [1: Pritchard dkk, Ch. 8; 3: Streeter dkk] [1: Pritchard dkk, Ch. 8; 3: Wylie et al]	2
12	Mahasiswa mampu memahami dan menganalisa konsep lapis batas. <i>External incompressible viscous flow - Boundary layer</i>	Mampu menganalisa dan membedakan aliran lapis batas yang dengan gradien tekanan dan yang tidak bergradien tekanan –	Short quiz <i>Short quiz</i>	- Kuliah -. <i>Lecture</i> [TM: 1 x (3 x 50")]		-. Aliran Eksternal kental dan tak termampatkan <i>External incompressible viscous flow</i> [1: Pritchard dkk, Ch. 9]	22.5



	flow with pressure gradient and without pressure gradient	Able to analyze and differentiate External incompressible viscous flow - boundary layer flow with pressure gradient and without pressure gradient				[1: Pritchard et al, Ch. 9]	
13	Mahasiswa mampu memahami dan menganalisa persamaan integral momentum (gradien tekanan nol dan tidak nol) - Boundary layer flow with pressure gradient and without pressure gradient.	Mampu menganalisa dan membedakan aliran lapis batas yang dengan gradien tekanan dan yang tidak bergradien tekanan - Able to analyze and differentiate Boundary layer flow with pressure gradient and	Diskusi Discussion	- Kuliah - Lecture [TM: 1 x (3 x 50")]		- Aliran Eksternal kental dan tak termampatkan External incompressible viscous flow [1: Pritchard dkk, Ch. 9] [1: Pritchard et al, Ch. 9]	



		<i>without pressure gradient</i>					
14	Mahasiswa mampu memahami menganalisa gaya-gaya aerodinamika akibat aliran fluida - Analisa Drag; <i>External incompressible viscous flow - Drag Analysis;</i>	Mampu menganalisa Aliran Eksternal kental dan tak termampatkan - Analisa Drag; <i>Able to analyze External incompressible viscous flow - Drag Analysis;</i>	Tugas Assignment	- Kuliah - Video Visualisasi aliran eksternal di sekitar sayap pesawat terbang - Latihan soal -. Lecture -. Video -. Problem solving [TM: 1 x (3 x 50")]		-. Aliran Eksternal kental dan tak termampatkan <i>External incompressible viscous flow - Drag</i> [1: Pritchard dkk, Ch. 9] [1: Pritchard et al, Ch. 9]	2
15	Mahasiswa mampu memahami menganalisa gaya-gaya aerodinamika akibat aliran fluida - Analisa Lift; <i>External incompressible</i>	Mampu menganalisa Aliran Eksternal kental dan tak termampatkan - Analisa Lift; <i>Able to analyze External incompressible viscous flow - Lift Analysis</i>	Diskusi Discussion	- Kuliah - Video Visualisasi aliran eksternal di sekitar sayap pesawat terbang - Latihan soal -. Lecture -. Video -. Problem solving		-. Aliran Eksternal kental dan tak termampatkan <i>External incompressible viscous flow - Lift</i> [1: Pritchard dkk, Ch. 9]	



	<i>viscous flow - Lift Analysis</i>			[TM: 1 x (3 x 50")]		[1: Pritchard et al, Ch. 9]	
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Exam</i>						22.5

Catatan :

22. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

23. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.

68. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

25. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

26. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

27. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

28. **Bentuk penilaian:** tes dan non-tes.



29. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
30. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
31. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
32. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
33. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI - ITS					
MATA KULIAH		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Direvisi
MENG GAMBAR MESIN		TM234103	Metalurgi	T=3	P=0	II	
OTORISASI		Pengembang RP		Koordinator RMK		KaProdi S1	
		Dosen Laboratorium Metallurgi		Putu Suwarta		Suwarno	
Capaian Pembelajaran	Program Studi	D. Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika: CPL 4 E. Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik: CPL 5 F. Kemampuan menguasai konsep ilmu sains dasar, matematika dan prinsip-prinsip rekayasa pada sistem mekanika: CPL 11 G. Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi.: CPL 6 H. Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data. : CPL7					
	Mata Kuliah						
	– Mahasiswa mampu menjelaskan fungsi gambar teknik pada bidang mekanika (D, E) – Mahasiswa mampu membuat dan menganalisa gambar kerja sebuah sistem mekanikal (D,E,F,G,H) – Mahasiswa mampu menunjukkan kesalahan pada gambar sesuai dengan standarisasi gambar Teknik (D,E,F,G) – Mahasiswa mampu membuat dan menggunakan gambar teknik sebagai alat komunikasi di bidang teknik (D,E,F,G)						



Diskripsi Bahan Kajian & Pokok Bahasan	Bahan Kajian	
	Menggambar Mesin	
	Pokok Bahasan	



	– Fungsi gambar, alat-alat gambar serta kegunaannya dan standarisasi (normalisasi) gambar teknik. – Penyajian benda dalam bentuk gambar pandangan tunggal atau gambar tiga dimensi, antara lain dalam proyeksi isometri, proyeksi dimetri dan proyeksi paralel. – Penyajian benda dalam bentuk gambar pandangan majemuk (proyeksi orthogonal) baik menurut sistem proyeksi Eropa maupun sistem proyeksi Amerika. – Aturan dasar memberi ukuran serta cara-cara memberi ukuran pada gambar. – Penyajian benda dalam bentuk gambar potongan/ penampang. – Penyajian benda dalam bentuk gambar skets, gambar rinci dan gambar susunan. – Cara penggambaran komponen standar, gambar ulir, gambar baut, gambar roda gigi, gambar bantalan dalam bentuk gambar rinci maupun gambar susunan. – Pengenalan dan aplikasi tanda pengerjaan, konfigurasi permukaan, toleransi, suaian. – Pengenalan simbol pengelasan.	
Pustaka	Utama :	
		1. Ir.Ohan Juhana, M Suratman S.Pd., "Menggambar Teknik Mesin Menurut Standar ISO" 2. G. Takeshi Sato, N Sugiarto Hartanto, "Menggambar Mesin Menurut standar ISO"
	Pendukung :	
		3. La Hey, "Ilmu Menggambar Bangunan Mesin". 4. ISO Standard Hand Book 12, " Technical Drawing" 5. David A Madsen, David P Madsen, "Engineering Drawing & Design" 6. Giesecke, "Technical Drawing with Engineering Graphics"
Media Pembelajaran	Software :	Hardware :
	Software CAD, Microsoft Office	Komputer, LCD Projector, Alat Gambar, Kertas Gambar, Meja Gambar (Lab)
Team Teaching	Putu Suwarta, Indra Sidharta, Fahmi Mubarok, Sutikno, Kis Agustin, Wahyu Wijanarko, Suwarno, Ika Dewi Wijayanti	



Assessment	Penilaian dibagi menjadi 2 komponen besar, dimana setiap mahasiswa wajib untuk lulus di 2 komponen tersebut, antara lain: - Nilai Kelas (Tugas Kelas, ETS, EAS, Evaluasi CAD) : 40%



		- Nilai Studio Gambar (terdiri dari 4 Tugas Studio) : 60% Jika ada satu komponen yang tidak lulus, maka mahasiswa dinyatakan tidak lulus kuliah dan wajib mengulang kelas				
Matakuliah Syarat		-				
Mg Ke-	Sub-Capaian Pembelajaran MK	Materi Pembelajaran [Pustaka]	Metode / Strategi Pembelajaran [Estimasi Waktu]	Assessment		
				Indikator	Bentuk	Bobot
(1)	Mahasiswa mampu menjelaskan fungsi gambar dan standarisasi gambar teknik serta macam-macam alat gambar	- Kontrak belajar - Pentingnya gambar teknik - Fungsi gambar teknik - Standarisasi gambar - Tugas perancang, juru gambar, dan pengawas gambar - Alat-alat gambar dan cara penggunaannya - Teknik penyimpanan gambar [1:Ohan Juana] [2:Takeshi Sato]	- Kuliah Pengantar & Brainstorming - Latihan soal - Pengarahan tugas studio [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu menjelaskan fungsi gambar dan standarisasi gambar serta aktif dalam diskusi kelas	- Keaktifan dalam diskusi kelas - Tugas kelas	0%
(2)	Mahasiswa mampu membuat dan menganalisa garis, huruf dan kepala gambar sesuai dengan standarisasi gambar teknik	- Pengenalan macam-macam garis - Pengenalan huruf - Pembuatan kepala gambar [1:Ohan Juana] [2:Takeshi Sato]	- Kuliah - Latihan soal [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu membuat garis, huruf dan kepala gambar dengan metode gambar manual Mampu memilih garis, huruf, dan bentuk kepala gambar sesuai standarisasi	- Keaktifan dalam diskusi kelas - Tugas kelas	0%



(3)	Mahasiswa mampu membuat dan menganalisa gambar teknik dengan sistem	- Pengertian proyeksi - Proyeksi Piktorial • Gambar Isometri • Gambar Dimetri	- Kuliah - Latihan soal (tugas kelas) - Pemberian tugas studio 1 (pada minggu ke-3)	Mampu membuat gambar teknik dengan sistem proyeksi piktorial dan proyeksi	- Keaktifan dalam diskusi kelas - Tugas kelas (optional)	5%



	proyeksi piktorial dan proyeksi ortogonal	• Gambar Miring (Oblique) - Proyeksi Ortogonal - Penentuan pandangan - Dasar-dasar menggambar proyeksi ortogonal - Susunan gambar [1:Ohan Juana] [2: Takeshi Sato]	[TM: 2x(2x50'')] : Teori [TM: 2x(1x50'')] : Praktek	ortogonal. Mampu menunjukkan dan membenarkan kesalahan gambar teknik dengan sistem proyeksi piktorial dan proyeksi ortogonal		
(4)	Mahasiswa mampu membuat dan menganalisa gambar potongan penampang	- Pengertian gambar potongan - Penyajian gambar potongan [1:Ohan Juana] [2: Takeshi Sato]	- Kuliah - Latihan soal [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu membuat gambar potongan penampang dengan metode gambar manual maupun menggunakan software. Mampu menunjukkan dan membenarkan kesalahan gambar potongan penampang	- Keaktifan dalam diskusi kelas - Tugas Studio 1 - Tugas Kelas (optional)	15%
(5)	Mahasiswa mampu menganalisa dan membuat jenis pandangan dan cara-cara penggambaran khusus pada gambar teknik	- Jenis-jenis pandangan - Cara-cara penggambaran khusus [1:Ohan Juana] [2: Takeshi Sato]	- Kuliah - Latihan soal - Pengumpulan tugas studio 1 - Pemberian tugas studio 2 (minggu ke 5) [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu menganalisa dan membuat jenis pandangan dan cara-cara penggambaran khusus pada gambar teknik dengan metode gambar manual	- Keaktifan dalam diskusi kelas - Tugas Kelas (optional)	0%



(6)	Mahasiswa mampu membuat dan	- Aturan-aturan dasar penunjukan ukuran	- Kuliah - Latihan soal	Mampu menganalisa dan menggambarkan	- Keaktifan dalam diskusi kelas	0%



	menganalisa penunjuk ukuran pada gambar Teknik	- Cara-cara penunjukan ukuran [1:Ohan Juana] [2: Takeshi Sato]	[TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	penunjuk ukuran pada gambar teknik	- Tugas Kelas (optional)	
(7)	- Tutorial CAD	- Pengenalan software CAD - Pelatihan menggambar komponen permesinan atau benda lainnya dengan menggunakan software CAD seperti inventor. [1:Ohan Juana] [2: Takeshi Sato] [3: David A Madsen]	- Tutorial - Latihan soal [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu memahami cara kerja software CAD dan menggunakan software tersebut untuk menggambar teknik	- Keaktifan dalam diskusi kelas - Tugas Kelas (optional)	5%
(8)	Evaluasi Tengah Semester: Pengumpulan tugas studio 2					10% 15%
(9)	Mahasiswa mampu menjelaskan toleransi ukuran pada gambar teknik	- Pengertian toleransi - Toleransi standar - Toleransi umum dan toleransi khusus - Toleransi suaian - Ketentuan penulisan toleransi pada gambar [1:Ohan Juana] [2: Takeshi Sato]	- Kuliah - Latihan soal - Pemberian tugas studio 3 (minggu ke 9) [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu menjelaskan toleransi ukuran pada gambar teknik	- Keaktifan dalam diskusi kelas - Tugas Kelas (optional)	0%
(10)	Mahasiswa mampu menjelaskan toleransi geometrik pada gambar teknik	- Toleransi geometrik - Jenis karakter dan simbol geometris - Hub. toleransi geometrik dengan toleransi ukuran	- Kuliah - Latihan soal (tugas kelas) [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu menjelaskan toleransi geometrik pada gambar teknik	- Keaktifan dalam diskusi kelas - Tugas Kelas (optional)	5%



		- Penerapan toleransi geometrik pada gambar [1:Ohan Juana] [2: Takeshi Sato]				
(11)	Mahasiswa mampu membuat dan menganalisa gambar ulir, dan baut.	- Gambar ulir - Gambar baut [1:Ohan Juana] [2: Takeshi Sato]	- Kuliah - Latihan soal - Pengumpulan tugas Studio 3 (minggu ke 11) [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu membuat dan menganalisa gambar ulir dan baut	- Keaktifan dalam diskusi kelas - Tugas kelas (optional)	15%
(12)	Mahasiswa mampu membuat dan menganalisa gambar roda gigi dan bantalan	- Gambar roda gigi - Gambar bantalan [1:Ohan Juana] [2: Takeshi Sato]	- Kuliah - Latihan soal [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu membuat dan menganalisa gambar roda gigi dan bantalan	- Keaktifan dalam diskusi kelas - Tugas Kelas (optional)	0%
(13)	Mahasiswa mampu menjelaskan symbol proses pengerjaan	- Gambar sambungan las - Simbol-simbol pengerjaan - Contoh-contoh penggunaan proses pengerjaan - Penggunaan symbol pengerjaan pada gambar [1:Ohan Juana] [2: Takeshi Sato]	- Kuliah - Latihan soal - Pemberian tugas studio 4 (minggu ke 13) [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu membedakan jenis gambar sambungan las	- Keaktifan dalam diskusi kelas - Tugas Kelas (optional)	0%



(14)	Mahasiswa mampu menjelaskan symbol proses pengerjaan dan menjelaskan konfigurasi permukaan pada gambar teknik	- Definisi kekasaran permukaan - Penunjukan nilai kekasaran permukaan dan arah bekas pengerjaan [1:Ohan Juana] [2: Takeshi Sato]	- Kuliah - Latihan soal [TM: 1x(2x50'')] : Teori [TM: 1x(1x50'')] : Praktek	Mampu menjelskan konfigurasi permukaan pada gambar teknik	- Keaktifan dalam diskusi kelas - Tugas Kelas (optional)	0%



(15)	Evaluasi penggunaan software CAD	- Evaluasi penguasaan penggunaan software CAD	- Evaluasi [TM: 1x(2x50'')] : Praktek	Mampu membuat gambar komponen permesinan menggunakan software CAD		5%
(16)	Evaluasi Akhir Semester					10%
	Pengumpulan tugas studio 4					15%

KRITERIA PENILAIAN

Jenis evaluasi	Fail Less than 50%	Pass 50 – 59%	Credit 60-69%	Distinction 70 – 79%	High Distinction 80 – 100%
Tugas kelas	Tidak mengikuti langkah-langkah pengerjaan. Pekerjaan hanya mencontoh tugas teman.	Gambar tidak selesai Gambar pandangan salah Penunjuk ukuran tidak lengkap Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Gambar tidak selesai Gambar yang dibuat benar Penunjuk ukuran tidak lengkap Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Gambar selesai Gambar yang dibuat benar Penunjuk ukuran benar Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Gambar selesai Gambar yang dibuat benar Penunjuk ukuran benar Penggunaan ketebalan garis tepat Kertas gambar bersih
Tugas studio	Tidak mampu menyelesaikan 60% soal ujian dengan waktu yang telah ditentukan.	Mampu menyelesaikan 70% soal ujian dengan waktu yang telah ditentukan Gambar pandangan salah Penunjuk ukuran tidak lengkap Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Mampu menyelesaikan 80% soal ujian dengan waktu yang telah ditentukan Gambar yang dibuat benar Penunjuk ukuran tidak lengkap Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Mampu menyelesaikan 90% soal ujian dengan waktu yang telah ditentukan Gambar yang dibuat benar Penunjuk ukuran benar Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Mampu menyelesaikan 100% soal ujian dengan waktu yang telah ditentukan Gambar yang dibuat benar Penunjuk ukuran benar Penggunaan ketebalan garis tepat Kertas gambar bersih



Jenis evaluasi	Fail Less than 50%	Pass 50 – 59%	Credit 60-69%	Distinction 70 – 79%	High Distinction 80 – 100%
Ujian tertulis (Kuis, ETS, EAS)	Tidak mampu menyelesaikan 60% soal ujian dengan waktu yang telah ditentukan.	Mampu menyelesaikan 70% soal ujian dengan waktu yang telah ditentukan Gambar pandangan salah Penunjuk ukuran tidak lengkap Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Mampu menyelesaikan 80% soal ujian dengan waktu yang telah ditentukan Gambar yang dibuat benar Penunjuk ukuran tidak lengkap Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Mampu menyelesaikan 90% soal ujian dengan waktu yang telah ditentukan Gambar yang dibuat benar Penunjuk ukuran benar Penggunaan ketebalan garis kurang tepat Kertas gambar kotor	Mampu menyelesaikan 100% soal ujian dengan waktu yang telah ditentukan Gambar yang dibuat benar Penunjuk ukuran benar Penggunaan ketebalan garis tepat Kertas gambar bersih



		INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)							
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)	
Korosi (Corrosion)	TM 234735	Metalurgi	T= 2.55	P= 0.45	Pilihan	10 November 2023	
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)		
	H. C. Kis Agustin Suwarno	Prof. Suwarno			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.		
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)						
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)					
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. (Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)					
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika.					



		(Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)					
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. (Ability to identify, formulate, analyze, and solve technical problems)					
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data (Ability to plan, solve and evaluate the task based on the analysis of data and information)					
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)						
	CPMK-1	Mahasiswa mampu memahami definisi korosi, klasifikasi korosi, aspek-aspek korosif, diagram polarisasi katodik dan anodik, serta mengerti bagaimana mengontrol proses korosi melalui material, lingkungan, maupun desain (Students are able to understand the definition of corrosion, types of corrosion, corrosive factors, cathodic and anodic polarization diagrams, and how to control the corrosion process through materials, environment, and design)					
	CPMK-2	Mahasiswa mengenal bentuk bentuk korosi serta tipikal paduan yang sensitif, mengukur laju korosi melalui eksperimen maupun secara pendekatan elektronik polarisasi (Students are familiar with various forms of corrosion and the typical alloys that are sensitive to them, and are able to measure the corrosion rate through experiments or by using the electrochemical polarization method)					
	CPMK-3	Mahasiswa mengenal prinsip korosi kering, diagram Ellingham dan aplikasinya, serta metoda mengontrol korosi kering melalui doping (Students are familiar with the principles of dry corrosion, the Ellingham diagram and its applications, as well as methods of controlling dry corrosion through doping)					
	CPMK-4	Mahasiswa mengenal logam paduan dan lingkungan tahan korosi (Students are familiar with corrosion-resistant alloys and environments)					
	CPMK-5	Mahasiswa mampu menerapkan konsep pengendalian korosi pada permasalahan di industri (Students are able to apply corrosion control concepts to real industrial problems)					
		Matrik CPL – CPMK					
		CPMK	CPL-4	CPL-6	CPL-7	CPL-8	CPL10
		CPMK-1	√	√			



			CPMK-2	√	√	√		
			CPMK-3		√	√	√	√
			CPMK-4	√	√		√	√
			CPMK-5			√	√	√
Deskripsi Singkat MK (Short Description of Course)	Mata kuliah ini membahas Prinsip serta pemahaman proses korosi logam, aspek korosif, Diagram Pourbaix, korosi kering & pemanfaatan Diagram Ellingham, mengontrol korosi dengan berbagai metoda sesuai bentuk korosinya, dan memanfaatkan potentiostat untuk mengukur laju korosi logam. <i>This course discusses the principles and understanding of metal corrosion processes, corrosive aspects, Pourbaix Diagrams, dry corrosion & the use of Ellingham Diagrams, controlling corrosion by various methods according to its corrosion form, and utilizing potentiostats to measure the rate of metal corrosion.</i>							
Bahan Kajian: Materi Pembelajaran (Course Materials)	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: 1. Proses korosi (Corrosion process) 2. Korosi basah serta aspek korosif, polarisasi, laju korosi. (Wet corrosion, corrosive aspects, polarisation, Corrosion rate) 3. Bentuk-bentuk korosi basah, (Types of wet corrosion) 4. Diagram Pourbaix (Pourbaix diagram) 5. Proteksi katodik & anodik (Cathodic and anodic protection) 6. Media korosif & Material tahan korosi (Corrosion-resistant materials) 7. Korosi kering, type oksida, doping, korosi catastrophic (Dry corrosion, oxide type, doping, catastrophic corrosion)							
Pustaka	Utama :							



(References)C		(Main)					
		1. Jones, Denny A., "Principles and Prevention of Corrosion", Mac Millan Publishing Company, a division of MacMillan, Inc. 2. Fontana, Mars G./Green, NibertD., "Corrosion Engineering", Mac Graw Hill International Book Company					
		Pendukung : (Supplementary) 1. Uhlig, Herbert H., "Corrosion and Corrosion Control" an Introduction to Corrosion Science and Engineering, second edition, John Wiley & Sons, Inc. 2. Thretewey& Chamberlain, " Korosi untuk Rekayasawan"					
Dosen Pengampu (Lecturers)		H. C. Kis Agustin, Prof. Suwarno					
Matakuliah syarat (Prerequisites)		Metalurgi 1 & Metalurgi 2					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mengerti definisi, pengertian, klasifikasi, kecenderungan logam untuk	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam	- Mampu memahami definisi, pengertian, klasifikasi, kecenderungan	Luring. - Contextual Teaching & Learning - Discussion & Brainstorming - Review & Summary		- Kontrak Kuliah - Penyampaian materi yg akan dibahas di kuliah ini - Definisi korosi	



	terkorosi, energi bebas Gibbs (<i>Students understand the definition, meaning, and classification of corrosion, the tendency of metals to corrode, and the concept of Gibbs free energy</i>)	menjelaskan definisi, pengertian, klasifikasi, kecenderungan logam untuk terkorosi, energi bebas Gibbs (<i>Completeness, clarity, accuracy (of content and timing), and originality in explaining the definition, meaning, and classification of corrosion, the tendency of metals to corrode, and the concept of Gibbs free energy</i>)	logam untuk terkorosi, energi bebas Gibbs (<i>Able to understand the definition, meaning, and classification of corrosion, the tendency of metals to corrode, and the concept of Gibbs free energy</i>) - Bentuk penilaian: tes dan non-tes (<i>Assessment form: tests and non-tests</i>)	[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- Sifat mekanik serta relasinya dengan struktur mikro dan komposisi kimia baja (<i>system in meeting of learning</i>) - showing(of material that will be discussed in this lecture - Corrosion definition - Mechanical properties and their relationship to the microstructure and chemical composition of the steel) [1, 2]	
2-3	Mahasiswa mengetahui konsep korosi basah, dan faktor yang terlibat	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan	- Mampu memahami konsep korosi basah, dan faktor yang terlibat	Luring. - Contextual Teaching & Learning - Discussion & Brainstorming		- Korosi basah (<i>aqueous corrosion</i>): syarat terjadinya	



	<i>(Students are familiar with the concept of wet corrosion and the factors involved)</i>	originalitas dalam menjelaskan konsep korosi basah, dan faktor yang terlibat <i>(Completeness, clarity, accuracy (of content and timing), and originality in explaining the concept of wet corrosion and the factors involved)</i>	<i>(Able to understand the the concept of wet corrosion and the factors involved)</i> - Bentuk penilaian: tes dan non-tes <i>(Assessment form: tests and non-tests)</i>	- Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		(faktor faktor pendukung) - Reaksi redoks - Polarisasi - Passivasi - Laju korosi - 3 Aspek korosi: material, lingkungan, reaksi - Diagram Pourbaix <i>(- Aqueous corrosion: conditions for occurrence (supporting factors)</i> - Redox reactions - Polarization - Passivation - Corrosion rate - 3 Aspects of corrosion: material, environment, reaction - Pourbaix diagram) [1, 2]	
4	Kuis (Quiz)						25%
5-7	Mahasiswa mengenal bentuk	Kelengkapan, kejelasan,	- Mampu membedakan	Luring.		- Bentuk bentuk korosi basah penyebabnya,	



	bentuk korosi basah, penyebab, dan pencegahannya <i>(Students learn about the types of wet corrosion, their causes, and how to prevent them)</i>	ketepatan (materi & waktu), dan originalitas dalam menjelaskan perbedaan bentuk bentuk korosi basah, serta mampu menjelaskan penyebab, mekanisme terjadinya, dan cara pencegahannya <i>(Completeness, clarity, accuracy (of content and timing), and originality in explaining the differences between types of wet corrosion, as well as the ability to explain their causes,</i>	bentuk bentuk korosi basah, serta mampu menjelaskan penyebab, mekanisme terjadinya, dan cara pencegahannya <i>(Able to distinguish the types of wet corrosion, and explain their causes, mechanisms, prevention methods)</i> - Bentuk penilaian: tes dan non-tes <i>(Assessment form: tests and non-tests)</i>	- Contextual Teaching & Learning - Discussion & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		mekanisme terjadinya, metoda pencegahannya, dan pengujiannya. - korosi merata - korosi galvanik - korosi selektif & korosi sumuran - korosi celah - korosi batas butir - korosi tegangan (SCC) - <i>forms of wet corrosion: the cause, the mechanism of its occurrence, the method of its prevention, and its testing.</i> - <i>Corrosion Evenly</i> - <i>galvanic corrosion</i> - <i>Selective corrosion & rust corrosion</i> - <i>Cut the slit</i> - <i>grain boundary corrosion</i> - <i>Stress corrosion Cracking (SCC)</i>	



		<i>mechanisms, prevention methods)</i>				[1, 2]	
8	Evaluasi Tengah Semester (Midterm Exam)						25%
9-10	Mahasiswa memahami konsep korosi kering dan permasalahannya (<i>Students understand the concept of dry corrosion and its associated issues</i>)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep korosi kering dan permasalahannya (<i>Completeness, clarity, accuracy (of content and timing), and originality in explaining the concept of dry corrosion and its associated issues</i>)	- Mampu memahami konsep korosi kering dan permasalahannya (<i>Able to understand the concept of dry corrosion and its associated issues</i>) - Bentuk penilaian: tes dan non-tes (<i>Assessment form: tests and non-tests</i>)	Luring. - Contextual Teaching & Learning - Discussion & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- Mekanisme korosi kering & reaksi - Diagram Ellingham - Oksida protektif - Type oksida - Kontrol korosi kering melalui doping (<i>- Dry corrosion mechanism & reaction</i>) - Ellingham diagram - Protective oxides - Type of oxide - Dry corrosion control through doping) [1, 2]	
11	Mahasiswa mampu mengukur laju korosi logam menggunakan	Kelengkapan, kejelasan, ketepatan (materi	- mampu mengukur laju korosi logam menggunakan	Luring. - Practicum		Praktikum	



	kupon ataupun menggunakan potentiostat. (Students are able to measure the rate of metal corrosion using coupons or using potentiostats)	& waktu), dan originalitas dalam melakukan pengukuran potensial suatu logam, tahanan elektrolit (Completeness, clarity, accuracy (of content and timing), and originality in measuring the potential of a metal and the electrolyte resistance)	kupon ataupun menggunakan potentiostat. (able to measure the rate of metal corrosion using coupons or using potentiostats) - Bentuk penilaian: tes dan non-tes (Assessment form: tests and non-tests)	- Discussion & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- Mengukur potensial korosi dan arus korosi logam - Mempelajari korosi logam yang berbeda (Practicum - Measure the corrosion potential and current of metal corrosion - Studying different metal corrosions)	
12-13	Mahasiswa mampu menjelaskan media korosif dan material tahan korosi (Students are able to explain corrosive media and corrosion-resistant materials)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan media korosif dan material tahan korosi	- Mampu menjelaskan media korosif dan material tahan korosi (Able to explain corrosive media and corrosion-resistant materials)	Luring. - Contextual Teaching & Learning - Discussion & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- Metals & alloys - Non metals - Sulfuric acid - Nitric acid - Hydrochloric acid - Media korosif lainnya (other corrosive media) [1, 2]	



		<i>(Completeness, clarity, accuracy (of content and timing), and originality in explaining corrosive media and corrosion-resistant materials)</i>	- Bentuk penilaian: tes dan non-tes (Assessment form: tests and non-tests)				
14	Presentasi (Presentation)						25%
15	Mahasiswa mampu menjelaskan <i>modern theory-applications</i> (Students are able to explain modern theories and their applications)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan <i>modern theory-applications</i> (Completeness, clarity, accuracy (of content and timing), and originality in explaining modern theories	- Mampu menjelaskan <i>modern theory-applications</i> (Able to explain modern theories and their applications) - Bentuk penilaian: tes dan non-tes (Assessment form: tests and non-tests)	Luring. - Contextual Teaching & Learning - Discussion & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- <i>Modern-theory applications</i> [1, 2]	



		<i>and their applications)</i>					
16	Evaluasi Akhir Semester (Final Exam)						25%



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
Mekanika Patahan (Fracture Mechanics)	TM234736		T= 3	P= 0	6	18 Januari 2023
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)	
	Sutikno	Sutikno			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)				
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja,				



		keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>(Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources)</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>(Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>(Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>(Ability to identify, formulate, analyze, and solve technical problems)</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>(Ability to plan, solve and evaluate the task based on the analysis of data and information)</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)	
	CPMK-1	Mahasiswa mampu memahami dan menjelaskan deformasi, tegangan, kriteria kegagalan, dan konsentrasi tegangan. <i>Students understand and explain deformation, stress, failure criterion, and stress concentration.</i>
	CPMK-2	Mahasiswa mampu memahami pengaruh cacat/retakan serta penalaran retakan terhadap kehandalan material logam (paduan). <i>Students understand the effect of defects/cracks and crack propagation on the reliability of metals (alloys).</i>
	CPMK-3	Mahasiswa mampu menilai integritas material struktur yang mengandung cacat dan melakukan estimasi umur Lelah. <i>Students are able to assess the integrity of structural materials that contain defects and estimate the fatigue life</i>



	CPMK-4	Mahasiswa mampu memahami konsep mekanika retakan dalam mendesain bahan teknik (paduan logam), proses manufaktur dan penyambungan logam, yang akan digunakan sebagai komponen, atau bahan struktur. <i>Students understand the concept of fracture mechanics in designing engineering materials (metal alloys), manufacturing processes, and metal joining, which will be applied as components, or structural materials.</i>																																			
		Matrik CPL – CPMK <table><tr><td></td><td>CPL-4</td><td>CPL-5</td><td>CPL-6</td><td>CPL-7</td><td>CPL-8</td><td>CPL-10</td></tr><tr><td>CPMK-1</td><td>✓</td><td>✓</td><td></td><td></td><td>✓</td><td></td></tr><tr><td>CPMK-2</td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td></tr><tr><td>CPMK-3</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td>✓</td></tr><tr><td>CPMK-4</td><td>✓</td><td>✓</td><td></td><td>✓</td><td></td><td>✓</td></tr></table>		CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-10	CPMK-1	✓	✓			✓		CPMK-2			✓	✓	✓		CPMK-3	✓	✓	✓			✓	CPMK-4	✓	✓		✓		✓
	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-10																															
CPMK-1	✓	✓			✓																																
CPMK-2			✓	✓	✓																																
CPMK-3	✓	✓	✓			✓																															
CPMK-4	✓	✓		✓		✓																															
Deskripsi Singkat MK <i>(Short Description of Course)</i>	Mata kuliah ini membahas tentang konsep dasar mekanika retakan, permasalahan kegagalan material teknik akibat adanya cacat/retakan, penjaran retakan, mekanisme patahan, ketangguhan material, dan aplikasi mekanika retakan dalam perancangan komponen sistem mekanikal. <i>This course studies the basic concepts of fracture mechanics, engineering material failure problems due to defects/cracks, crack propagation, fracture mechanisms, material toughness, and the implementation of fracture mechanics in the design components of mechanical system.</i>																																				
Bahan Kajian: Materi Pembelajaran <i>(Course Materials)</i>	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: • Konsep dasar mekanika patahan dan kegagalan material Teknik • Kekuatan kohesif dan actual, deformasi dan kriteria kegagalan • Konsentrasi tegangan • Cacat/retakan dan ketangguhan • Zona plastis diujung retakan • Mekanisme patahan dan pertumbuhan retakan • Mekanika patahan elastic linier • Kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur)																																				



	• Mulur (mekanisme, ketahanan mulur material) • Lingkungan yang mempengaruhi retakan • Aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal <i>The course will learn the following subjects:</i> • <i>Basic concepts fracture mechanics and failure of Engineering materials</i> • <i>Actual and cohesive strength, deformation and failure criteria</i> • <i>Stress concentration</i> • <i>Defects/cracks and toughness</i> • <i>Plastic zone at the tip of the crack</i> • <i>Fracture mechanisms and crack growth</i> • <i>Linear elastic fracture mechanics (LEFM)</i> • <i>Fatigue (failure, Fatigue crack propagation and estimated life)</i> • <i>Creep (mechanism, material creep resistance)</i> • <i>Environment influencing cracks</i> • <i>Implementation of fracture mechanics in designing component of mechanical system</i>	
Pustaka (References)	Utama : (Main)	
	Slides/Handouts/Notes	
	Pendukung : (Supplementary)	
	[51].	T.L. Anderson, Ph.D., Fracture Mechanics-Fundamentals and Applications, Third Edition, CRC Press LLC, Florida, 2005
	[52].	Fernand Ellyin, Fatigue damage, crack growth and life prediction, Chapman & Hall, 1997
	[53].	Michael F. Ashby, An introduction to properties, applications, and design, Third edition, Elsevier Butterworth Heinemann, 2008
	[54].	Kare Hellan, Introduction to fracture mechanics, McGraw-Hill Company, 1985
	[55].	C. H. Wang, DSTO Aeronautical and Maritime Research Laboratory, 1996



	[56]. Alan T. Zehnder, Fracture Mechanics, Springer, 2012 [57]. P.J.G. Schreurs, Fracture Mechanics, Eindhoven University of Technology, 2012 [58]. Stanislav Lasek, Fracture Mechanics, Technical University of Ostrava, 2015						
Dosen Pengampu (Lecturers)	Sutikno						
Matakuliah syarat (Prerequisites)	Tidak ada mata kuliah prasyarat <i>No Pre-requisite</i>						
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk	Luring	Daring		



			(Criteria & Model)	(Offline)	(Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa memahami konsep dasar mekanika patahan dan kegagalan material teknik	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dasar mekanika patahan dan kegagalan material teknik	• Mampu menjelaskan konsep dasar mekanika patahan dan kegagalan material Teknik • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Discussion & Brainstorming • Review & Summary • Oral Post-test (random) • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Kontrak Kuliah • Konsep dasar mekanika patahan dan kegagalan material teknik • [1]:1; [6]:1; [7]:1; [8]:1 • [Handout di myITS Classroom]	
	<i>Students understand the basic concepts of fracture mechanics and failure of engineering materials</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining the basic concept fracture mechanics and failure of engineering materials</i>	• <i>Able to explain the basic concepts of fracture mechanics and failure of engineering materials</i> • <i>Forms of assessment: test and non-test</i>	• <i>Contextual Teaching & Learning</i> • <i>Discussion & Brainstorming</i> • <i>Review & Summary</i> • <i>Oral Post-test (random)</i> • <i>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</i>		• <i>Course Contract</i> • <i>Basic concepts of fracture mechanics and failure of engineering materials</i> • <i>[1]:1; [6]:1; [7]:1; [8]:1</i> • <i>[Handout di myITS Classroom]</i>	



2 - 3	Mahasiswa memahami kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan, serta konsentrasi tegangan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan, serta konsentrasi tegangan	• Mampu menjelaskan kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan, serta konsentrasi tegangan • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Problem-based learning • Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random) • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan • Konsentrasi tegangan • [2]:8; [7]:5; [8]:2 • [Handout di myITS Classroom]	
	<i>Students understand cohesive and actual strength, deformation and failure criteria, and stress concentration</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining actual and cohesive strength, deformation and failure criteria, and stress concentration</i>	• Able to explain actual and cohesive strength, deformation and failure criteria, as well as stress concentration • Form of assessment: test and non-test	• Contextual Teaching & Learning • Problem-based learning • Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random)		• Actual and cohesive strength, deformation and failure criteria • Stress concentration • [2]:8; [7]:5; [8]:2 • [Handout di myITS Classroom]	



				• [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]			
4	Evaluasi 1 (EV-1) Mahasiswa memahami konsep dasar mekanika patahan dan kegagalan material teknik, kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan, serta konsentrasi tegangan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dasar mekanika patahan dan kegagalan material teknik, kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan, serta konsentrasi tegangan	• Mampu menjelaskan konsep dasar mekanika patahan dan kegagalan material teknik, kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan, serta konsentrasi tegangan • Bentuk penilaian: tes dan non-tes	• Written evaluation (analysis/synthesis) • Case studies • Presentation • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"] • Cognitive - Tasks Cognitive - Assignment		• Konsep dasar mekanika patahan dan kegagalan material teknik • Kekuatan kohesif dan aktual, deformasi dan kriteria kegagalan • Konsentrasi tegangan • [1]:1; [2]:8; [6]:1; [7]:1, 5; [8]:1, 2 • [Handout di myITS Classroom]	25 %
	Evaluation 1 (EV-1) <i>Students understand the basic concepts of fracture mechanics and failure of engineering</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining the basic concepts of fracture mechanics and failure of engineering materials, actual and</i>	• Able to explain the basic concepts of fracture mechanics and failure of engineering	• Written evaluation (analysis/synthesis) • Case studies • Presentation • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Basic concepts of fracture mechanics and failure of engineering materials • Actual and cohesive strength, deformation and failure criteria	



	<i>materials, actual and cohesive strength, deformation and failure criteria, and stress concentration</i>	<i>cohesive strength, deformation and failure criteria, and stress concentration</i>	<i>materials, actual and cohesive strength, deformation and failure criteria, and stress concentration</i> • <i>Forms of assessment: test and non-test</i>	• <i>Cognitive - Tasks / Cognitive - Assignment</i>		• <i>Stress concentration</i> • [1]:1; [2]:8; [6]:1; [7]:1, 5; [8]:1, 2 • [Handout di myITS Classroom]	
5	Mahasiswa memahami Cacat/retakan dan ketangguhan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan Cacat/retakan dan ketangguhan	• Mampu menjelaskan Cacat/retakan dan ketangguhan • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Problem-based learning • Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random) • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Cacat/retakan dan ketangguhan • [1]:7; [6]:6; [8]:3 • [Handout di myITS Classroom]	
	<i>Students understand</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining</i>	• <i>Able to explain defects/cracks and toughness</i>	• <i>Contextual Teaching & Learning</i>		• <i>Defects/cracks and toughness</i>	



	<i>defects/cracks and toughness</i>	<i>defects/cracks and toughness</i>	• <i>Forms of assessment: test and non-test</i>	• <i>Problem-based learning</i> • <i>Discussion & Brainstorming</i> • <i>Practice questions & Homework</i> • <i>Individual assignments</i> • <i>Review & Summary</i> • <i>Oral Post-test (random)</i> • <i>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</i>		• <i>[1]:7; [6]:6; [8]:3</i> • <i>[Handout di myITS Classroom]</i>	
6 - 7	Mahasiswa memahami Zona plastis diujung retakan, mekanisme patahan dan pertumbuhan retakan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan zona plastis diujung retakan, mekanisme patahan dan pertumbuhan retakan	• Mampu menjelaskan zona plastis diujung retakan, mekanisme patahan dan pertumbuhan retakan • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Problem-based learning • Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random)		• Zona plastis diujung retakan • Mekanisme patahan dan pertumbuhan retakan • [1]:7; [6]:6; [8]:3 • [Handout di myITS Classroom]	



				• [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]			
	<i>Students understand the plastic zone at the tip of a crack, fracture mechanisms and crack growth</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining the plastic zone at the crack tip, fracture mechanisms and crack growth</i>	• <i>Able to explain the plastic zone at the tip of the crack, the fracture mechanism and crack growth</i> • <i>Forms of assessment: test and non-test</i>	• <i>Contextual Teaching & Learning</i> • <i>Problem-based learning</i> • <i>Discussion & Brainstorming</i> • <i>Practice questions & Homework</i> • <i>Individual assignments</i> • <i>Review & Summary</i> • <i>Oral Post-test (random)</i> • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• <i>Plastic zone at the tip of the crack</i> • <i>Fracture mechanisms and crack growth</i> • [1]:7; [6]:6; [8]:3 • [Handout di myITS Classroom]	
8	Evaluasi 2 (EV-2) Mahasiswa memahami Cacat/retakan dan ketangguhan, zona plastis diujung retakan, mekanisme patahan dan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan Cacat/retak dan ketangguhan, zona plastis diujung retakan, mekanisme patahan dan pertumbuhan retakan	• Mampu menjelaskan Cacat/retakan dan ketangguhan, zona plastis diujung retakan, mekanisme	• Written evaluation (analysis/synthesis) • Case studies • Presentation • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"] • Cognitive - Quiz Cognitive - Quiz		• Cacat/retakan dan ketangguhan • Zona plastis diujung retakan • Mekanisme patahan dan pertumbuhan retakan • [1]:7; [6]:6; [8]:3	25 %



	pertumbuhan retakan		patahan dan pertumbuhan retakan • Bentuk penilaian: tes dan non-tes			• [Handout di myITS Classroom]	
	Evaluation 2 (EV-2) Students understand defects/cracks and toughness, the plastic zone at the end of the crack, fracture mechanisms and crack growth	<i>Completeness, clarity, accuracy (material & time), and originality in explaining defects/cracks and toughness, plastic zones at crack tips, fracture mechanisms and crack growth</i>	• Able to explain defects/cracks and toughness, plastic zones at the ends of cracks, fracture mechanisms and crack growth • Forms of assessment: test and non-test	• Written evaluation (analysis/synthesis) • Case studies • Presentation • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"] • Cognitive - Quiz / Cognitive - Quiz		• Defects/cracks and toughness • Plastic zone at the tip of the crack • Fracture mechanisms and crack growth • [1]:7; [6]:6; [8]:3 • [Handout di myITS Classroom]	
9	Mahasiswa memahami mekanika patahan elastik linier	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan	• Mampu menjelaskan mekanika	• Contextual Teaching & Learning • Problem-based learning		• Mekanika patahan elastik linier (Linier Elastic Fracture Mechanics -LEFM)	



		mekanika patahan elastik linier	patahan elastik linier • Bentuk penilaian: tes dan non-tes	• Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random) • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• [1]:2; [6]:2 • [Handout di myITS Classroom]	
	<i>Students understand the mechanics of linear elastic fracture</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining linear elastic fracture mechanics</i>	• <i>Able to explain the mechanics of linear elastic fracture</i> • <i>Forms of assessment: test and non-test</i>	• <i>Contextual Teaching & Learning</i> • <i>Problem-based learning</i> • <i>Discussion & Brainstorming</i> • <i>Practice questions & Homework</i> • <i>Individual assignments</i> • <i>Review & Summary</i> • <i>Oral Post-test (random)</i> • <i>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</i> •		• <i>Linear elastic fracture mechanics (LEFM)</i> • [1]:2; [6]:2 • [Handout di myITS Classroom]	



10 - 11	Mahasiswa memahami Kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur) dan Mulur (mekanisme, ketahanan mulur material)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan Kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur) dan Mulur (mekanisme, ketahanan mulur material)	• Mampu menjelaskan Kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur) dan Mulur (mekanisme, ketahanan mulur material) • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Problem-based learning • Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random) • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur) • Mulur (mekanisme, ketahanan mulur material) • [1]:10; [2]:7; [3]:12, 17, 18, 20; [4]:6; [7]:12 • [Handout di myITS Classroom]	
	<i>Students understand Fatigue (failure, Fatigue crack propagation and estimated life) and Creep (mechanism, material creep resistance)</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining Fatigue (failure, crack propagation Fatigue and estimated life) and Creep (mechanism, material creep resistance)</i>	• <i>Able to explain Fatigue (failure, Fatigue crack propagation and estimated life) and Creep (mechanism, material creep resistance)</i> • <i>Forms of assessment: test and non-test</i>	• <i>Contextual Teaching & Learning</i> • <i>Problem-based learning</i> • <i>Discussion & Brainstorming</i> • <i>Practice questions & Homework</i> • <i>Individual assignments</i> • <i>Review & Summary</i>		• <i>Fatigue (failure, Fatigue crack propagation and estimated life)</i> • <i>Creep (mechanism, material creep resistance)</i> • <i>[1]:10; [2]:7; [3]:12, 17, 18, 20; [4]:6; [7]:12</i> • <i>[Handout di myITS Classroom]</i>	



				• <i>Oral Post-test (random)</i> • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]			
12	Evaluasi 3 (EV-3) Mahasiswa memahami mekanika patahan elastik linier, kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur) dan mulur (mekanisme, ketahanan mulur material)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan mekanika patahan elastik linier, kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur) dan mulur (mekanisme, ketahanan mulur material)	• Mampu menjelaskan mekanika patahan elastik linier, kelelahan (kegagalan, penjaran retakan Lelah dan perkiraan umur) dan mulur (mekanisme, ketahanan mulur material) • Bentuk penilaian: tes dan non-tes	• Written evaluation (analysis/synthesis) • Case studies • Presentation • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"] • Case Study Case Method		• Mekanika patahan elastik linier • Kelelahan • Mulur • [1]:2, 10; [2]:7; [3]:12, 17, 18, 20; [4]:6; [6]:2; [7]:12 • [Handout di myITS Classroom]	25 %
	Evaluation 3 (EV-3) <i>Students understand linear elastic fracture mechanics, fatigue (failure, fatigue crack propagation</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining linear elastic fracture mechanics, fatigue (failure, crack propagation Fatigue and estimated life) and</i>	• <i>Able to explain linear elastic fracture mechanics, fatigue (failure, crack propagation</i>	• <i>Written evaluation (analysis/synthesis)</i> • <i>Case studies</i> • <i>Presentation</i> • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• <i>Linear elastic fracture mechanics</i> • <i>Fatigue</i> • <i>Creep</i> • [1]:2, 10; [2]:7; [3]:12, 17, 18, 20; [4]:6; [6]:2; [7]:12	



	<i>and estimated life) and creep (mechanism, material creep resistance)</i>	<i>creep (mechanism, material creep resistance)</i>	<i>Fatigue and estimated life) and creep (mechanism, material creep resistance) • Forms of assessment: test and non-test</i>	<i>• Case Study Case Method</i>		<i>• [Handout di myITS Classroom]</i>	
13	Mahasiswa memahami lingkungan yang mempengaruhi retakan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan lingkungan yang mempengaruhi retakan	• Mampu menjelaskan lingkungan yang mempengaruhi retakan • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Problem-based learning • Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random) • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Lingkungan yang mempengaruhi retakan • [1]:11 • [Handout di myITS Classroom]	
	<i>Students understand the environment that influences cracks</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining</i>	<i>• Able to explain the environment that influences cracks</i>	• Contextual Teaching & Learning • Problem-based learning		• Environment influencing cracks • [1]:11	



		<i>the environment that influences cracks</i>	• <i>Forms of assessment: test and non-test</i>	• <i>Discussion & Brainstorming</i> • <i>Practice questions & Homework</i> • <i>Individual assignments</i> • <i>Review & Summary</i> • <i>Oral Post-test (random)</i> • <i>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</i>		• <i>[Handout di myITS Classroom]</i>	
14 - 15	Mahasiswa memahami aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal	• Mampu menjelaskan aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Problem-based learning • Discussion & Brainstorming • Practice questions & Homework • Individual assignments • Review & Summary • Oral Post-test (random)		• Aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal • [1]:9, [3]:23, [4]:9, [8]:8 • [Handout di myITS Classroom]	



				• [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]			
	<i>Students understand the implementation of fracture mechanics in designing components of mechanical system</i>	<i>Completeness, clarity, accuracy (material & time), and originality in explaining the implementation of fracture mechanics in the designing components of mechanical system</i>	• <i>Able to explain the implementation of fracture mechanics in designing components of mechanical system</i> • <i>Forms of assessment: test and non-test</i>	• <i>Contextual Teaching & Learning</i> • <i>Problem-based learning</i> • <i>Discussion & Brainstorming</i> • <i>Practice questions & Homework</i> • <i>Individual assignments</i> • <i>Review & Summary</i> • <i>Oral Post-test (random)</i> • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• <i>Implementation of fracture mechanics in the designing components of mechanical system</i> • [1]:9, [3]:23, [4]:9, [8]:8 • [Handout di myITS Classroom]	
16	Evaluasi 4 (EV-4) Mahasiswa memahami lingkungan yang mempengaruhi retakan dan aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan lingkungan yang mempengaruhi retakan dan aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal	• Mampu menjelaskan lingkungan yang mempengaruhi retakan dan aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal	• Written evaluation (analysis/synthesis) • Case studies • Presentation • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"] • Project results Team-based Project		• Lingkungan yang mempengaruhi retakan • Aplikasi mekanika patahan dalam perancangan komponen sistem mekanikal • [1]:9, 11; [3]:23; [4]:9; [8]:8	25 %



			• Bentuk penilaian: tes dan non-tes			• [Handout di myITS Classroom]	
	Evaluation 4 (EV-4) Students understand the environment that influences cracks and the Implementation of fracture mechanics in designing components of mechanical system	Completeness, clarity, accuracy (material & time), and originality in explaining the environment that influences cracks and the Implementation of fracture mechanics in designing components of mechanical system	• Able to explain the environment that influences cracks and the implementation of fracture mechanics in designing components of mechanical system • Forms of assessment: test and non-test	• Written evaluation (analysis/synthesis) • Case studies • Presentation • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"] • Project results Team-based Project		• Environment influencing cracks • Implementation of fracture mechanics in designing components of mechanical system • [1]:9, 11; [3]:23; [4]:9; [8]:8 • [Handout di myITS Classroom]	



Catatan :

23. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
24. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
69. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
26. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
27. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
28. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
29. **Bentuk penilaian:** tes dan non-tes.
30. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
31. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
32. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
33. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
34. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



		RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM						
MATA KULIAH		KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Direvisi
PENGANTAR TEKNIK MESIN		TM234101			T=2	P=0	I	28 Agustus 2023
OTORISASI		Pengembang RP		Koordinator RMK		KaPRODI S1		
		Suwarno				Suwarno		
Capaian Pembelajaran	CPL-PRODI yang dibebankan pada MK							
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems</i>						
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>Ability to identify, formulate, analyze, and solve technical problems</i>						
	CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika <i>Ability to be responsible to society and obey professional ethics in solving the problem of mechanical systems</i>						
	Mata Kuliah							
	CPMK-1	Mahasiswa mampu menggambarkan profesi, ranah kerja, tanggung jawab disiplin ilmu teknik mesin. <i>Students able to describe profession, scope of work, and responsibility in mechanical engineering</i>						
	CPMK-2	Mahasiswa mampu menganalisa suatu permasalahan fisik dengan pendekatan keilmuan Teknik mesin <i>Students able to analysis physical system using mechanical approach</i>						



	CPMK-3	Mahasiswa mampu menganalisis permasalahan fisik dari sisi design dan material <i>Student able to analyze physical system from design and material manufacturing and control</i>																																	
	CPMK-4	Mahasiswa mampu menganalisis permasalahan fisik dari sisi rekayasa fluida, thermal <i>Student able to analyze physical system from fluids and thermal system</i>																																	
Matrik CPL – CPMK																																			
<table><tr><td>CPMK</td><td>CPL-4</td><td>CPL-8</td><td>CPL-11</td><td>Bobot (%)</td></tr><tr><td>CPMK-1</td><td></td><td></td><td>v</td><td>25</td></tr><tr><td>CPMK-2</td><td>v</td><td>v</td><td></td><td>25</td></tr><tr><td>CPMK-3</td><td>v</td><td>v</td><td></td><td>25</td></tr><tr><td>CPMK-4</td><td>v</td><td>v</td><td></td><td>25</td></tr><tr><td>Total bobot (%)</td><td>37.5</td><td>37.5</td><td>25</td><td>100</td></tr></table>						CPMK	CPL-4	CPL-8	CPL-11	Bobot (%)	CPMK-1			v	25	CPMK-2	v	v		25	CPMK-3	v	v		25	CPMK-4	v	v		25	Total bobot (%)	37.5	37.5	25	100
CPMK	CPL-4	CPL-8	CPL-11	Bobot (%)																															
CPMK-1			v	25																															
CPMK-2	v	v		25																															
CPMK-3	v	v		25																															
CPMK-4	v	v		25																															
Total bobot (%)	37.5	37.5	25	100																															
Bahan Kajian																																			



Diskripsi Bahan Kajian & Pokok Bahasan	Batang Tubuh Keilmuan Teknik Mesin (Mechanical Design, Forces in Structures and Machines, Material and Stresses, Fluids Engineering, Thermal and Energy Systems, Motions and Power Transmission)	
	Pokok Bahasan	
	Dalam kuliah ini mahasiswa diberikan pengetahuan tentang profesi insinyur, termasuk peran, etika, budaya serta tanggung jawab profesi keinsinyuran. Mahasiswa dikenalkan dengan batang tubuh keilmuan Teknik mesin antara lain: Mechanical Design, Forces in Structures and Machines, Material and Stresses, Fluids Engineering, Thermal and Energy Systems, Motion and Power Transmission beserta cabang – cabang di bawahnya. Di samping itu, mahasiswa akan diberikan tugas besar sederhana yang berkaitan dengan materi yang diajarkan. Dengan mengikuti mata kuliah Pengantar Teknik Mesin ini, mahasiswa diharapkan mampu melihat dan menganalisa suatu persoalan melalui pendekatan keilmuan Teknik Mesin.	
Pustaka	Utama :	
	[59]. J. Wickert, K. Lewis, An Introduction to Mechanical Engineering. Cengage learning , 2013	
	Pendukung :	
	[60]. John O. Bird, Carl T. F. Ross, Mechanical Engineering Principles, 2nd edition, Routledge, Taylor & Francis, 2012 [61]. M. Clifford, R. Brooks, Alan Howe et al. An Introduction to Mechanical Engineering Part 1. Hodder, 2009 [62]. M. Clifford, R. Brooks, Alan Howe et al. An Introduction to Mechanical Engineering Part 2. Hodder, 2009	
Media Pembelajaran	Software :	Hardware :
	-	PC & LCD Projector
Team Teaching	Sutikno, Putu Suwarta	
Assessment	Homework (<i>Case-Study</i>) Project Evaluasi tertulis (Quiz, ETS dan EAS)	
Matakuliah Syarat	-	



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
1	- Mahasiswa memiliki gambaran ruang lingkup dan ranah kerja teknik mesin, serta mampu melihat persoalan dengan pendekatan <i>engineering</i>	- Mahasiswa memiliki gambaran ruang lingkup dan ranah kerja teknik mesin, serta mampu melihat persoalan dengan pendekatan <i>engineering</i>	Oral Post-Test (acak): Tanya – jawab	Perkuliahan [TM: 3x50"] Kuliah tatap muka Belajar Terstruktur [TM: 3x60"] Problem Solving Belajar Mandiri [TM: 3x60"] Studi Kasus	- Kontrak kuliah - Review: - Lingkup dan Ranah Kerja Teknik Mesin - Peran dan sumbangsih Teknik mesin - Posisi dan daya tawar profesi insinyur di Indonesia dan dunia - Studi Kasus, misal: - <i>Development</i> SpaceX Falcon Heavy - <i>Development</i> Pesawat R80 [1]: Bab 1, 3 dan 5 [2]: Handout di myITS Calssroom	-
2	- Mahasiswa mampu melihat persoalan dengan pendekatan <i>engineering</i> (teknik mesin/sistem mekanikal)	- Mampu melihat persoalan dengan pendekatan <i>engineering</i> (teknik mesin/sistem mekanikal)	Oral Pre-Test (acak): Tanya – jawab Tugas Mandiri: Studi Kasus	Perkuliahan [TM: 3x50"] Kuliah tatap muka Belajar Terstruktur [TM: 3x60"] Problem Solving Belajar Mandiri [TM: 3x60"] Studi Kasus	- Aturan yang mengikat profesi insinyur - UU No. 11 Tahun 2014 tentang Keinsinyuran - Rule dan Etika Kerja - Komunikasi - Kesehatan dan keselamatan kerja [1]: Bab 8 [2]: Handout di myITS Calssroom	-



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
3	- Mahasiswa memiliki gambaran dan pengertian tentang proses dan tahapan pemecahan masalah yang berkaitan dengan desain dan system mekanikal	- Memiliki gambaran tahapan penyelesaian masalah dengan pendekatan system mekanikal	Oral Pre-Test (acak): Tanya – jawab Tugas Mandiri: Studi Kasus	Perkuliahan [TM: 3x50"] Kuliah tatap muka Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video tentang produk yang didesain oleh insinyur Teknik Mesin	- Mechanical Design - Proses Desain: Requirement, Konsep, Detail, Realisasi (Fabrikasi/Manufaktur) - Proses Fabrikasi/Manufaktur - Studi kasus konsep desain - Statik: Struktur Jembatan - Dinamik: Mousetrap-powered vehicles - Urban Power Infrastructure [1]: Bab 8 [2]: Handout di myITS Calssroom	-
4	- Mahasiswa memiliki gambaran dan pengertian tentang proses dan tahapan pemecahan masalah yang berkaitan dengan desain dan system mekanikal	- Memiliki gambaran tahapan penyelesaian masalah dengan pendekatan system mekanikal	Kuis: 3 soal 150 mnt	Perkuliahan [TM: 3x50"] Kuliah Tatap Muka Kuis 1 (asesmen CPMK 1-2) Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video tentang produk yang didesain oleh insinyur Teknik Mesin	- Mechanical Design - Proses Desain: Requirement, Konsep, Detail, Realisasi (Fabrikasi/Manufaktur) - Proses Fabrikasi/Manufaktur - Studi kasus konsep desain - Statik: Struktur Jembatan - Dinamik: Mousetrap-powered vehicles - Urban Power Infrastructure [1]: Bab 8 [2]: Handout di myITS Calssroom	4/15



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
5	- Mahasiswa memahami perbedaan antara <i>truss</i> dan <i>beam</i> , beserta gaya – gaya yang bekerja pada keduanya.	- Memahami <i>truss</i> dan <i>beam</i>	Oral Post-Test (acak): Tanya – jawab	Perkuliahan [TM: 3x50"] Kuliah tatap muka Belajar Terstruktur [TM: 3x60"] Contoh Soal Belajar Mandiri [TM: 3x60"] Studi Kasus	- Forces in Structures and Machines - Komponen Gaya (Cartesian dan polar) - Resultan Gaya (teoritis dan grafis) - Momen Gaya - Keseimbangan Gaya dan Momen - Truss and beam - Pengenalan Tugas Besar - Jembatan Tusuk Sate [1]: Bab 9 [2]: Handout di myITS Calssroom	-
6	- Mahasiswa memiliki pemahaman dasar mengenai Material Teknik, pengertian sifat mekanik, serta fenomena akibat adanya gaya (tarik/tekan) yang diberikan pada material.	- Memiliki pemahaman dasar tentang material Teknik, sifat mekanik, serta respon material	Oral Pre-Test (acak): Tanya – jawab Tugas Mandiri: Studi Kasus	Perkuliahan [TM: 3x50"] Kuliah tatap muka Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video tentang uji tarik, uji kekerasan material	- Material Science and Stress - <i>Engineering Materials</i> - <i>Tension and Compression</i> - <i>Material Response</i> - <i>Shear</i> - <i>Safety Factor</i> - Monitoring Tugas Besar I [1]: Bab 9 [2]: Handout di myITS Calssroom	-



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
7	- Mahasiswa mampu menuangkan ide ke dalam sketsa/gambar terkait tugas besar	- Mahasiswa mampu membuat sketsa / gambar	Kuis: 2 soal 100 mnt	Perkuliahan [TM: 3x50"] Presentasi Tanya – jawab Kuis 2 (asesmen CPMK 3) Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Monitoring dan Asistensi Tugas Besar [1]: Bab 9 [2]: Handout di myITS Calssroom	3/15
8	- EVALUASI TENGAH SEMESTER (ETS)	- -	Oral Post-Test (acak):	Perkuliahan [TM: 3x50"] Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	- Review: [1]: Bab 3, 5, dan 6 [2]: Handout di myITS Calssroom	-



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
9	- Mahasiswa mampu menyampaikan/ mempresentasikan ide terkait tugas besar	- Mahasiswa mampu menyampaikan ide / gagasannya	Oral Pre-Test (acak): Tanya – jawab Tugas Mandiri: Studi Kasus	Perkuliahan [TM: 3x50"] Presentasi Belajar Terstruktur [TM: 3x60"] Tanya-Jawab Belajar Mandiri [TM: 3x60"] Praktek	- Presentasi dan Unjuk Kerja Tugas Besar [1]: Bab 5 dan 7 [2]: Handout di myITS Calssroom	-
10	- Mahasiswa memiliki gambaran serta pemahaman dasar mengenai Fluida, karakteristik, beserta aplikasinya dalam dunia keteknikan.	- Memiliki gambaran serta pemahaman dasar mengenai Fluida beserta karakteristik	Oral Pre-Test (acak): Tanya – jawab Tugas Mandiri: Studi Kasus	Perkuliahan [TM: 3x50"] Kuliah tatap muka Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video tentang aplikasi mekanika fluida	- Mekanika Fluida - Properti Fluida - Aliran Laminar dan Turbulen - Gaya angkat dan gaya hambat - Aliran pada Pipa - Studi Kasus - Misal: Airfoil pesawat, Down force pada mobil F1 - Mesin - mesin Fluida (Pompa, Kompresor, Turbin) - Tugas Besar II: <i>Mousetrap-powered vehicles</i> Briefing (w.11) [1]: Bab 6 dan 7 [2]: Handout di myITS Calssroom	-



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
11	- Mahasiswa memiliki gambaran serta pemahaman dasar mengenai Fluida, karakteristik, beserta aplikasinya dalam dunia keteknikan.	- Memiliki gambaran serta pemahaman dasar mengenai Fluida beserta karakteristik	Kuis: 3 soal 150 mnt	Perkuliahan [TM: 3x50"] Kuliah tatap muka Kuis 3 (asesmen CPMK 4) Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video tentang aplikasi mekanika fluida	- Mekanika Fluida - Properti Fluida - Aliran Laminar dan Turbulen - Gaya angkat dan gaya hambat - Aliran pada Pipa - Studi Kasus - Misal: Airfoil pesawat, Down force pada mobil F1 - Mesin - mesin Fluida (Pompa, Kompresor, Turbin) - Tugas Besar II: <i>Mousetrap-powered vehicles</i> - Briefing (w.11) [1]: Bab 7 [2]: Handout di myITS Calssroom	4/15
12	- Mahasiswa memiliki gambaran serta pemahaman dasar mengenai Konversi dan Konservasi Energi beserta penerapannya.	- Memiliki gambaran serta pemahaman dasar mengenai Konversi dan Konservasi Energi beserta penerapannya.	Oral Pre-Test (acak): Tanya – jawab Tugas Mandiri: Studi Kasus	Perkuliahan [TM: 3x50"] Transfer Materi Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video dan animasi tentang pembangkit listrik thermal (PLTU, diesel engine, gas turbine)	- Thermal and Energy Systems - Energi mekanik, usaha, dan daya - Konservasi dan Konversi Energi - Nilai kalor, kalor spesifik, perpindahan panas - Power generations, Motor Pembakaran Luar dan Motor Pembakaran Dalam - Siklus Rankine dan Siklus Brayton - Siklus Otto dan Siklus Diesel - Studi Kasus: - Pembangkit listrik termal	-



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
					- Jet engine, mesin 2 tak, mesin 4 tak [1]: Bab 16 [2]: Handout di myITS Calssroom	
13	- Mahasiswa memiliki gambaran serta pemahaman dasar mengenai Konversi dan Konservasi Energi beserta penerapannya.	- Memiliki gambaran serta pemahaman dasar mengenai Konversi dan Konservasi Energi beserta penerapannya.	Kuis: 2 soal 100 mnt	Perkuliahan [TM: 3x50"] Transfer Materi Kuis 4 (asesmen CPMK 5) Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video dan animasi tentang pembangkit listrik thermal (PLTU, diesel engine, gas turbine)	- Thermal and Energy Systems - Energi mekanik, usaha, dan daya - Konservasi dan Konversi Energi - Nilai kalor, kalor spesifik, perpindahan panas - Power generations, Motor Pembakaran Luar dan Motor Pembakaran Dalam - Siklus Rankine dan Siklus Brayton - Siklus Otto dan Siklus Diesel - Studi Kasus: - Pembangkit listrik termal - Jet engine, mesin 2 tak, mesin 4 tak [1]: Bab 16 [2]: Handout di myITS Calssroom	2/15



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
14	- Mahasiswa memiliki gambaran serta pemahaman dasar mengenai Gerak (translasi, rotasi, dan kombinasinya), mekanisme, macam-macam penghantar daya, serta penerapannya.	- Memiliki pemahaman dasar mengenai Gerak, mekanisme, macam-macam penghantar daya, serta penerapannya.	Oral Pre-Test (acak): Tanya – jawab Tugas Mandiri: Studi Kasus	Perkuliahan [TM: 3x50"] Transfer Materi Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video tentang komponen transmisi daya serta aplikasinya	- Motion and Power Transmission - Gerak Translasi, Rotasi, dan Koriolis - Mekanisme sederhana dan Mekanisme Kompleks - Macam – macam pemindah/penghantar daya - Poros dan Gear (spur, R&P, bevel, helical, worm) - <i>chain – sprocket</i> - <i>belt – pulley</i> - Kecepatan, Torsi, dan Daya pada Penghantar Daya - Studi Kasus - Gear transmission, chain drive, and CVT - Planetary Gear - Tugas Besar II: <i>Mousetrap-powered vehicles</i> - Monitoring dan Asistensi (w.14 & w. 15) [1]: Bab 10 [2]: Handout di myITS Calssroom	-



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
15	- Mahasiswa memiliki gambaran serta pemahaman dasar mengenai Gerak (translasi, rotasi, dan kombinasinya), mekanisme, macam-macam penghantar daya, serta penerapannya.	- Memiliki pemahaman dasar mengenai Gerak, mekanisme, macam-macam penghantar daya, serta penerapannya.	Kuis: 2 soal 100 mnt	Perkuliahan [TM: 3x50"] Transfer Materi Kuis 5 (asesmen CPMK 6) Belajar Terstruktur [TM: 3x60"] Studi Kasus Belajar Mandiri [TM: 3x60"] Menyajikan video tentang komponen transmisi daya serta aplikasinya	- Motion and Power Transmission - Gerak Translasi, Rotasi, dan Koriolis - Mekanisme sederhana dan Mekanisme Kompleks - Macam – macam pemindah/penghantar daya - Poros dan Gear (spur, R&P, bevel, helical, worm) - <i>chain – sprocket</i> - <i>belt – pulley</i> - Kecepatan, Torsi, dan Daya pada Penghantar Daya - Studi Kasus - Gear transmission, chain drive, and CVT - Planetary Gear - Tugas Besar II: <i>Mousetrap-powered vehicles</i> - Monitoring dan Asistensi (w.14 & w. 15) [1]: Bab 10 [2]: Handout di myITS Calssroom	2/15



Mg Ke-	Sub-CPMK	Penilaian		Pembelajaran		Bobot Nilai
		Indikator	Kriteria	Bentuk & Metode [Estimasi Waktu]	Materi [Pustaka]	
16	- EVALUASI AKHIR SEMESTER (EAS)	-	Ujian Remedi: 4 soal 200 mnt	Perkuliahan [TM: 3x50"] Belajar Terstruktur [TM: 3x60"] Belajar Mandiri [TM: 3x60"]	Sesuai CPMK/sub CPMK yang diujikan	*



		RENCANA PEMBELAJARAN SEMESTER DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM						
MATA KULIAH		KODE	Rumpun MK		BOBOT (sks)		SEMESTE R	Direvisi
POLIMER DAN KOMPOSIT		TM234733	Polimer dan Komposit		T=3	P=0	VII	
OTORISASI		Pengembang RP		Koordinator RMK		KETUA PRODI		
Capaian Pembelajaran MK	Program Studi							
	1.1.2 Being able to apply mathematics, science, and engineering principles to solve complex engineering problems on composite material							
	1.1.2 Mampu menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa yang kompleks pada sistem mekanikal dan komponen-komponen yang diperlukan.							
	1.3.2 Being able to formulate solutions for engineering problems on composite material systems by taking into account economic factors, health and public safety, cultural, social and environmental							
	1.3.2 Mampu merumuskan solusi untuk masalah rekayasa di bidang sistem mekanikal dan komponen-komponen yang diperlukan dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan							
		2.1.1 Mastering the concepts of design and analysis of the mechanical properties of composite material and elaborate it in a mathematical model						



	2.1.1 Menguasai konsep desain serta analisa sifat mekanik material komposit dan penjabarannya dalam model matematika
	3.2.2 Being able to take responsibility for the work in the field of mechanical 3.2.2 Mampu bertanggungjawab pada pekerjaan di bidang mekanikal
	4.5.1 Value cultural diversity, views, beliefs/religion and others point of view 4.5.1 Menghargai keanekaragaman budaya, pandangan, kepercayaan, dan agama serta pendapat/ temuan orisinal orang lain
	Mata Kuliah
	At the end of the course, students should be able to comprehend and elucidate the relation between the mechanical properties of polymer composites and their structure. Gain the ability to elucidate manufacturing techniques of polymer composite, they are able to comprehend the linear elastic analysis of fiber reinforced composites concept and also able to design a composite plate laminate. Mahasiswa mampu menganalisa [C4,A3,P3] hubungan antara struktur dan sifat mekanik material polimer komposit , menganalisa teknik produksi material polimer komposit, mampu memahami dan menggunakan [C4,A3,P3] metode analisa sifat mekanik material komposit, serta mampu memilih dan merekayasa [C3,A2,P3] material komposit berbentuk laminate.
Diskripsi Bahan Kajian & Pokok Bahasan	Bahan Kajian
	Polimer & Komposit
	Pokok Bahasan
	This course covers the description and properties of fiber and matrix materials in composite materials, manufacturing techniques of composite materials, micromechanics and macromechanics analysis of composite materials. It discusses anisotropic material behaviour, design, analysis and applications of laminated plate and fiber reinforced composites, micromechanical and macromechanical analysis of elastic constant, failure analysis of composite materials. This



	course aims to gain advanced knowledge and analyzing skills on the linear elastic analysis of fiber reinforced composites. Materi yang terangkum di dalam mata kuliah ini antara lain sifat mekanik bahan serat dan matriks penyusun material komposit, teknik produksi material komposit, analisa mikromekanik dan makromekanik material komposit. Mata kuliah ini akan mengenalkan konsep material anisotropik, desain material komposit berbentuk laminate, analisa mikromekanik dan makromekanik elastik konstan, serta analisa kegagalan material komposit. Secara garis besarnya, mata kuliah ini mengenalkan kemampuan merekayasa material komposit serta menganalisa sifat elastis dari material komposit	
Pustaka	Utama : 1. D.Hull, An Introduction to Composite Materials, 1st Ed., Cambridge University Press, 1981 2. N.G. McCrum, C.P. Buckley and C.B. Bucknall, Principles of Polymer Engineering, 1st Ed., Oxford University Press, 1988 3. R.F. Gibson, Principles of Composite Material Mechanics, McGraw-Hill, Inc., 1994 4. L.H. Sperling, Introduction to Physical Polymer Science, John Wiley & Son, 2006	
	Pendukung : 4. G.Z. Voiadjis, P.I. Kattan, Mechanics of Composite Materials with MATLAB, Springer, 2005 5. S.K. Mazumdar, Composite Manufacturing, CRC Press, 2002 6. P.K. Mallick, Fibre Reinforced Composites: Materials, Manufacturing and Design, CRC Press, 2007 7. Anil Kumar, Rakesh Gupta, Fundamentals of Polymer Engineering, Marcel Dekker Inc, 2003	
	Software :	Hardware :
	Matlab, Abaqus	PC & LCD Projector
Team Teaching		
Assessment	Tugas Kelas Case Study Project Evaluasi tertulis (ETS dan EAS)	



Matakuliah Syarat	Metalurgi

Mg Ke-	Sub-Capaian Pembelajaran MK	Materi Pembelajaran [Pustaka]	Metode / Strategi Pembelajaran [Estimasi Waktu]	Assessment		
				Indikator	Bentuk	Bobot
(1)	[C4,A3][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu menganalisa karakteristik dasar material komposit	- Kontrak Kuliah dan Perkenalan Materi - Pengenalan material komposit - Karakteristik dasar - Klasifikasi material komposit - Kelebihan dan kekurangan - Desain dengan material komposit - Aplikasi Ref. 1 - Bab 1 Ref. 2 - Bab 8 Ref. 3 - Bab 1	Transfer Materi Studi Kasus [TM: 1x(3x50'')]	Mampu mampu menganalisa karakteristik dasar material komposit	Latihan soal	5 %
(2-3)	[C4,A3][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu menganalisa sifat	- Matriks pada komposit - Polymer matriks - Thermosetting polymer - Thermoplastik polymer	Transfer Materi Tugas Kelas Studi Kasus Latihan soal [TM: 2x(3x50'')]	mampu menganalisa sifat mekanik polymer matriks	Latihan Soal Homework	5 %



	mekanik polymer matriks	- Polymer matriks untuk aplikasi suhu tinggi - Moulding compound Ref. 1- Bab 2 Ref. 2- Bab 1,2,6 Ref. 4- Bab 1-9, Bab 11				
(4)	[C5,A4][Conceptual knowledge, Analyze]: Mahasiswa mampu menganalisa sifat mekanik penguat/ reinforcement pada komposit	Penguat/reinforced pada komposit - Karakteristik dasar serat penguat - Fibre packing - Kekuatan dan tegangan serat - Arah dan distribusi serat - Serat karbon - Serat glass - Serat UHMWPE - Serat tumbuhan - Susunan serat penguat komposit - Penguat particulate Ref. 1-Bab 2 ,4 Ref. 2-Bab 1,2,6	Kuliah Tugas Kelas Latihan soal Case Study Project 1 [TM: 1x(3x50'')]	mampu menganalisa sifat mekanik material reinforcement	Latihan Soal Homework Case Study Project	10 %
(5)	[C5,A4][Conceptual knowledge, Analyze]: Mahasiswa mampu menjelaskan tipe daerah interface dan	- Daerah interface - Kompleksitas daerah dekat serat - Mekanisme bonding	Transfer Materi Tugas Kelas Studi Kasus Problem Solving	mampu menjelaskan tipe daerah interface dan menganalisa sifat	Latihan Soal Homework	10 %



	menganalisa sifat mekanik daerah interface	- Adsorption dan wetting - Interdiffusion, chemical reaction, electrostatic attraction, mechanical keying - Kekuatan interfacial - Fibre pull-out, push-out, push --down - ILSS test - Fragmentation and microbond test - Control of bond strength - Coupling agents - Coatings Ref. 1- Bab 3, 7	[TM: 1x(3x50'')]	mekanik daerah interface		
(6-7)	[C5,A4][<i>Conceptual knowledge, Analyze</i>]: Mahasiswa mampu menganalisa sifat elastic dari material komposit	Sifat elastik material komposit Hubungan tegangan-regangan UD lamina Transformasi Tegangan Elastik konstant Komposit serat pendek Panjang serat kritis Tegangan rata-rata Elastic modulus <i>Aligned fibre</i>	Transfer Materi Tugas Kelas Studi Kasus Problem Solving [TM: 2x(3x50'')]	mampu menganalisa sifat elastis dari material komposit	Latihan Soal Homework	10%



		<i>Non-aligned fibre</i> Laminates & CLT Konfigurasi laminate Tegangan <i>interlaminar</i> & <i>edge effects</i> Ref. 1- Bab 4,5,6 Ref. 2- Bab 6 Ref. 3- Bab 2,3,6,7				
(8)	[C5,A4][Conceptual knowledge, Analyze]: Mahasiswa mampu menganalisa sifat mekanik material komposit	Evaluasi sifat mekanik material komposit - Kekuatan laminae - Axial tensile strength - Transverse tensile strength - Compressive strength - Ply failure - Mekanika patahan - Analisa Griffith - Stress intensity factor - Strain energy release rate factor Ref.1 -Bab 7,8,9,10 Ref. 2-Bab 4,6,8 Ref. 3-Bab 4,6,7,8,9	Transfer Materi Tugas Kelas Problem Solving [TM: 1x(3x50")]	mampu menganalisa sifat mekanik material komposit	Latihan Soal Homework	5%
(9)	Evaluasi Tengah Semester (Presentasi case study project 1)					



(10-11)	[C3,A2][Conceptual knowledge, Analyze]: Mahasiswa mampu menganalisa sifat mekanik dan pola kegagalan material komposit	Evaluasi sifat mekanik material komposit - Ketangguhan - Interfacial fracture - Delamination - Kontribusi matriks - Fibre fracture - Interfacial debonding - Frictional sliding - Pengaruh arah serat - Fatigue - Creep - Damping of composite Ref.1 - Bab 7,8,9,10 Ref. 2 - Bab 4,6,8 Ref. 3 - Bab 4, 6,7,8,9	Transfer Materi Tugas Kelas Problem Solving [TM: 2x(3x50'')]	mampu menganalisa sifat mekanik material komposit	Latihan Soal Homework	5 %
(12)	[C3,A2][Conceptual knowledge, Analyze]: Mahasiswa mampu menganalisa pengaruh temperatur terhadap sifat mekanik material komposit	- Sifat thermal material komposit - Hygrothermal degradation - - Efek Hygrothermal terhadap tegangan-regangan lamina - - Analisa mikromekanikal Ref.3- Bab 5	Transfer Materi Problem Solving Case Study Project 2 [TM: 1x(3x50'')]	mampu menganalisa pengaruh temperatur terhadap sifat mekanik material komposit	Latihan Soal	5%



(13)	[C3,A2][Conceptual knowledge, Analyze]: Mahasiswa mampu menganalisa pengaruh kelembaban terhadap sifat mekanik material komposit	- Hygrothermal degradation - Efek Hygrothermal terhadap tegangan-regangan lamina Ref.3- Bab 5	Transfer Materi Tugas Kelas Problem Solving [TM: 1x(3x50'')]	mampu menganalisa pengaruh kelembaban terhadap sifat mekanik material komposit	Latihan Soal Homework	5%
(14)	[C3,A2][Conceptual knowledge, Analyze]: Mahasiswa menganalisa pengaruh metode produksi material thermosetting komposit terhadap sifat mekaniknya	- Metode produksi thermoset komposit Ref. 5- Bab 6.	Transfer Materi Studi Kasus [TM: 1x(3x50'')]	menganalisa pengaruh metode produksi material thermosetting komposit terhadap sifat mekaniknya	Latihan Soal	5 %
(15)	[C3,A2][Conceptual knowledge, Analyze]: Mahasiswa menganalisa pengaruh metode produksi material thermoplastic komposit terhadap sifat mekaniknya	- Metode produksi thermoplastic komposit Ref. 5- Bab 6.	Transfer Materi Studi Kasus [TM: 1x(3x50'')]	menganalisa pengaruh metode produksi material themoplastic komposit terhadap sifat mekaniknya	Latihan Soal	5%
(16)	Evaluasi Akhir Semester (Presentasi case study project 2)					



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER (Semester Learning Plan)						
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
Logam Paduan Industri (Industrial Alloys)	TM 234732	Metalurgi	T= 3	P= 0	Pilihan	20 Nov. 2023
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)	
	Indra Sidharta	Suwarno			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi. (Able to manage one's own learning and develop oneself as a lifelong learner to compete at the national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability and understanding technology-based entrepreneurship)				



	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>(Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)</i>
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>(Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources)</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>(Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>(Ability to identify, formulate, analyze, and solve technical problems)</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>(Ability to plan, solve and evaluate the task based on the analysis of data and information)</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)	
	CPMK-1	Mahasiswa mampu memahami dan menjelaskan proses sintesis logam paduan non ferrous. <i>(Students are able to understand and explain the synthesis process of non ferrous alloy)</i>
	CPMK-2	Mahasiswa mampu memahami dan menjelaskan karakteristik logam paduan non ferrous. <i>(Students are able to understand and explain the characteristics of non ferrous alloy)</i>
	CPMK-3	Mahasiswa mampu memahami dan menjelaskan transformasi fase pada logam paduan non ferrous.



		(Students are able to understand and explain the phase transformation of non ferrous alloy)																																			
	CPMK-4	Mahasiswa mampu menunjukkan hubungan antara transformasi fase dan sifat mekanik dari logam paduan non ferrous (Students are able to show the relation of phase transformation and mechanical properties of non ferrous alloy)																																			
		Matrik CPL – CPMK <table><tr><td></td><td>CPL-3</td><td>CPL-4</td><td>CPL-5</td><td>CPL-7</td><td>CPL-8</td><td>CPL-10</td></tr><tr><td>CPMK-1</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td></td></tr><tr><td>CPMK-2</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td></td></tr><tr><td>CPMK-3</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td></td></tr><tr><td>CPMK-4</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr></table>		CPL-3	CPL-4	CPL-5	CPL-7	CPL-8	CPL-10	CPMK-1	X	X	X		X		CPMK-2	X	X	X		X		CPMK-3	X	X	X		X		CPMK-4		X	X	X	X	X
	CPL-3	CPL-4	CPL-5	CPL-7	CPL-8	CPL-10																															
CPMK-1	X	X	X		X																																
CPMK-2	X	X	X		X																																
CPMK-3	X	X	X		X																																
CPMK-4		X	X	X	X	X																															
Deskripsi Singkat MK (Short Description of Course)	Mata kuliah ini membahas tentang karakter, transformasi metalurgi, sintesis dan aplikasi dari beberapa logam non ferrous. Terdapat dua project dimana mahasiswa akan melakukan eksperimen dan analisis sederhana (This course discusses the character, metallurgical transformation, synthesis and application of several non-ferrous metals. There are two projects where students will carry out simple experiments and analysis)																																				
Bahan Kajian: Materi Pembelajaran (Course Materials)	1. Mekanisme penguatan pada logam (Strengthening mechanism) 2. Aluminium dan paduannya: teknologi pembuatan, metalurgi, mekanisme penguatan, karakter dan aplikasinya. (Aluminium and its alloys: manufacturing technology, metallurgy, strengthening mechanism, character and application) 3. Magnesium dan paduannya: teknologi pembuatan, metalurgi, mekanisme penguatan, karakter dan aplikasinya. (Magnesium and its alloys: manufacturing technology, metallurgy, strengthening mechanism, character and application) 4. Titanium dan paduannya: teknologi pembuatan, metalurgi, mekanisme penguatan, karakter dan aplikasinya. (Titanium and its alloys: manufacturing technology, metallurgy, strengthening mechanism, character and application) 5. Superalloys: teknologi pembuatan, metalurgi, mekanisme penguatan, karakter dan aplikasinya. (Superalloys: manufacturing technology, metallurgy, strengthening mechanism, character and application)																																				
Pustaka (References)	Utama : (Main)																																				



		5. William D Callister, Materials Science and Engineering: An Introduction, Wiley 6. Ian Polmer, "Light Alloys: From Traditional Alloys to Nanocrystals", Butterworth-Heinemann, UK, 2006. 7. Gerd Lütjering, James C. Williams, "Titanium", Springer-Verlag Berlin Heidelberg, Germany, 2007. 8. Roger C. Reed, "The Superalloys: Fundamentals and Applications", Cambridge University Press, 2006					
		Pendukung : (Supplementary)					
		9. George E. Totten, D. Scott MacKenzie, "Handbook of Aluminium Vol. 1 & 2", Marcell-Dekker Inc., USA, 2003. 10. William F. Smith, "Structure and Properties of Engineering Alloys", McGraw-Hill Inc., Singapore, 1993. 11. Horst E. Friedrich, Barry L. Mordike, "Magnesium Technology", Springer-Verlag Berlin Heidelberg, Germany, 2006. 12. Matthew J. Donachie, Stephen J. Donachie, "SUPERALLOYS: A Technical Guide", ASM International, USA, 2002.					
Dosen Pengampu (Lecturers)		Indra Sidharta					
Matakuliah syarat (Prerequisites)		Metalurgi 1, Metalurgi 2					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami karakter umum logam paduan non Ferrous	Kelengkapan, kejelasan, ketepatan (materi &	• Mampu menjelaskan konsep dasar	• Contextual Teaching & Learning • Diskusi & Brainstorming		• Kontrak Kuliah (Learning contract) • Perkenalan materi (Introduction)	



	<i>(Students are able to understand the general character of non-ferrous alloy metals)</i>	waktu), dan originalitas dalam menjelaskan konsep mekanisme penguatan logam <i>(Completeness, clarity, accuracy (material & time), and originality in explaining the concept of metal strengthening mechanism)</i>	mekanisme penguatan logam <i>(Able to explain the basic concepts of metal strengthening mechanisms)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	• Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Review mekanisme penguatan pada logam <i>(Strengthening mechanism)</i> [1]	
2-3	Mahasiswa mampu memahami karakter, sintesis dan aplikasi paduan aluminium <i>(Students are able to understand the character, synthesis</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter,	• Mampu menjelaskan karakter, sintesis dan aplikasi paduan aluminium <i>(Able to explain the character, synthesis and</i>	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Karakter/sifat paduan aluminium <i>(Characteristics of aluminium)</i> • Transformasi fase pada paduan aluminium	



	<i>and application of aluminum alloys)</i>	sintesis dan aplikasi paduan aluminium <i>(Completeness, clarity, accuracy (material & time), and originality in explaining the character, synthesis and application of aluminum alloys)</i>	<i>application of aluminum alloys)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>			<i>(Phase transformation of aluminium alloys)</i> • Sintesis & aplikasi paduan aluminium <i>(Synthesis and application of aluminium alloys)</i> [2]	
4-5	Mahasiswa mampu menunjukkan hubungan antara transformasi fase dan sifat mekanik dari logam paduan aluminium <i>(Students are able to show the relationship between phase transformation and</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter, sintesis dan aplikasi paduan aluminium	• Mampu menjelaskan karakter, sintesis dan aplikasi paduan aluminium <i>(Able to explain the character, synthesis and application of aluminum alloys)</i> • Bentuk penilaian: tes dan non-tes	• Project based • Praktikum & eksperimen sederhana • Diskusi & Brainstorming • Review & Summary [TM: 3x50"] – [PT: 3x60"] – [BM: 3x60"]		• Karakter/sifat paduan aluminium <i>(Characteristics of aluminium)</i> • Tranformasi fase pada paduan aluminium <i>(Phase transformation of aluminium alloys)</i> • Uji Metallography <i>(Metallography test)</i>	30



	<i>mechanical properties of aluminum alloys)</i>	<i>(Completeness, clarity, accuracy (material & time), and originality in explaining the character, synthesis and application of aluminum alloys)</i>	<i>(Assessment Form: tests and non-tests)</i>			• Uji mekanik (Mechanical test) [1,2, Jurnal relevan]	
6-7	Mahasiswa mampu memahami karakter, sintesis dan aplikasi paduan magnesium <i>(Students are able to understand the character, synthesis and application of magnesium alloys)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter, sintesis dan aplikasi paduan magnesium <i>(Completeness, clarity, accuracy (material & time), and originality in</i>	• Mampu menjelaskan karakter, sintesis dan aplikasi paduan magnesium <i>(Able to explain the character, synthesis and application of magnesium alloys)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Karakter/sifat paduan magnesium <i>(Characteristics of magnesium)</i> • Tranformasi fase pada paduan magnesium <i>(Phase transformation of magnesium alloys)</i> • Sintesis & aplikasi paduan magnesium <i>(Synthesis and application of aluminium alloys)</i> [2]	



		<i>explaining the character, synthesis and application of magnesium alloys)</i>					
8	Evaluasi Tengah Semester (Midterm Exam)						20
9-11	Mahasiswa mampu memahami karakter, sintesis dan aplikasi paduan titanium <i>(Students are able to understand the character, synthesis and application of titanium alloys)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter, sintesis dan aplikasi paduan titanium <i>(Completeness, clarity, accuracy (material & time), and originality in explaining the character,</i>	• Mampu menjelaskan karakter, sintesis dan aplikasi paduan titanium <i>(Able to explain the character, synthesis and application of titanium alloys)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Karakter/sifat paduan titanium <i>(Characteristics of titanium)</i> • Tranformasi fase pada paduan titanium <i>(Phase transformation of titanium alloys)</i> • Sintesis & aplikasi paduan titanium <i>(Synthesis and application of aluminium alloys)</i> [3]	



		<i>synthesis and application of titanium alloys)</i>					
12-13	Mahasiswa mampu menunjukkan hubungan antara transformasi fase dan sifat mekanik dari logam paduan titanium <i>(Students are able to show the relationship between phase transformation and mechanical properties of titanium alloys)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter, sintesis dan aplikasi paduan titanium <i>(Completeness, clarity, accuracy (material & time), and originality in explaining the character, synthesis and application of titanium alloys)</i>	• Mampu menjelaskan karakter, sintesis dan aplikasi paduan titanium <i>(Able to explain the character, synthesis and application of titanium alloys)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	• Project based • Praktikum & eksperimen sederhana • Diskusi & Brainstorming • Review & Summary <i>[TM: 3x50"] – [PT: 3x60"] – [BM: 3x60"]</i>		• Karakter/sifat paduan titanium <i>(Characteristics of titanium)</i> • Tranformasi fase pada paduan titanium <i>(Phase transformation of titanium alloys)</i> • Uji Metallography <i>(Metallography test)</i> • Uji mekanik <i>(Mechanical test)</i> <i>[1,3, Jurnal relevan]</i>	30



14-15	Mahasiswa mampu memahami karakter, sintesis dan aplikasi paduan superalloys (<i>Students are able to understand the character, synthesis and application of superalloys</i>)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter, sintesis dan aplikasi paduan superalloys (<i>Completeness, clarity, accuracy (material & time), and originality in explaining the character, synthesis and application of superalloys</i>)	• Mampu menjelaskan karakter, sintesis dan aplikasi paduan superalloys (<i>Able to explain the character, synthesis and application of superalloys</i>) • Bentuk penilaian: tes dan non-tes (<i>Assessment Form: tests and non-tests</i>)	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Karakter/sifat paduan superalloys (<i>Characteristics of superalloys</i>) • Tranformasi fase pada paduan superalloys (<i>Phase transformation of superalloys</i>) • Sintesis & aplikasi paduan superalloys (<i>Synthesis and application of superalloys</i>) [4]	
16	Evaluasi Akhir Semester (<i>Final Exam</i>)						20



	RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM SEMESTER LEARNING PLAN BACHELOR STUDY PROGRAM-DEPARTMENT OF MECHANICAL ENGINEERING FACULTY OF INDUSTRIAL TECHNOLOGY AND SYSTEMS ENGINEERING					Kode Dokumen Document code	
	RENCANA PEMBELAJARAN SEMESTER / SEMESTER LEARNING PLAN						
	MATA KULIAH (MK) Course	KODE Code	Rumpun MK Cluster	BOBOT (sks) Credits		SEMESTER Semester	Tgl Penyusunan Date of compilation
	Metalurgi 2 Metallurgy 2	TM234305 TM234305	Metalurgi Metallurgy	T=2	P=1	3	27 Oktober 2023 27 th October 2023
OTORISASI AUTHORIZATION		Pengembang RPS RPS compiler		Koordinator RMK Coordinator of cluster		Ketua PRODI Head of study program	
		Helena C. Kis Agustin, Sutikno, Indra Sidharta, Suwarno, Fahmi Mubarok, Ika Dewi Wijayanti, Putu Suwarta, Wahyu Wijanarko		Ika Dewi Wijayanti		Atok Setiyawan	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK Graduate Learning Outcomes						
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika. The ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems.					



Learning outcomes	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>The ability to design mechanical components, systems and/or processes to meet expected needs with an analytical engineering approach based on cutting-edge science & technology and considering technical standards, performance aspects, reliability, and ease of implementation, and/or utilizing the potential of local and national resources with a global perspective.</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>The ability to perform laboratory and/or field experiments and analyze and interpret data to strengthen engineering judgment.</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>The ability to identify, formulate, analyze and solve engineering problems.</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcomes	
	CPMK-1	Mahasiswa mampu menunjukkan metode pengujian tidak merusak <i>Students are able to demonstrate non-destructive testing methods.</i>
	CPMK-2	Mahasiswa mampu menjelaskan konsep diagram fasa dan diagram Fe-Fe ₃ C serta menganalisa keterkaitannya dengan transformasi fasa pada baja. <i>Students are able to explain the concept of phase diagrams and Fe-Fe₃C diagrams and analyze their relationship to phase transformations in steel.</i>
	CPMK-3	Mahasiswa mampu menganalisa perlakuan panas terhadap sifat mekanik material. <i>Students are able to analyze heat treatment on the mechanical properties of materials.</i>
	CPMK-4	Mahasiswa mampu menjelaskan konsep karakter besi tuang dan baja serta kegagalan korosi pada material secara kerja individu maupun secara berkelompok dalam kerjasama tim. <i>Students are able to explain the concept of cast iron and steel characteristics and corrosion failure in materials through individual work or in groups in teamwork.</i>



		Matrik CPL – CPMK Matrix of CPL-CPMK				
		CPMK	CPL-4	CPL-5	CPL-6	CPL-8
		CPMK-1	V		V	V
		CPMK-2	V	V		V
		CPMK-3	V		V	V
		CPMK-4	V	V	V	V
Deskripsi Singkat MK Brief description of course	Mata kuliah Metalurgi 2 ini fokus mempelajari pengujian tidak merusak, diagram fasa, diagram Fe-Fe₃C, transformasi baja, perlakuan panas, serta korosi. Untuk mendapatkan pemahaman yang lebih komprehensif, mata kuliah ini juga meliputi praktikum terkait metalografi. <i>This Metallurgy 2 course focuses on studying non-destructive testing, phase diagrams, Fe-Fe₃C diagrams, steel transformation, heat treatment, and corrosion. To gain a more comprehensive understanding, this course also includes practical work related to metallography.</i>					
Bahan Kajian: Materi Pembelajaran Study material: Contents	Bahan kajian dalam kuliah ini sebagai berikut: <i>The study material in this lecture is as follows:</i> -Pengujian tidak merusak: penetrant test, magnetic test, ultrasonic test, radiography test, visual test -Non-destructive testing: penetrant test, magnetic test, ultrasonic test, radiography test, visual test -Diagram fasa -Phase diagrams -Diagram Fe-Fe₃C -Diagram of Fe-Fe₃C -Transformasi fasa pada baja: diagram I-T & C-T -Phase transformations in steel: I-T and C-T diagrams -Perlakuan panas : annealing, hardening, surface hardening -Heat treatment: annealing, hardening, surface hardening					



	-Besi dan baja: baja paduan (low & high alloy steel), besi tuang -Iron and steel: alloy steel (low & high alloy steel), cast iron -Korosi -Corrosion -Praktikum: metallography -Practical work: metallography				
Pustaka References	Utama : Primary				
	[1] Sidney H. Avner, "Introduction to Physical Metallurgy", McGraw-Hill Inc., USA, 1974 [2] William F. Smith, "Structure and Properties of Engineering Alloys", McGraw-Hill Inc., Singapore				
	Pendukung : Supporting				
	[3] William D. Callister, "Materials Science and Engineering: An Introduction", John Willey & Sons Inc., Asia, 2007 [4] NDT Resource Center, www.ndt-ed.org.				
Tim Dosen Pengampu Team lecturing	Helena C. Kis Agustin, Sutikno, Indra Sidharta, Suwarno, Fahmi Mubarak, Ika Dewi Wijayanti, Putu Suwarta, Wahyu Wijanarko				
Matakuliah syarat Prerequisite course	Metalurgi 1 Metallurgy 1				
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar	Penilaian Evaluation	Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]	Materi Pembelajaran [Pustaka] Learning materials [References]	Bobot Penilaian (%)



	(Sub-CPMK) Final outcomes of each stage of learning			Learning Forms, Learning Methods, Student Assignments, [Estimated Time]			Assessment Weight (%)
		Indikator Indicator	Kriteria & Bentuk Criteria and Forms	Luring Offline	Daring Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu menunjukkan karakter dan tipe uji tidak merusak <i>Students are able to demonstrate the character and type of non-destructive testing.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter dan tipe uji tidak merusak <i>Completeness, clarity, accuracy (material & time), and originality in explaining the character and type of test are not detrimental</i>	• Mampu dan terampil menjelaskan karakter dan tipe uji tidak merusak <i>Able and skilled to explain the character and type of non-destructive testing</i> • Teknik penilaian: tes dan non-tes <i>Assessment techniques: tests and non-tests</i>	• Contextual Teaching & Learning <i>Contextual Teaching & Learning</i> • Diskusi & Brainstorming <i>Discussion and Brainstorming</i> [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"] [Class meeting: 3x50"] – [Task Completion: 3x60"] –	• Latihan soal & Homework di MyITS Classroom <i>Practice questions & homework in MyITS Classroom</i> • Tugas Mandiri di MyITS Classroom <i>Self-Assignments in MyITS Classroom</i> • Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of lecture PPTs in MyITS Classroom</i>	• Kontrak kuliah <i>Class contract</i> • Perkenalan materi <i>Introduction of lecture</i> • Uji tidak merusak <i>Non-destructive testing</i> [1], [3], [4] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	



				<i>[Independent learning: 3x60"]</i>			
2-3	Mahasiswa mampu memahami diagram fasa biner untuk logam paduan <i>Students are able to understand binary phase diagrams for metal alloys</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan diagram fasa biner untuk logam paduan <i>Completeness, clarity, accuracy (material & time), and originality in explaining binary phase diagrams for metal alloys</i>	• Mampu dan terampil menjelaskan diagram fasa biner untuk logam paduan <i>Able and skilled to explain binary phase diagrams for metal alloys</i> • Teknik penilaian: tes dan non-tes <i>Assessment techniques: tests and non-tests</i>	• Contextual Teaching & Learning <i>Contextual Teaching & Learning</i> • Diskusi & Brainstorming <i>Discussion and Brainstorming</i> <i>[TM: 6x50"] - [PT: 6x60"] - [BM: 6x60"] [Class meeting: 6x50"] – [Task Completion: 6x60"] – [Independent learning: 6x60"]</i>	• Latihan soal & Homework di MyITS Classroom <i>Practice questions & homework in MyITS Classroom</i> • Tugas Mandiri di MyITS Classroom <i>Self-Assignments in MyITS Classroom</i> • Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of lecture PPTs in MyITS Classroom</i>	• Pengenalan diagram fasa • Diagram fasa biner untuk logam paduan <i>[1] dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom</i>	
4	Evaluasi 1 Evaluation 1	Kelengkapan, kejelasan, ketepatan (materi & waktu),	• Mampu dan terampil menjelaskan konsep dasar uji tidak merusak dan diagram	• Evaluasi tertulis (analisis/sintesis)	• Quiz pilihan ganda di MyITS Classroom	• Konsep dasar uji tidak merusak dan	25



	Mahasiswa memahami konsep dasar uji tidak merusak dan diagram fasa biner untuk logam paduan <i>Students understand the basic concepts of non-destructive testing and binary phase diagrams for metal alloys</i>	dan originalitas dalam menjelaskan konsep dasar uji tidak merusak dan diagram fasa biner untuk logam paduan <i>Completeness, clarity, accuracy (material & time), and originality in explaining the basic concepts of non-destructive testing and binary phase diagrams for metal alloys.</i>	fasa biner untuk logam paduan <i>Able and skilled to explain the basic concepts of non-destructive testing and binary phase diagrams for metal alloys.</i> • Teknik penilaian: tes dan praktikum <i>Assessment techniques: tests and practicum</i>	<i>Written evaluation (analysis/synthesis)</i> • Case study <i>Case study</i> • Presentasi <i>Presentation</i> Waktu ujian: max. 3x50" Time for exam: max. 3x50"	<i>Multiple choice quizzes in MyITS Classroom</i>	diagram fasa biner untuk logam paduan <i>Basic concepts of non-destructive testing and binary phase diagrams for metal alloys</i> [1] dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	
5-6	Mahasiswa mampu memahami diagram fasa Fe-Fe₃C <i>Students are able to understand the Fe-Fe₃C phase diagram</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dasar diagram fasa Fe-Fe₃C <i>Completeness, clarity, accuracy (material & time),</i>	• Mampu dan terampil menjelaskan konsep diagram fasa Fe-Fe₃C <i>Able and skilled to explain the concept of the Fe-Fe₃C phase diagram</i> • Teknik penilaian: tes dan non-tes	• Contextual Teaching & Learning <i>Contextual Teaching & Learning</i> • Diskusi & Brainstorming	• Latihan soal & Homework di MyITS Classroom <i>Practice questions & homework in MyITS Classroom</i> • Tugas Mandiri di MyITS Classroom	• Pengenalan dan konsep dasar diagram Fe-Fe₃C • Perhitungan fasa, komposisi kimia, dan <i>mass fraction</i> dari diagram Fe-Fe₃C	



		and originality in explaining the basic concepts of the Fe-Fe ₃ C phase diagram.	Assessment techniques: tests and non-tests	Discussion and Brainstorming [TM: 6x50"] – [PT: 6x60"] – [BM: 6x60"] [Class meeting: 6x50"] – [Task Completion: 6x60"] – [Independent learning: 6x60"]	Self-Assignments in MyITS Classroom • Review & Summary PPT perkuliahan di MyITS Classroom Review & Summary of lecture PPTs in MyITS Classroom	[1] dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	
7	Evaluasi 2 Evaluation 2 Mahasiswa memahami konsep dasar diagram Fe-Fe ₃ C <i>Students understand the basic concept of the Fe-Fe₃C diagram</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dasar diagram Fe-Fe ₃ C <i>Completeness, clarity, accuracy (material & time), and originality in explaining the basic concepts of the Fe-Fe₃C diagram.</i>	• Mampu dan terampil menjelaskan konsep dasar diagram Fe-Fe ₃ C <i>Able and skilled to explain the basic concept of the Fe-Fe₃C diagram</i> • Teknik penilaian: tes dan praktikum <i>Assessment techniques: tests and practicum</i>	• Evaluasi tertulis (analisis/sintesis) <i>Written evaluation (analysis/synthesis)</i> • Case study <i>Case study</i> • Presentasi <i>Presentation</i> Waktu ujian: max. 3x50"	• Quiz pilihan ganda di MyITS Classroom <i>Multiple choice quizzes in MyITS Classroom</i>	• Konsep dasar diagram Fe-Fe ₃ C <i>Basic concept of Fe-Fe₃C diagram</i> [1] dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	25



				<i>Time for exam: max. 3x50"</i>			
8-9	Mahasiswa mampu memahami konsep dasar transformasi baja <i>Students are able to understand the basic concept of steel transformation</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan konsep dasar transformasi fasa pada baja <i>Completeness, clarity, accuracy (material & time), and originality in explaining the basic concepts of phase transformation in steel</i>	• Mampu dan terampil menjelaskan konsep dasar transformasi fasa pada baja <i>Able and skilled in explaining the basic concepts of phase transformation in steel</i> • Teknik penilaian: tes dan non-tes <i>Assessment techniques: tests and non-tests</i>	• Contextual Teaching & Learning <i>Contextual Teaching & Learning</i> • Diskusi & Brainstorming <i>Discussion and Brainstorming</i> <i>[TM: 6x50"] - [PT: 6x60"] - [BM: 6x60"]</i> <i>[Class meeting: 6x50"] – [Task Completion: 6x60"] – [Independent learning: 6x60"]</i>	• Latihan soal & Homework di MyITS Classroom <i>Practice questions & homework in MyITS Classroom</i> • Tugas Mandiri di MyITS Classroom <i>Self-Assignments in MyITS Classroom</i> • Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of lecture PPTs in MyITS Classroom</i>	• Konstruksi diagram IT & CCT <i>Construction of IT and CCT diagrams</i> • Faktor yang mempengaruhi IT & CCT <i>Factors influencing IT & CCT</i> • Laju pendinginan kritis <i>Critical cooling rate</i> • Pembentukan bainit <i>Bainite formation</i> • Pembentukan martensit <i>Martensite formation</i> <i>[1], [2], dan [3]</i>	



						PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	
10-11	Mahasiswa mampu menguraikan karakter dan proses perlakuan panas <i>Students are able to describe the characteristics and processes of heat treatment</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter dan proses perlakuan panas <i>Completeness, clarity, accuracy (material & time), and originality in explaining the characteristics and processes of heat treatment</i>	• Mampu dan terampil menjelaskan karakter dan proses perlakuan panas <i>Able and skilled to explain the characteristics and processes of heat treatment</i> • Teknik penilaian: tes dan non-tes <i>Assessment techniques: tests and non-tests</i>	• Contextual Teaching & Learning <i>Contextual Teaching & Learning</i> • Diskusi & Brainstorming <i>Discussion and Brainstorming</i> [TM: 6x50"] - [PT: 6x60"] - [BM: 6x60"] [Class meeting: 6x50"] – [Task Completion: 6x60"] – [Independent learning: 6x60"]	• Latihan soal & Homework di MyITS Classroom <i>Practice questions & homework in MyITS Classroom</i> • Tugas Mandiri di MyITS Classroom <i>Self-Assignments in MyITS Classroom</i> • Review & Summary PPT perkuliahan di MyITS Classroom <i>Review & Summary of lecture PPTs in MyITS Classroom</i>	• Annealing & macamnya <i>Annealing and its types</i> • Hardening & macamnya <i>Hardening and its types</i> • Full hardening & hardenability <i>Full hardening & hardenability</i> • Austempering <i>Austempering</i> • Precipitation hardening <i>Precipitation hardening</i>	



						• Tempering <i>Tempering</i> • Surface Hardening <i>Surface hardening</i> [1], [2], dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	
12	Evaluasi 3 Evaluation 3 Mahasiswa mampu memahami konsep dasar transformasi baja dan mampu menguraikan karakter dan proses perlakuan panas	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam memahami konsep dasar transformasi baja dan menjelaskan karakter dan proses perlakuan panas <i>Completeness, clarity, accuracy (material & time), and originality in</i>	• Mampu dan terampil memahami konsep dasar transformasi baja dan menjelaskan karakter serta proses perlakuan panas <i>Able and skilled to understand the basic concept of steel transformation and explain the characteristics and heat treatment processes</i> • Teknik penilaian: tes dan praktikum	• Evaluasi tertulis (analisis/sintesis) <i>Written evaluation (analysis/syntheses)</i> • Case study <i>Case study</i> • Presentasi <i>Presentation</i>	• Quiz pilihan ganda di MyITS Classroom <i>Multiple choice quizzes in MyITS Classroom</i>	• Transformasi baja <i>Transformations in steel</i> • Perlakuan panas <i>Heat treatment</i> [1], [2], dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	25



	<i>Students are able to understand the basic concepts of steel transformation and are able to describe the characteristics and heat treatment processes</i>	<i>understanding the basic concepts of steel transformation and explaining the characteristics and processes of heat treatment</i>	<i>Assessment techniques: tests and practicum</i>	<i>Waktu ujian: max. 3x50" Time for exam: max. 3x50"</i>			
13-14	Mahasiswa mampu menguraikan karakter baja dan paduannya <i>Students are able to describe the characteristics of steel and its alloys</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam memahami karakter baja dan paduannya <i>Completeness, clarity, accuracy (material & time), and originality in understanding the character of steel and its alloys</i>	• Mampu dan terampil memahami karakter baja dan paduannya <i>Able and skilled in understanding the character of steel and its alloys</i> • Teknik penilaian: tes dan non-tes <i>Assessment techniques: tests and non-tests</i>	• Contextual Teaching & Learning <i>Contextual Teaching & Learning</i> • Diskusi & Brainstorming <i>Discussion and Brainstorming</i> [TM: 6x50"] – [PT: 6x60"] – [BM: 6x60"]	• Latihan soal & Homework di MyITS Classroom <i>Practice questions & homework in MyITS Classroom</i> • Tugas Mandiri di MyITS Classroom <i>Self-Assignments in MyITS Classroom</i> • Review & Summary PPT perkuliahan di MyITS Classroom	• Klasifikasi & kodifikasi baja <i>Classification & codification of steel</i> • Pengaruh unsur paduan pada baja <i>Effect of alloying elements on steel</i> • Baja paduan rendah <i>Low alloy steel</i> • Baja tahan karat <i>Stainless steel</i>	



				[Class meeting: 6x50"] – [Task Completion: 6x60"] – [Independent learning: 6x60"]	Review & Summary of lecture PPTs in MyITS Classroom	• Baja perkakas Tool steel • Besi tuang Cast iron [1] dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	
15	Mahasiswa mampu menjelaskan tipe dan mekanisme dasar korosi	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam memahami tipe dan mekanisme dasar korosi	• Mampu dan terampil memahami tipe dan mekanisme dasar korosi • Teknik penilaian: tes dan non-tes <i>Assessment techniques: tests and non-tests</i>	• Contextual Teaching & Learning <i>Contextual Teaching & Learning</i> • Diskusi & Brainstorming <i>Discussion and Brainstorming</i> [TM: 6x50"] – [PT: 6x60"] – [BM: 6x60"]	• Latihan soal & Homework di MyITS Classroom <i>Practice questions & homework in MyITS Classroom</i> • Tugas Mandiri di MyITS Classroom <i>Self-Assignments in MyITS Classroom</i> • Review & Summary PPT perkuliahan di MyITS Classroom	• Pengenalan tipe & mekanisme korosi <i>Introduction to corrosion types and mechanisms</i> • Konsep dasar pencegahan korosi <i>Basic concepts of corrosion prevention</i> [1] dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	



				[Class meeting: 6x50"] – [Task Completion: 6x60"] – [Independent learning: 6x60"]	Review & Summary of lecture PPTs in MyITS Classroom		
16	Evaluasi 4 Mahasiswa mampu menguraikan karakter baja dan paduannya serta mampu menjelaskan tipe dan mekanisme dasar korosi <i>Students are able to describe the characteristics of steel and its alloys and are able to explain the types and</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menguraikan karakter baja dan paduannya serta mampu menjelaskan tipe dan mekanisme dasar korosi <i>Completeness, clarity, accuracy (material & time), and originality in describing the characteristics of steel and its alloys and being able to explain the types and</i>	• Mampu dan terampil menguraikan karakter baja dan paduannya serta mampu menjelaskan tipe dan mekanisme dasar korosi <i>Able and skilled in describing the characteristics of steel and its alloys and able to explain the types and basic mechanisms of corrosion</i> • Teknik penilaian: tes <i>Assessment techniques: tests</i>	• Evaluasi tertulis (analisis/sintesis) <i>Written evaluation (analysis/syntheses)</i> • Case study <i>Case study</i> • Presentasi <i>Presentation</i> Waktu ujian: max. 3x50" Time for exam: max. 3x50"	• Quiz pilihan ganda di MyITS Classroom <i>Multiple choice quizzes in MyITS Classroom</i>	• Baja dan paduannya • Korosi [1] dan [3] PPT perkuliahan di MyITS Classroom PPT lecture is in MyITS Classroom	25



	<i>basic mechanisms of corrosion</i>	<i>basic mechanisms of corrosion</i>					

Catatan :

24. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

25. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.

70. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

27. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

28. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

29. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

30. **Bentuk penilaian:** tes dan non-tes.

31. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.



32. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.

33. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.

34. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.

35. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN Faculty of Industrial Technology and Systems Engineering Undergraduate Program of Mechanical Engineering Department					Kode Dokumen (Document Code)
RENCANA PEMBELAJARAN SEMESTER						
(Semester Learning Plan)						
MATA KULIAH (Subject)	KODE (Code)	Rumpun MK (Course Cluster)	BOBOT (sks) (Credit)		SEMESTER (Semester)	Tgl Penyusunan (Preparation Date)
Perlakuan Panas (Heat Treatment)	TM 234730	Metalurgi	T= 3	P= 0	Pilihan	20 Nov. 2023
OTORISASI (Authorization)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)			Ketua PRODI (Head of Undergraduate Program)	
	H. C. Kis Agustin Indra Sidharta	Suwarno			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika (Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)				
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. (Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)				





Deskripsi Singkat MK (Short Description of Course)	Mata kuliah ini membahas tentang teknologi perlakuan panas, transformasi fase pada logam dan hubungannya dengan karakter logam.	
Bahan Kajian: Materi Pembelajaran (Course Materials)	6. Prinsip dasar difusi (Basic principles of diffusion) 7. Prinsip dasar thermodinamika dan diagram fase (Thermodynamics and phase diagram) 8. Karakter antarmuka kristal dan struktur mikro (Crystal interface and microstructure) 9. Prinsip dasar solidifikasi (Solidification) 10. Transformasi difusional pada benda padat (Diffusional transformation) 11. Transformasi non difusi pada benda padat (Diffusionless transformation) 12. Praktikum perlakuan panas (Practicum)	
Pustaka (References)	Utama : (Main)	
		13. D. A. Porter, K. E. Easterling, Phase Transformation in Metals and Alloys, Chapman-Hall, Inggris, 1992. 14. George E. Totten, Steel Heat Treatment, Taylor & Francis, USA, 2002
	Pendukung : (Supplementary)	
		15. Karl Erik Thelning, Steel and its Heat Treatment, Butterworths, London.
Dosen Pengampu	H. C. Kis Agustin	



(Lecturers)							
Matakuliah syarat (Prerequisites)		Metalurgi 1, Metalurgi 2					
Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami pengaruh perlakuan panas terhadap sifat mekanik (Students are able to understand the effect of heat treatment on mechanical properties)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam pengaruh perlakuan panas terhadap sifat mekanik (Completeness, clarity, accuracy (material &	- Mampu menjelaskan pengaruh perlakuan panas terhadap terhadap sifat mekanik (Able to explain the effect of heat treatment on mechanical properties) - Bentuk penilaian: tes dan non-tes	- Contextual Teaching & Learning - Diskusi & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- Kontrak Kuliah (Learning contract) - Perkenalan materi (Introduction) - Review beberapa jenis perlakuan panas (Review on heat treatment) - Pengenalan prinsip dasar difusi (Introduction to diffusion) [1]	



		<i>time), and originality in the effect of heat treatment on mechanical properties)</i>	<i>(Assessment form: tests and non-tests)</i>				
2	Mahasiswa mampu memahami dasar termodinamika dan diagram fase (<i>Students are able to understand the basics of thermodynamics and phase diagrams</i>)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan dasar termodinamika dan diagram fase (<i>Completeness, clarity, accuracy (material & time), and originality in explaining the basics of</i>	• Mampu menjelaskan dasar termodinamika dan diagram fase (<i>Able to explain the basics of thermodynamics and phase diagrams</i>) • Bentuk penilaian: tes dan non-tes (<i>Assessment form: tests and non-tests</i>)	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Prinsip dasar termodinamika material (<i>Introduction to thermodynamic of material</i>) • Prinsip dasar diagram fase (<i>Phase diagram</i>) [1]	



		<i>thermodynamics and phase diagrams)</i>					
3-4	Mahasiswa mampu memahami karakter antar muka Kristal dan struktur mikro <i>(Students are able to understand the character of crystal interfaces and microstructure)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter antar muka Kristal dan struktur mikro <i>(Completeness, clarity, accuracy (material & time), and originality in explaining the character of crystal interfaces and microstructure)</i>	• Mampu menjelaskan karakter antar muka Kristal dan struktur mikro <i>(Able to explain the character of crystal interfaces and microstructure)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment form: tests and non-tests)</i>	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary [TM: 3x50"] – [PT: 3x60"] – [BM: 3x60"]		• Karakter antarmuka Kristal <i>(Crystal interface)</i> • Struktur mikro <i>(Microstructure)</i> [1]	
5	Kuis <i>(Quiz)</i>						



6-7	Mahasiswa mampu menguraikan pembekuan yang terjadi pada logam (<i>Students are able to describe the solidification that occurs in metals</i>)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan pembekuan yang terjadi pada logam (<i>Completeness, clarity, accuracy (material & time), and originality in explaining the solidification that occurs in metals</i>)	• Mampu menjelaskan pembekuan yang terjadi pada logam (<i>Able to explain the solidification that occurs in metals</i>) • Bentuk penilaian: tes dan non-tes (<i>Assessment form: tests and non-tests</i>)	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary [TM: 3x50"] – [PT: 3x60"] – [BM: 3x60"]		• Pembekuan logam murni (<i>Solidification of pure metal</i>) • Pembekuan logam paduan (<i>Solidification of alloy</i>) • Pembekuan ingot dan produk cor (<i>Solidification of ingot and cast metal</i>) [1,2]	
8	Evaluasi Tengah Semester (Midterm Exam)						
9-10	Mahasiswa mampu menguraikan transformasi secara difusi pada logam (<i>Students are able to describe diffusional</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas	• Mampu menjelaskan transformasi secara difusi pada logam	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary		• Nukleasi (<i>Nucleation</i>) • Pertumbuhan presipitat (<i>Precipitate growth</i>) • Kinetika transformasi	



	<i>transformations in metals)</i>	dalam menjelaskan transformasi secara difusi pada logam (<i>Completeness, clarity, accuracy (material & time), and originality in explaining diffusional transformations in metals)</i>	(<i>Able to explain diffusional transformations in metals)</i>) • Bentuk penilaian: tes dan non-tes (<i>Assessment form: tests and non-tests)</i>)	[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		(<i>Transformation kinetics)</i>) • Presipitasi pada paduan Age Hardenable (<i>Precipitation of age hardenable alloy)</i>) • Presipitasi ferrite dari austenite (<i>Precipitation of ferrite from austenite)</i>) • Transformasi eutectoid (<i>Eutectoid transformation)</i>) [1, 2]	
11-12	Mahasiswa mampu menguraikan transformasi non difusi pada logam (<i>Students are able to describe non-diffusional transformations in metals)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan transformasi non difusi pada logam	• Mampu menjelaskan transformasi non difusi pada logam (<i>Able to explain non-diffusional transformations in metals)</i>) • Bentuk penilaian: tes dan non-tes	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary [TM: 3x50"] – [PT: 3x60"] – [BM: 3x60"]		• Karakter transformasi non difusi (<i>Characteristics of non diffusional transformation)</i>) • Teori dasar pembentukan martensite (<i>Formation of martensite)</i>)	



		<i>(Completeness, clarity, accuracy (material & time), and originality in explaining non-diffusional transformations in metals)</i>	<i>(Assessment form: tests and non-tests)</i>			• Pertumbuhan martensite (<i>Martensite growth</i>) • Tempering • Pengerasan pada baja (<i>Hardening of steel</i>) • Perubahan dimensi pada proses hardening & tempering (<i>Distortion during hardening & tempering</i>) [1,2]	
13-15	Mahasiswa mampu merancang dan melakukan perlakuan panas (<i>Students are able to design and perform heat treatment</i>)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam merancang dan melakukan perlakuan panas (<i>Completeness, clarity, accuracy (material &</i>	• Mampu merancang dan melakukan perlakuan panas (<i>Able to design and perform heat treatment</i>) • Bentuk penilaian: tes dan non-tes (<i>Assessment form: tests and non-tests</i>)	• Project based • Praktikum dan Eksperimen sederhana • Diskusi & Brainstorming • Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Praktikum perlakuan panas & metallography untuk logam baja (<i>Practicum</i>) [1,2,3, Jurnal relevan]	



		<i>time), and originality in designing and performing heat treatment)</i>					
16	Evaluasi Akhir Semester (Final Exam)						



	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM DEPARTEMEN TEKNIK MESIN PROGRAM STUDI S1 TEKNIK MESIN <i>Faculty of Industrial Technology and Systems Engineering</i> <i>Undergraduate Program of Mechanical Engineering Department</i>					Kode Dokumen <i>(Document Code)</i>
	RENCANA PEMBELAJARAN SEMESTER <i>(Semester Learning Plan)</i>					
MATA KULIAH <i>(Subject)</i>	KODE <i>(Code)</i>	Rumpun MK <i>(Course Cluster)</i>	BOBOT (sks) <i>(Credit)</i>		SEMESTER <i>(Semester)</i>	Tgl Penyusunan <i>(Preparation Date)</i>
Teknik Cor <i>(Casting Technology)</i>	TM 234729	Metalurgi	T= 3	P= 0	Pilihan	20 Nov. 2023
OTORISASI <i>(Authorization)</i>	Pengembang RPS <i>(Developer Lecturer of Semester Learning Plan)</i>	Koordinator RMK <i>(Course Cluster Coordinator)</i>			Ketua PRODI <i>(Head of Undergraduate Program)</i>	
	Indra Sidharta	Suwarno			Dr. Ir. Is Bunyamin Suryo, ST, MSc., IPM, AEng.	
Capaian Pembelajaran <i>(Learning Outcomes)</i>	CPL-PRODI yang dibebankan pada MK <i>(PLO Program Charged to The Course)</i>					
	CPL-3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi.				



		<i>(Able to manage one's own learning and develop oneself as a lifelong learner to compete at the national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability and understanding technology-based entrepreneurship)</i>
	CPL-4	Kemampuan menerapkan matematika, sains, dan prinsip rekayasa untuk menyelesaikan masalah rekayasa pada sistem mekanika <i>(Ability to apply mathematics, science, and engineering principles to solve engineering problems in mechanical systems)</i>
	CPL-5	Kemampuan mendesain komponen, sistem dan/atau proses mekanika untuk memenuhi kebutuhan yang diharapkan dengan pendekatan analitis rekayasa berbasis ilmu & teknologi mutakhir dan mempertimbangkan standar teknis, aspek kinerja, keandalan, serta kemudahan penerapan, dan/atau memanfaatkan potensi sumber daya lokal dan nasional dengan wawasan global. <i>(Ability to design components, systems, and/or mechanical processes to fulfill the expected needs with an engineering analytical approach based on advanced science and technology and consider the technical standard, performance, reliability, ease of implementation, and/or utilize the local and national resources)</i>
	CPL-6	Kemampuan melaksanakan eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik. <i>(Ability to conduct the laboratory and/or field experiments, analyze, and interpret the data to strengthen the technical assessment)</i>
	CPL-7	Kemampuan menerapkan metode, keterampilan dan piranti teknik yang modern yang diperlukan untuk praktek sistem mekanika. <i>(Ability to apply the methodology, skill, and modern devices/tools which are needed for the practice of mechanical systems)</i>
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik. <i>(Ability to identify, formulate, analyze, and solve technical problems)</i>
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data <i>(Ability to plan, solve and evaluate the task based on the analysis of data and information)</i>



	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)																																																													
	CPMK-1	Mahasiswa mampu memahami dan menjelaskan teknologi pengecoran logam yang meliputi macam teknik pengecoran, perancangan sistem saluran pengecoran dan karakter metalurginya <i>(Students are able to understand and explain metal casting technology, which includes various casting techniques, the design of casting gating systems, and its metallurgical characteristics)</i>																																																												
	CPMK-2	Mahasiswa mampu merancang sistem saluran pengecoran. <i>(Students are able to design casting gating systems)</i>																																																												
	CPMK-3	Mahasiswa mampu memahami dan menjelaskan metalurgi pengecoran logam. <i>(Students are able to understand and explain the metallurgy of metal casting)</i>																																																												
	CPMK-4	Mahasiswa mampu menunjukkan hubungan antara proses pengecoran, solidifikasi dan sifat mekanik dari logam hasil pengecoran <i>(Students are able to demonstrate the relationship between the casting process, solidification, and the mechanical properties of cast metals)</i>																																																												
		Matrik CPL – CPMK <table><tr><td></td><td>CPL-1</td><td>CPL-2</td><td>CPL-3</td><td>CPL-4</td><td>CPL-5</td><td>CPL-6</td><td>CPL-7</td><td>CPL-8</td><td>CPL-9</td><td>CPL-10</td><td>CPL-11</td></tr><tr><td>CPMK-1</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td>X</td><td></td><td></td><td></td></tr><tr><td>CPMK-2</td><td></td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td></tr><tr><td>CPMK-3</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td>X</td><td></td><td></td><td></td></tr><tr><td>CPMK-4</td><td></td><td></td><td></td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td></td><td>X</td><td></td></tr></table>		CPL-1	CPL-2	CPL-3	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-9	CPL-10	CPL-11	CPMK-1			X	X	X			X				CPMK-2				X	X	X	X	X				CPMK-3			X	X	X			X				CPMK-4				X	X		X	X		X	
	CPL-1	CPL-2	CPL-3	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-9	CPL-10	CPL-11																																																			
CPMK-1			X	X	X			X																																																						
CPMK-2				X	X	X	X	X																																																						
CPMK-3			X	X	X			X																																																						
CPMK-4				X	X		X	X		X																																																				
Deskripsi Singkat MK	Mata kuliah ini membahas tentang teknologi pengecoran, perencanaan sistem saluran pengecoran, dan karakter metalurgi logam cor. <i>(This course discusses casting technology, the design of casting gating systems, and the metallurgical characteristics of cast metals)</i>																																																													



(Short Description of Course)	
Bahan Kajian: Materi Pembelajaran (Course Materials)	13. Macam proses pengecoran dan Dasar pengecoran. (Various casting processes and casting fundamentals) 14. Perancangan dan perhitungan sistem saluran pengecoran (Design and calculation of casting gating systems) 15. Metalurgi pengecoran (Casting metallurgy) 16. Macam cacat pengecoran dan pencegahannya (Casting Defects & Prevention) 17. Praktikum proses pengecoran (Casting project)
Pustaka (References)	Utama : (Main) 16. Slide Kuliah 17. Prof. Ir. Tata Surdia, MS.Met.E, Prof. Dr.Kenji Chijiwa, Teknik Pengecoran Logam, PT. Pradnya Paramita, Jakarta, 2000. 18. AFS, Basic Principles of Gating & Riser, American Foundrymen's Society (Incorporated) Training & Research Institute, Des Plaines, Illinois, 1973. 19. ASM International, Casting Design and Performance, ASM International, 2009 Pendukung : (Supplementary) 20. John Campbell, OBE, FEng, Casting, Butterworth-Heinemann Ltd, Linacre House, Jordan Hill, Oxford, 1995. 21. Flinn A., Fundamentals of metals Casting, Addison Wesley Publishing Co. Inc. 1987.
Dosen Pengampu (Lecturers)	Indra Sidharta
Matakuliah syarat (Prerequisites)	Metalurgi 1, Metalurgi 2



Mg Ke- / (Week)	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) (Final Ability of Each Learning Stage (LLO))	Penilaian (Assesment)		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, (Learning Model; Learning Method; Student Assignment)		Materi Pembelajaran (Learning Materials)	Bobot Penilaian (%) (Assesment Credit (%))
		Indikator / (Indicator)	Kriteria & Bentuk (Criteria & Model)	Luring (Offline)	Daring (Online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami sejarah & latar belakang pengecoran (Students are able to understand the history & background of casting)	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan sejarah dan latar belakang pengecoran (Completeness, clarity, accuracy (material & time), and originality in explaining the history and background of casting)	- Mampu menjelaskan sejarah dan latar belakang pengecoran (Able to explain the history and background of casting) - Bentuk penilaian: tes dan non-tes (Assessment Form: tests and non-tests)	- Contextual Teaching & Learning - Diskusi & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- Kontrak Kuliah (Learning contract) - Perkenalan materi (Introduction) - Review teknologi pengolahan logam (Review of metal processing technology) - Sejarah dan latar belakang teknologi pengecoran (History and background of casting technology) [1]	



2	Mahasiswa mampu memahami dasar, karakteristik dan macam teknologi pengecoran <i>(Students are able to understand the basics, characteristics and types of casting technology)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan dasar, karakteristik dan macam teknologi pengecoran <i>(Completeness, clarity, accuracy (material & time), and originality in explaining the basics, characteristics and types of casting technology)</i>	• Mampu menjelaskan dasar, karakteristik dan macam teknologi pengecoran <i>(Able to explain the basics, characteristics and types of casting technology)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Dasar-dasar pengecoran <i>(Fundamentals of casting)</i> • Karakteristik pengecoran <i>(Characteristics of casting)</i> • Teknologi pengecoran <i>(Casting technology)</i> [1, 2]	
3-5	Mahasiswa mampu memahami dan merancang sistem saluran pengecoran	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan	• Mampu menjelaskan dan merancang sistem saluran pengecoran	• Contextual Teaching & Learning • Diskusi & Brainstorming		• Sistem saluran pengecoran <i>(Gating system)</i>	



	<i>(Students are able to understand and design casting gating systems)</i>	originalitas dalam menjelaskan dan merancang sistem saluran pengecoran <i>(Completeness, clarity, accuracy (material & time), and originality in explaining and designing casting gating systems)</i>	<i>(Able to explain and design casting gating systems)</i> Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	- Tutorial software simulasi pengecoran - Review & Summary [TM: 3x50"] – [PT: 3x60"] – [BM: 3x60"]		- Sistem penambah <i>(Riser system)</i> - Pengenalan software berbasis metode elemen hingga <i>(Finite element method (FEM) based software)</i> [1,2, 3, 4]	
6-7	Mahasiswa mampu merancang sistem saluran pengecoran dan menghubungkan proses pengecoran dengan karakter metalurgi dari logam yang dicor <i>(Students are able to design casting gating systems and relate the casting process to the metallurgical</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam merancang sistem saluran pengecoran dan menghubungkan proses pengecoran dengan karakter metalurgi logam cor	- Mampu menjelaskan dan merancang sistem saluran pengecoran <i>Able to explain and design casting gating systems</i> - Mampu menghubungkan proses pengecoran dengan karakter metalurgi dari logam yang dicor	- Project based - Eksperimen berbasis simulasi - Diskusi & Brainstorming - Review & Summary [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		- Teknologi pengecoran <i>Casting technology</i> - Sistem saluran pengecoran <i>Gating system</i> - Sistem penambah <i>Riser system</i> - Software simulasi pengecoran <i>Casting software</i> [1,2, 3, 4]	30



	<i>characteristics of the cast metal)</i>	<i>(Completeness, clarity, accuracy (material & time), and originality in designing casting gating systems and relating the casting process to the metallurgical characteristics of cast metals)</i>	<i>Able to relate the casting process to the metallurgical characteristics of the cast metal</i> • Bentuk penilaian: tes dan non-tes <i>Assessment Form: tests and non-tests</i>				
8	Evaluasi Tengah Semester (Midterm Exam)						20
9-10	Mahasiswa mampu memahami karakter metalurgi pada logam cor <i>(Students are able to understand the metallurgical characteristics of cast metals)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan karakter metalurgi pada logam cor	• Mampu menjelaskan karakter metalurgi pada logam cor Able to explain the metallurgical characteristics of cast metals • Bentuk penilaian: tes dan non-tes Assessment Form: tests and non-tests	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Logam cair (<i>Liquid metal</i>) • Materi terperangkap (<i>Entrapment</i>) • Aliran (<i>Flow</i>) • Pembekuan logam (<i>Solidification</i>) • Segregasi (<i>Segregation</i>) [1, 5, 6]	



		<i>(Completeness, clarity, accuracy (material & time), and originality in explaining the metallurgical characteristics of cast metals)</i>					
11-12	Mahasiswa mampu memahami kualitas logam hasil pengecoran <i>(Students are able to understand the quality of cast metals)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan kualitas logam hasil pengecoran <i>(Completeness, clarity, accuracy (material & time), and originality in explaining the</i>	• Mampu menjelaskan kualitas logam hasil pengecoran <i>(Able to explain the quality of cast metals)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	• Contextual Teaching & Learning • Diskusi & Brainstorming • Review & Summary [TM: 3x50"] – [PT: 3x60"] – [BM: 3x60"]		• Cacat pengecoran <i>(Casting defect)</i> • Pengujian kualitas pengecoran <i>(Testing)</i> [1,5, 6]	



		<i>quality of cast metals)</i>					
13-15	Mahasiswa mampu merancang dan melakukan pengecoran <i>(Students are able to design and perform casting)</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam merancang dan melakukan pengecoran <i>(Completeness, clarity, accuracy (material & time), and originality in designing and performing casting)</i>	• Mampu merancang dan melakukan pengecoran <i>(Able to design and perform casting)</i> • Bentuk penilaian: tes dan non-tes <i>(Assessment Form: tests and non-tests)</i>	• Project based • Praktikum dan Eksperimen sederhana • Diskusi & Brainstorming • Review & Summary • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Praktikum pembuatan pola & cetakan <i>(Pattern & mold making)</i> • Praktikum pengecoran <i>(Casting practices)</i> • Uji metalografi <i>(Metallography test)</i> • Uji mekanik <i>(Mechanical test)</i> [1,5,6, Jurnal relevan]	30
16	Evaluasi Akhir Semester <i>(Final Exam)</i>						20



 RENCANA PEMBELAJARAN SEMESTER PROGRAM STUDI SARJANA DEPARTEMEN TEKNIK MESIN FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM						Kode Dokumen		
RENCANA PEMBELAJARAN SEMESTER								
MATA KULIAH (MK)		KODE	Rumpun MK		BOBOT (sks)		SEMESTER	Tgl Penyusunan
Kerja Praktek		TM234801	-		T=2 P=0		V	7 November 2023
OTORISASI		Pengembang RPS		Koordinator RMK			Ketua PRODI	
				Suwarno			Atok Setiyawan	
Capaian Pembelajaran (CP)	CPL-PRODI yang dibebankan pada MK							
	CPL-1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekseleksi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal.						
	CPL-2	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi						
	CPL-8	Kemampuan mengidentifikasi, merumuskan, menganalisis dan menyelesaikan permasalahan teknik						
	CPL-9	Kemampuan berkomunikasi secara efektif baik lisan maupun tulisan, dan menerapkan kewirausahaan berbasis teknologi						
	CPL-10	Kemampuan merencanakan, menyelesaikan dan mengevaluasi tugas berdasarkan hasil analisis informasi dan data						



	CPL-11	Kemampuan untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan sistem mekanika							
	Capaian Pembelajaran Mata Kuliah (CPMK)								
	CPMK-1	Mahasiswa mampu menerapkan aturan yang diterapkan dalam panduan Kerja Praktik							
	CPMK-2	Mahasiswa mampu menerapkan ilmu teknik mesin, ranah kerja, dan tanggung jawab disiplin Ilmu Teknik Mesin di Industri							
	CPMK-3	Mahasiswa mampu mengaplikasikan professional skills secara professional dan tanggungjawab							
	CPMK-4	Mahasiswa mampu berpikir kritis dan berkomunikasi baik secara tulis maupun lisan secara baik							
	CPMK-5	Mahasiswa mampu bekerjasama dalam tim pada masing-masing pihak							
	CPMK-6	Mahasiswa mampu membuat laporan kerja praktik dan mempresentasikannya							
		Matrik CPL – CPMK							
		CPMK	CPL-1	CPL-3	CPL-8	CPL-9	CPL-10	CPL-11	Bobot (%)
		CPMK-1	v	v	v	v	v	v	15
		CPMK-2	v	v	v	v	v	v	20
		CPMK-3	v	v	v	v	v	v	15
		CPMK-4	v	v	v	v	v	v	15
		CPMK-5	v	v	v	v	v	v	15
		CPMK-6	v	v	v	v	v	v	20
		Total bobot (%)	16.66	16.66	16.66	16.66	16.66	16.66	100
Deskripsi Singkat MK	Dalam mata kuliah ini mahasiswa diberikan kesempatan untuk mengembangkan kompetensi di industri tentang profesi <i>engineer</i> , termasuk peran, etika, budaya serta tanggung jawab profesi <i>engineer</i> dalam disiplin ilmu teknik mesin. Mahasiswa dikenalkan tentang konsep dan aturan-aturan kerja praktik serta divisi/departemen di industri mitra. Di samping itu, mahasiswa akan diberikan tugas yang								



	berkaitan dengan studi kasus secara nyata di industri mitra. Dengan mengikuti mata kuliah kerja praktik ini, mahasiswa diharapkan mampu dapat meningkatkan kompetensinya dan mengembangkan kreativitas dalam praktik industri						
Bahan Kajian: Materi Pembelajaran	Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: - Panduan kerja praktik - Sistem organisasi dan pengenalan industri - Pelaksanaan pekerjaan proyek/tugas kerja praktik - Kelengkapan laporan kerja praktik						
Pustaka	Utama :						
	[1]. Panduan Kerja Praktik Departemen Teknik Mesin						
	Pendukung :						
	[2]. Peraturan-peraturan akademk						
Dosen Pengampu	Koordinator Kerja praktek, Dosen Pembimbing						
Matakuliah syarat	Telah lulus minimal 72 SKS Telah lulus Mata Kuliah Metalurgi I, Metalurgi II, Elemen Mesin I Sudah lulus/sedang mengambil Mata Kuliah Elemen Mesin II dan Proses Manufaktur I						
Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
(1)	(2)	Indikator	Kriteria & Bentuk	Luring (<i>offline</i>)	Daring (<i>online</i>)	(7)	(8)
1	Mahasiswa mampu memahami	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas	Kriteria: - Rubrik - Marking Scheme	Bentuk: Diskusi, brainstorming Metode: Ekspositori dan		- Konsep, tujuan dan peraturan kerja praktik	



	konsep dan peraturan kerja praktik	dalam menjelaskan konsep dan peraturan kerja praktik	Bentuk: Asistensi dan diskusi	<i>discovery learning, cooperative learning</i> [TM: 1x(2x50'')] Diskusi [BT: 1x(2x50'')] Menyelesaikan tugas kerja praktik [BM: 1x(2x50'')] Mempelajari pedoman kerja praktik		- Kontrak kerja praktik dengan mitra kerja praktik - Pengenalan mitra kerja praktik [Panduan dan SOP Kerja praktik]	
2	Mahasiswa mampu memahami proses industri terkait dengan pendekatan <i>engineering</i> khususnya disiplin ilmu teknik mesin	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan persoalan di perusahaan dengan pendekatan <i>engineering</i> (teknik	Kriteria: - Rubrik - Marking Scheme Bentuk: Asistensi dan diskusi	Bentuk: Diskusi, brainstorming Metode: Ekspositori dan <i>discovery learning, cooperative learning</i> [TM: 1x(2x50'')] Diskusi [BT: 1x(2x50'')] Menyelesaikan tugas kerja praktik		Pengenalan departemen/divisi mitra kerja praktik	3



		mesin/sistem mekanikal)		[BM: 1x(2x50")] Mempelajari pedoman kerja praktik			
3-14	Mahasiswa mampu menyelesaikan tugas kerja praktik dan permasalahan di industry dan membuat kelengkapan laporan kerja praktik dengan professional dan tanggung baik secara mandiri maupun berkelompok	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan persoalan di perusahaan dengan pendekatan <i>engineering</i> (teknik mesin/sistem mekanikal)	Kriteria: - Rubrik - Marking Scheme Bentuk: Asistensi dan diskusi serta studi kasus	Bentuk: Diskusi, brainstorming Metode: Ekspositori dan <i>discovery learning</i> , <i>cooperative learning</i> [TM: 1x(2x50")] Diskusi [BT: 1x(2x50")] Menyelesaikan tugas kerja praktik [BM: 1x(2x50")] Mempelajari pedoman kerja praktik		Pengisian tugas mingguan dan rancangan laporan kerja praktik serta penyelesaian tugas dari pembimbing lapangan	
15	Mahasiswa menyusun laporan kerja praktik dengan	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam	Kriteria: - Rubrik - Marking Scheme	Bentuk: Diskusi, brainstorming Metode: Ekspositori dan <i>discovery learning</i> ,		Pengisian tugas mingguan dan rancangan laporan kerja praktik	10



	menerapkan pengetahuan keteknikmesinan (<i>engineering</i>) dan keterampilan selama pelaksanaan kerja praktik sesuai dengan aturan yang berlaku	menyelesaikan permasalahan penyusunan laporan kerja praktik	Bentuk: Asistensi dan diskusi	<i>cooperative learning</i> [TM: 1x(2x50'')] Diskusi [BT: 1x(2x50'')] Menyelesaikan tugas kerja praktik [BM: 1x(2x50'')] Mempelajari pedoman kerja praktik			
16	Mahasiswa mengumpulkan laporan kerja praktik dan mempresentasikan hasil kerja praktik pada pihak industri dan kampus	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam mempresentasikan laporan hasil kerja praktik	Kriteria: - Rubrik - Marking Scheme Bentuk: Asistensi dan diskusi	Bentuk: Diskusi, brainstorming Metode: Ekspositori dan <i>discovery learning</i> , <i>cooperative learning</i> [TM: 1x(2x50'')] Diskusi [BT: 1x(2x50'')] Menyelesaikan tugas kerja praktik		Pengumpulan Laporan kerja praktik dan Evaluasi Presentasi	



				[BM: 1x(2x50")] Mempelajari pedoman kerja praktik			

Catatan :

25. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.

26. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.

71. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

28. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

29. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

30. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.

31. **Bentuk penilaian:** tes dan non-tes.

32. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.



33. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.

34. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.

35. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.

36. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

Pengelolaan Pembelajaran

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

BAB 11





11 Pengelolaan Pembelajaran

Learning Management

Pelaksanaan kurikulum dan pembelajaran mengacu pada standar pengelolaan yg terdapat pada pasal 40-41 Permendikbud Nomor 3 Tahun 2020 dan sesuaikan dengan SOTK UPPS.

Pengelolaan pembelajaran dapat dijelaskan dengan Tabel sebagai berikut:

The implementation of curriculum and learning is based on the management standards as stipulated in Articles 40–41 of the Ministry of Education and Culture Regulation (Permendikbud) No. 3 of 2020 and aligned with the Organizational Structure and Work Procedure (SOTK) of the Academic Executing Unit (UPPS). Learning management is described in the following table:

No	Aktifitas / Activity	Pejabat / Person in Charge
1	Penanggung jawab dalam penyusunan kurikulum <i>Person responsible for curriculum development</i>	Kepala departemen <i>Head of Department</i>
2	PIC Perangkat pembelajaran (RPS, RAE dan RT) MK pada Kurikulum <i>Person in charge (PIC) for learning instruments (RPS, RAE, and RT) of courses in the curriculum</i>	Ketua RMK/Kepala Laboratorium/Pengampu MK <i>Head of RMK / Laboratory Head / Course Instructor</i>
3	PIC monitoring dan evaluasi pelaksanaan kurikulum (mengacu pada perangkat pembelajaran) <i>PIC for monitoring and evaluating curriculum implementation (referring to the learning instruments):</i> • Pemeriksaan kesesuaian soal dengan CPMK dan / CPL <i>Reviewing alignment of exam questions with CPL/CPMK</i> • Pemeriksaan lama waktu asesmen dengan bobot sks MK <i>Reviewing assessment time duration according to course credit weight</i>	Sekretaris Departemen I <i>First Department Secretary</i>
4	PIC monev pelaksanaan MB – KM <i>PIC for monitoring and evaluating MBKM implementation:</i> • Pemeriksaan lama waktu kegiatan MB – KM <i>Reviewing the duration of MBKM activities</i>	Sekretaris Departemen I <i>First Department Secretary</i>



- Pemeriksaan kesesuaian kemampuan yang diperoleh dengan CPL
Reviewing the alignment of acquired competencies with CPL
 - Pemeriksaan kesesuaian bentuk dan teknik dalam asesmen dengan CPL
Reviewing alignment of assessment forms and techniques with CPL
 - Pemeriksaan panduan untuk mahasiswa, dosen pembimbing di lapangan, dan dosen pembimbing Prodi
Reviewing guidance for students, field supervisors, and academic supervisors
- 5 PIC monitoring dan evaluasi ketercapaian CPL, serta pelaporan ketercapaian CPL
PIC for monitoring and evaluating CPL attainment and reporting on CPL achievement

Kepala Departemen
Head of department

