

MODULE HANDBOOK

Master of Engineering
Physics Program (MoEP)
Curriculum 2018-2023



PREFACE

Academic quality in higher education is a complex concept that is built based on various needs and expectation of stakeholders. These stakeholders provide valuable information derived into expected learning outcomes to accommodate the market-required competences as engineer, project manager, researcher, further study, technopreneur and lecturer. To maintain and improve the quality of academic processes in higher education, particularly at Institut Teknologi Sepuluh Nopember (ITS), quality assurance system (QAS-ITS) has been implemented to date. The current implementation of QAS-ITS reflects a systematic measure, which was initially built to guarantee the fulfillment of National Standard for Higher Education, to support continuous improvement of study programs run in ITS.

Master Program of Engineering Physics (MoEP) within the Department of Engineering Physics, Faculty of Industrial Technology and System Engineering (INDSYS), also performs regular quality assurance check following the QAS-ITS and is currently accredited A (excellent) by the National Accreditation Board. Following our vision toward internationally reputable study program in Engineering Physics, MoEP has been actively involved in various international cooperation in both research and educational activities in the last decade. Further, the Department of Engineering Physics support the MoEP to be internationally accredited by ASIIN (Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik). This self-assessment report (SAR) is compiled as part of the evaluation document for the ASIIN accreditation board to assess the educational processes of achieving the Program Learning Outcome (PLO) of MoEP, INDSYS-ITS.

In this occasion, I desire also to acknowledge and express my gratitude and appreciation to Rector of ITS, Board of Quality Assurance (QA) of ITS, and Task force team of MoEP for the preparation of ASIIN accreditation.

Surabaya, 2022

Dr. Ir. Suyanto, S.T., M.T.
Head of Engineering Physics Department - INDSYS
Institut Teknologi Sepuluh Nopember

TABLE OF CONTENT

PREFACE.....	ii
TABLE OF CONTENT	iii
Compulsory Courses (General)	1
TF185101 RPS RAE Fisika Teknik Lanjut (<i>Advanced Engineering Physics</i>)	1
TF185102 RPS RAE Matematika Teknik Lanjut (<i>Advanced Engineering Mathematics</i>)	12
TF185271 RPS RAE Metodologi Penelitian dan Proposal Tesis (<i>Research Methodology and Thesis Proposal</i>).....	24
TF185371 RPS RAE Kerja Praktek (<i>Internship</i>).....	34
Compulsory Courses (Instrumentation Engineering)	40
TF185104 RPS RAE Dinamika Sistem Lanjut (<i>Advanced Dynamic Systems</i>)	40
TF185103 RPS RAE Instrumentasi Lanjut (<i>Advanced Instrumentation</i>).....	49
TF185201 RPS RAE Kontrol Otomatik Lanjut (<i>Advanced Automatic Control</i>).....	59
TF185202 RPS RAE Optimisasi Sistem (<i>System Optimization</i>).....	72
TF18503 RPS RAE Pemrosesan Sinyal (<i>Signal Processing</i>).....	80
TF185301 RPS RAE Rekayasa Desain (<i>Design Engineering</i>)	88
Compulsory Courses (<i>Energy Engineering and Environmental Conditioning</i>)	99
TF185140 RPS RAE Pemetaan Potensi Energi (<i>Energy Potential Mapping</i>).....	99
TF185210 RPS RAE Teknologi Konversi Energi (<i>Energy Conversion Technology</i>)	110
TF185220 RPS RAE Optimasi Sistem Energi (<i>Energy System Optimization</i>)	129
TF185210 RPS RAE Sistem Energi Terbarukan (<i>Renewable Energy System</i>)	136
TF185140 RPS RAE Audit dan Manajemen Energi (<i>Energy Audit & Management</i>)	147
Elective Courses (Instrumentation Engineering)	158
TF185312 RPS RAE Pengendalian Proses secara Statistik (<i>Statistical Process Control</i>)	158
TF185313 RPS RAE Kecerdasan Buatan untuk Sistem Instrumentasi (<i>Artificial Intelligence for Instrumentation Systems</i>)	175
TF185321 RPS RAE Fisika Tubuh Manusia (<i>Physics of Human Body</i>).....	186
TF185322 RPS RAE Asesmen Teknologi Kesehatan (<i>Health Technology Assessment</i>)	202
TF185323 RPS RAE Instrumentasi Medis (<i>Medical Instrumentation</i>).....	199
TF185331 RPS RAE Sensor Fotonik (<i>Photonic Sensor</i>)	211
TF185412 RPS RAE Manajemen Keselamatan Proses (<i>Process Safety Management</i>).....	226
TF185413 RPS RAE Teknologi Sensor dan Transmitter (<i>Sensor and Transmitter Technology</i>)	225
TF185421 RPS RAE Teknologi Pencitra Medis (<i>Medical Imaging Technologies</i>)	231

TF185432 RPS RAE Perangkat Fotonik (<i>Photonic Devices</i>)	242
Elective Courses (<i>Energy Engineering and Environmental Conditioning</i>)	314
TF185150 RPS RAE Mekanika Fluida (<i>Fluid Mechanics</i>)	332
TF185315 RPS RAE Sistem Distribusi Energi (<i>Energy Distribution System</i>).....	354
TF185317 RPS RAE Keberlanjutan dan Kebijakan Energi (<i>Sustainable and Energy Policy</i>).....	363
TF185444 RPS RAE Konservasi Energi (<i>Energy Conservation</i>)	297

Compulsory Courses (General)

TF185101 RPS RAE Fisika Teknik Lanjut (*Advanced Engineering Physics*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>			RP
	Fisika Teknik Lanjut <i>Advanced Engineering Physics</i>			Edisi: Agt 2018 Edition: Aug 2018
Kode (Code): TF185101	Bobot sks (T/P): (3/0) Credits (T/P): (3/0)	Rumpun MK: Wajib Field of Specialization: compulsory	Smt: 1 Semester: 1	
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Prof. Sekartedjo	Koordinator RMK Field Coordinator Head of Master Program	Ka PRODI Head of Master Program Aulia M T Nasution	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-1 Mampu mengaplikasikan pengetahuan matematika, fisika, dan kerekayasaan tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (60%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems.</i> CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan kerekayasaan dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (40%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>		
	CP-MK <i>Course Learning Outcome (CLO)</i>			
	1. Mahasiswa mampu mengidentifikasi konsep fisika dalam bidang keteknikan (CP-1) 50%			

	<i>Students are able to identify several physics concepts in the field of engineering</i> 2. Mahasiswa mampu merumuskan dan menganalisis konsep fisika dalam bidang keteknikan (CP-2) 30% <i>Students are able to formulate and analyze physics concepts in the field of engineering</i> 3. Mahasiswa mampu mengembangkan konsep-konsep fisika pada bidang keteknikan (CP-1, CP-2) 20% <i>Students are able to develop physics concepts in the engineering field</i>	
Diskripsi Singkat MK <i>Course Description</i>	Kuliah ini membahas tentang penjelasan dan penerapan konsep-konsep advanced fisika yang ada pada berbagai bidang keteknikan di industri. Cakupan materi yang diberikan terkait dengan bidang peminatan pada teknik fisika yang meliputi bidang instrumentasi, energi, material, fotonik, energi, dan akustik. <i>This lecture discusses the explanation and application of advanced physics concepts that exist in various engineering fields in industry. The scope of the material provided is related to the field of specialization in physics engineering which includes the fields of instrumentation, energy, materials, photonics, energy, and acoustics.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Termodinamika 2. Fenomena Transport 3. Fisika Sensor 4. Fisika Semikonduktor 1. <i>Thermodynamics</i> 2. <i>Transport Phenomenon</i> 3. <i>Sensor Physics</i> 4. <i>Semiconductor Physics</i>	
Pustaka <i>Reading Materials</i>	Utama: Main	- O'Connel JP. And Haile, JM., Thermodynamics: Fundamentals for Applications, Cambridge Univ. Press, 2005 - Fraden, J., Handbook of Modern Sensors: Physics, Designs, and Applications, 3rd ed., Springer Verlag, 2004 - Grundmann, M., The Physics of Semiconductors, Springer Verlag, Berlin-Heidelberg, 2006
	Pendukung: Supporting	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: Software	Perangkat keras: Hardware
	-	Private Computer
Tim Pengajar	Prof. Sekartedjo; Dr.Ing. Doty D. Risanti	

Team Teaching						
Matakuliah syarat Entry requirement						
Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessment point (%) (7)
1	Mampu mengidentifikasi penerapan konsep fisika secara terintegrasi pada berbagai permasalahan engineering di Industri. <i>Able to identify the application of physics concepts in an integrated manner to various engineering problems in Industry.</i>	- Dapat mengidentifikasi dan menjelaskan konsep dasar fisika yang terlibat dalam sistem yang ditinjau. - Dapat menjelaskan hukum-hukum fisika yang terkait. <i>Can identify and explain the basic physics concepts involved in the system under review.</i> <i>Can explain the laws of physics related.</i>	TUGAS 1: Mahasiswa mengidentifikasi dan menjelaskan konsep dasar fisika untuk sebuah kasus. <i>ASSIGNMENT 1: Students identify and explain the basic concepts of physics for a case.</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Konsep termodinamika dan fenomena transport di industri (digunakan sebagai contoh kasus) <i>Thermodynamic concepts and transport phenomena in industry (used as case examples)</i>	5% (CP-MK1) 2.5% (CP-MK2)
2,3	Mampu menganalisa hukum-hukum dasar dan persamaan keadaan pada suatu sistem termodinamika, karakteristik serta penerapan persamaan keadaan dalam suatu sistem termodinamis fasa tunggal: gas, cairan <i>Able to analyze basic laws and equations of state in a thermodynamic system,</i>	- Dapat mengidentifikasi persamaan keadaan yang terlibat dalam suatu sistem termodinamis - Dapat menjelaskan parameter-parameter yang mencirikan karakteristik termodinamis dari sistem termodinamis fasa tunggal, jamak, reaktif serta non-reaktif <i>Can identify the equations of state involved in a thermodynamic system.</i>	TUGAS 2: Mahasiswa membuat review dan mempresentasikan dalam kelas. <i>ASSIGNMENT 2: Students make reviews and present in class.</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Sistem termodinamis fasa tunggal: - Gas Ideal & real - Cairan ideal & real - Sistem termodinamis fasa jamak - Sistem reaktif vs non reaktif, serta hukum-hukum termodinamis yang terlibat. <i>Single phase thermodynamic system:</i> <i>Ideal & real gas</i>	5% (CP-MK1) 2.5% (CP-MK2) 2.5% (CP-MK3)

	<i>characteristics, and application of equations of state in a single-phase thermodynamic system: gases and liquids.</i>	• <i>Can explain the parameters that characterize the thermodynamic characteristics of single phase, multiple, reactive, and non-reactive thermodynamic systems</i>			• <i>Ideal & real fluids</i> • <i>Multi-phase thermodynamic system</i> • <i>The reactive vs non-reactive system, and the thermodynamic laws involved.</i>	
4	Mampu menerapkan fenomena konduksi kalor serta kuantifikasinya pada sistem konduksi 1D dan perluasan sistem 2D nya <i>Able to apply the phenomenon of heat conduction and its quantification to the 1D conduction system and the expansion of its 2D system.</i>	Dapat menerapkan hukum-hukum konduksi dalam menyelesaikan problem karakterisasi sistem konduksi kalor dalam berbagai bentuk geometri. <i>Can apply the laws of conduction in solving the problem of characterizing heat conduction systems in various geometric shapes</i>	TUGAS 3: Mahasiswa menyelesaikan soal quiz. <i>ASSIGNMENT 3: Students complete quiz problems.</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Fenomena, hukum, dan karakterisasi sistem konduksi 1D • Fenomena, hukum, dan karakterisasi sistem konduksi 2D • <i>Phenomena, laws and characterization of the 1D . conduction system</i> • <i>Phenomena, laws and characterization of the 2D conduction system</i>	5% (CP-MK1) 2.5% (CP-MK2)
5,6	Mampu menerapkan fenomena konveksi kalor serta kuantifikasinya pada sistem konveksi bebas dan paksa (terbuka & tertutup), serta analogi perpindahan massa terkait. <i>Able to apply the phenomenon of heat convection and its quantification in free and forced convection systems</i>	Dapat menerapkan hukum-hukum konveksi paksa dalam menyelesaikan problem karakterisasi sistem konveksi bebas, paksa terbuka & tertutup (<i>external vs internal flows</i>), serta analogi perpindahan massa terkait. <i>Able to apply the laws of forced convection in solving the problem of characterizing free convection systems, forced open & closed</i>	TUGAS 4: Mahasiswa membuat review dan mempresentasikan dalam kelas. <i>ASSIGNMENT 4: Students make reviews and present in class.</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Fenomena, hukum, dan karakterisasi sistem konveksi bebas pada berbagai bentuk geometri • Fenomena, hukum, dan korelasi empiris dalam karakterisasi sistem konveksi paksa tertutup & terbuka • Analisis non-dimensional & analogi perpindahan massa • <i>Phenomena, laws, and characterization of free</i>	5% (CP-MK1) 2.5% (CP-MK2) 2.5% (CP-MK3)

	<i>(open & closed), as well as related mass transfer analogies.</i>	<i>(external vs internal flows), and related mass transfer analogies.</i>			<i>convection systems in various geometric shapes</i> <i>Phenomena, laws, and empirical correlations in the characterization of closed & open forced convection systems</i> <i>Non-dimensional analysis & mass transfer analogies</i>	
7	Mampu menganalisa fenomena radiasi: Proses, Karakteristik, dan Perpindahan radiasi antar permukaan. <i>Able to analyze radiation phenomena: Process, Characteristics, and Transfer of radiation between surfaces.</i>	Dapat menganalisa hukum-hukum radiasi dalam menyelesaikan problem karakterisasi sistem radiasi. <i>Can analyze radiation laws in solving radiation system characterization problems problem.</i>	Non-Test: Diskusi hukum radiasi dan analisisnya. <i>Non-Test: Discussion of the law of radiation and its analysis</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Fenomena, hukum, karakterisasi sistem radiasi, dan pertukaran antar permukaan pada berbagai bentuk geometri. <i>Phenomena, laws, characterization of radiation systems, and interchange between surfaces in various geometric shapes.</i>	-
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)

9,10	Mampu menjelaskan dan menganalisa konsep detail tentang konsep fisika proses sensing, sensor & sistem sensor: konfigurasi, klasifikasi, aplikasi, dan karakteristik sensor. <i>Able to explain and analyze detailed concepts about the physics concept of the sensing process, sensors & sensor systems: configuration, classification, application, and sensor characteristics.</i>	Dapat menjelaskan dan menganalisa detail tentang konsep fisika proses sensing (untuk berbagai besaran fisis yang di sensing), sensor dan sistem sensor, serta karakteristik terkait. <i>Can explain and analyze in detail about the physical concepts of the sensing process (for various physical quantities that are sensed), sensors and sensor systems, as well as related characteristics.</i>	TUGAS 5: 1. Mahasiswa membuat review perkembangan teknologi sensor 2. Mahasiswa mengerjakan soal dari buku text utama ASSIGNMENT 5: 1. Students write a comprehensive review on the development of sensor technology. 2. Students solve the exercise problems in the main handbook	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Sensor & sistem sensor • Karakteristik sensor • Prinsip fisika dari proses sensing: elektrik, mekanik, akustik, Thermal, optic. • <i>Sensors & sensor system</i> • <i>Sensor characteristics</i> • <i>The physical principles of the sensing process: electrical, mechanical, acoustic, thermal, optical.</i>	5% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)
11	Mampu menjelaskan dan menganalisa komponen optik dan elektronik (sistem akuisisi data) dalam suatu sistem sensor. <i>Able to explain and analyze optical and electronic components (data acquisition system) in a sensor system</i>	Dapat menjelaskan dan menganalisa dengan baik konsep optik dan elektronik dalam suatu sensor, dan memilih dengan tepat komponen-komponen terkait yang diperlukan dalam proses pembangunan suatu sensor / sistem sensor. <i>Able to explain and analyze well the concept of optics and electronics in a sensor, and correctly select the related components needed in the process of building a sensor / sensor system.</i>	Non-Test: Diskusi phukum radiasi dan analisisnya. <i>Non-Test: Discussion of the law of radiation and its analysis</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Konsep radiometri & fotometri • Komponen optik dalam sensor • Komponen elektronik untuk sistem akuisisi data elektronik suatu sensor / sistem sensor • <i>Concepts of radiometry and photometry</i> • <i>Optical components in the sensor</i> • <i>Electronic components for the electronic data acquisition system of a sensor / sensor system</i>	-

12	Mampu menjelaskan jenis ikatan dan karakteristiknya, kristal: struktur, kisi, dan klasifikasinya, serta bentukan alloy. <i>Be able to explain the types of bonds and their characteristics, crystals: structure, lattice, and their classification, and the formation of alloys.</i>	• Dapat menjelaskan dengan baik konsep dari beberapa dan jenis ikatan inter-atomik beserta karakteristiknya • Dapat menjelaskan detail tentang kristal: struktur, kisi, dan klasifikasinya, serta bentukan alloy dan karakteristik terkaitnya karakteristiknya. • <i>Can explain well the concept of several and types of inter-atomic bonds and their characteristics.</i> • <i>Can explain in detail about crystals: their structure, lattice, and classification, as well as the formation of alloys and their related characteristics.</i>	TUGAS 6: Mahasiswa menyelesaikan soal quiz. <i>ASSIGNMENT 6: Students complete quiz problems.</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Ikatan kovalen, ionic, campuran, metalik, dan van-der-Waals: Struktur kristal, Kisi (<i>Lattice</i>), Klasifikasi jenis kristal, Bentukan alloy & karakteristiknya. <i>Covalent, ionic, mixed, metallic and van-der-Waals bonds: Crystal structure, Lattice, Classification of crystal types, Alloy formation & characteristics.</i>	5% (CP-MK1) 2.5% (CP-MK2) 2.5% (CP-MK3)
13,14	Mampu menjelaskan dan menganalisa konsep detail tentang struktur pita dan transport muatan dalam semikonduktor. <i>Able to explain detailed concepts about band structure and charge transport in semiconductors</i>	• Dapat menjelaskan dan menganalisa struktur pita energi semikonduktordan sifat semikonduktor. • Dapat menjelaskan dan menganalisa tranport pembawa muatan intrinsik/ ekstrinsik berdasarkan distribusi Fermi. • <i>Can explain the structure of the energy band of semiconductors and semiconductor properties.</i>	TUGAS 7: Mahasiswa menyelesaikan latihan soal dan mendiskusikan dalam kelas. <i>ASSIGNMENT 7: Students complete exercise problems and discuss in class.</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Free electron model, Periodic potentials, Struktur pita energi pada beberapa semikonductor • Equation of Electron, Electronic Defect States, Fermi Distribution • Carrier Concentration, Intrinsic Conduction, Shallow Impurities, Doping. • <i>Free electron model, Periodic potentials, Energy</i>	5% (CP-MK1) 2.5% (CP-MK2) 2.5% (CP-MK3)

		• <i>Can explain the transport of intrinsic/extrinsic charge carriers based on the Fermi distribution.</i>			<i>band structure in some semiconductors</i> • <i>Equation of Electron, Electronic Defect States, Fermi Distribution</i> • <i>Carrier Concentration, Intrinsic Conduction, Shallow Impurities, Doping.</i>	
15	Mampu menjelaskan konsep detil tentang rekombinasi muatan dalam semikonduktor. <i>Able to explain the detailed concept of charge recombination in semiconductors.</i>	Dapat menjelaskan rekombinasi pasangan donor-akseptor dan pita-pengotor. <i>Can explain donor-acceptor and impurity-band pair recombination.</i>	Non-Test: Diskusi hukum radiasi dan analisisnya. <i>Non-Test: Discussion of the law of radiation and its analysis</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Band–Band Recombination • Donor–Acceptor Pair Transitions • Band–Impurity Recombination • <i>Bands Recombination</i> • <i>Donor–Acceptor Pair Transitions</i> • <i>Band–Impurity Recombination</i>	
16	Evaluasi Akhir Semester <i>Final Examination</i>					10% (CP-MK1) 5% (CP-MK2)

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTIRS ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Fisika Teknik Lanjut Advanced Engineering Physics		RA&E
			Edisi (<i>Edition</i>): Agt 2018 Aug 2018
Kode (<i>Code</i>): TF185101	Bobot sks (T/P): (3/0) Credits (T/P): (3/0)	Rumpun MK: Wajib Field of Specialization: compulsory	Smt: 1 Semester: 1
OTORISASI (<i>Authorization</i>)	Penyusun RA & E Contact Person – Assessment & Evaluation Plan Prof. Sekartedjo	Koordinator RMK Field Coordinator Head of Master Program	Ka PRODI Head of Master Program Aulia M T Nasution

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)
--------------	------------------	-----------------------------------	---------------------	---------------------	---------------------

1	Mampu mengidentifikasi penerapan konsep fisika secara terintegrasi pada berbagai permasalahan engineering di Industri. <i>Able to identify the application of physics concepts in an integrated manner to various engineering problems in Industry.</i>	TUGAS 1: Mahasiswa mengidentifikasi dan menjelaskan konsep dasar fisika untuk sebuah kasus. <i>COGNITIVE - ASSIGNMENT 1: Students identify and explain the basic concepts of physics for a case.</i>	5%	5%	
2,3	Mampu menganalisa hukum-hukum dasar dan persamaan keadaan pada suatu sistem termodinamika, karakteristik serta penerapan persamaan keadaan dalam suatu sistem termodinamis fasa tunggal: gas, cairan <i>Able to analyze basic laws and equations of state in a thermodynamic system, characteristics, and application of equations of state in a single-phase thermodynamic system: gases and liquids.</i>	TUGAS 2: Mahasiswa membuat review dan mempresentasikan dalam kelas. <i>COGNITIVE - ASSIGNMENT 2: Students make reviews and present in class.</i>	5%	2.5%	2.5%
4	Mampu menerapkan fenomena konduksi kalor serta kuantifikasinya pada sistem konduksi 1D dan perluasan sistem 2D nya <i>Able to apply the phenomenon of heat conduction and its quantification to the 1D conduction system and the expansion of its 2D system.</i>	TUGAS 3: Mahasiswa menyelesaikan soal quiz. <i>COGNITIVE - ASSIGNMENT 3: Students complete quiz problems.</i>	5%	5%	
5,6	Mampu menerapkan fenomena konveksi kalor serta kuantifikasinya pada sistem konveksi bebas dan paksa (terbuka & tertutup), serta analogi perpindahan massa terkait. <i>Able to apply the phenomenon of heat convection and its quantification in free and forced convection systems (open & closed), as well as related mass transfer analogies.</i>	TUGAS 4: Mahasiswa membuat studi kasus dan mempresentasikan dalam kelas. <i>PROJECT-BASED - ASSIGNMENT 4: Students make case study and present in class.</i>	5%	2.5%	2.5%
8	Evaluasi Tengah Semester (ETS) <i>COGNITIVE - Mid Term Examination</i>		5%	5%	5%

9,10	Mampu menjelaskan dan menganalisa konsep detail tentang konsep fisika proses sensing, sensor & sistem sensor: konfigurasi, klasifikasi, aplikasi, dan karakteristik sensor. <i>Able to explain and analyze detailed concepts about the physics concept of the sensing process, sensors & sensor systems: configuration, classification, application, and sensor characteristics.</i>	TUGAS 5: 1. Mahasiswa membuat review perkembangan teknologi sensor 2. Mahasiswa mengerjakan soal dari buku text utama <i>CASE-BASED - ASSIGNMENT 5:</i> <i>1. Students write a comprehensive review on the development of sensor technology.</i> <i>2. Students solve the exercise problems in the main handbook</i>	5%	5%	5%
12	Mampu menjelaskan jenis ikatan dan karakteristiknya, kristal: struktur, kisi, dan klasifikasinya, serta bentukan alloy. <i>Be able to explain the types of bonds and their characteristics, crystals: structure, lattice, and their classification, and the formation of alloys.</i>	TUGAS 6: Mahasiswa menyelesaikan soal quiz. <i>COGNITIVE - ASSIGNMENT 6:</i> <i>Students complete quiz problems.</i>	5%	2.5%	2.5%
13,14	Mampu menjelaskan dan menganalisa konsep detail tentang struktur pita dan transport muatan dalam semikonduktor. <i>Able to explain detailed concepts about band structure and charge transport in semiconductors</i>	TUGAS 7: Mahasiswa menyelesaikan latihan soal dan mendiskusikan dalam kelas. <i>COGNITIVE - ASSIGNMENT 7:</i> <i>Students complete exercise problems and discuss in class.</i>	5%	2.5%	2.5%
16	Evaluasi Akhir Semester <i>COGNITIVE - Final Examination</i>		10%	5%	
Total Bobot Penilaian (%) <i>Total Point (%)</i>			50%	30%	20%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Matematika Teknik Lanjut <i>Advanced Engineering Mathematics</i>		RP Edisi: Agt 2018 Edition: Aug 2018
Kode (Code): TF185102	Bobot sks (T/P): (3/0) Credits (T/P): (3/0)	Rumpun MK: Wajib Field of Specialization: compulsory	Smt: 1 Semester: 1
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Gunawan Nugroho	Koordinator RMK Field Coordinator: Head of Master Program	Ka PRODI Head of Master Program Aulia M T Nasution
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-1 Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (60%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems.</i> CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (40%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	1. Mahasiswa mampu membedakan berbagai tipe model matematika sebuah sistem dalam bentuk matematis. (CP-1) 40% <i>Students are able to distinguish various types of mathematical models of a system in mathematical form.</i>	

	2. Mahasiswa mampu menyelesaikan berbagai tipe model matematika sistem dengan metode: Transformasi Laplace, Transformasi Fourier, Transformasi Z, dan pendekatan model ruang keadaan, baik model linier maupun non linier. (CP-2) 40% <i>Students are able to solve various types of system mathematical models using the methods: Laplace transform, Fourier transform, Z transform, and state space model approaches, both linear and non-linear models.</i> 3. Mahasiswa mampu mempresentasikan karakteristik model matematika sistem yang telah diteliti oleh peneliti lain. (CP-1, CP-2) 20% <i>Students are able to present the characteristics of the mathematical model of the system that has been studied by other researchers.</i>	
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini mempelajari tentang Model Matematis sebuah sistem, dimana model sistem merupakan model riil di industri atau aplikasi rekayasa yang digunakan di masyarakat. Mata kuliah ini merupakan salah satu prasyarat bagi mahasiswa yang akan mendesain sebuah sistem yang ada di industri dan meningkatkan kemampuan penguasaan konsep secara matematis untuk dikembangkan pada penelitian tesis. <i>This course studies the Mathematical Model of a system, where the system model is a real model in industry or engineering applications used in society. This course is one of the prerequisites for students who will design a system that exists in the industry and improve the ability to master mathematical concepts to be developed in thesis research.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	- Variabel Komplek dan Fungsi variable Komplek - Deret, Tranformasi dan Integral Fourier, Transformasi Laplace, Transformasi Z serta sifat-sifatnya - Penyelesaian PDE dengan Tranformasi Fourier, Laplace, dan Z - Matriks, Operasi dan sifatnya - Persamaan Ruang Keadaan, Penyelesaian Persamaan ruang keadaan, dan sifat-sifatnya <i>Complex Variables and Complex Variable Functions</i> <i>Series, Fourier Integral and Transformation, Laplace Transform, Z Transformation, and their properties</i> <i>Solving PDE with Fourier Transform, Laplace, and Z</i> <i>Matrices Operations, and their properties</i> <i>Equation of Space of State, Solving the equation of state space, and its properties</i>	
Pustaka <i>Reading Materials</i>	Utama: Main	- Modul ajar Matematika teknik Lanjut, Aulia Siti Aisjah, http://share.its.ac.id/course/view.php?id=307 - Kreizigs, Erwin; (2011) Advanced Engineering Mathematics, 10th edition, Wiley plus.
	Pendukung: Supporting	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: Software	Perangkat keras: Hardware
	-	Private Computer
Tim Pengajar Team Teaching	Dr. Gunawan Nugroho, Prof. Aulia S.A.	

Matakuliah syarat <i>Entry requirement</i>	-
---	---

Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessment point (%)</i> (7)
1-3	Mahasiswa mampu menjelaskan variabel kompleks dalam fenomena fisika <i>Students are able to explain complex variables in physical phenomena</i>	Ketepatan penjelasan tentang konsep variabel dan fungsi variabel kompleks dalam fenomena fisika <i>Accuracy of explanation of the concept of variables and functions of complex variables in physical phenomena</i>	Tugas 1 1. Mencari literatur / jurnal untuk aplikasi dari penggunaan konsep fungsi variabel kompleks pada fenomena fisika 2. Presentasi hasil penjejukan literatur, dalam bentuk: makalah singkat dan ppt pendukung <i>1. Searching literature/journals for application of the use of the concept of complex variable functions to physical phenomena</i> <i>2. Presentation of the results of the literature tracking, in the form of: short papers and supporting ppt</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	• Variabel kompleks, Bentuk polar, Operasi pada variabel kompleks, Fungsi dari variabel kompleks. • Sifat fungsi dari variabel kompleks (derivatif, integral), Persamaan Cauchy Rieman dan aplikasi pada fenomena fisika, Persamaan Laplace dan aplikasi pada fenomena fisika. • Fungsi Trigonometri dan Hiperbolik, persamaan Euler, Integrasi fungsi variabel kompleks, Teorema integral Cauchy, Derivatif fungsi analitik, Ketidaksamaan Cauchy. • <i>Complex variables, Polar forms, Operations on complex variables, Functions of complex variables.</i> • <i>Functional properties of complex variables (derivatives, integrals), the Cauchy Rieman equation and its application to physical phenomena, Laplace's equation</i>	5% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)

					<i>and its application to physical phenomena.</i> • <i>Trigonometric and Hyperbolic functions, Euler equations, Integration of complex variable functions, Cauchy integral theorem, Analytical function derivatives, Cauchy inequalities.</i>	
4-7	Mahasiswa mampu membedakan dan menerapkan konsep Transformasi Fourier, Transformasi Laplace, dan Transformasi Z untuk penyelesaian Persamaan Differensial <i>Students are able to distinguish and apply the concepts of Fourier Transform, Laplace Transform, and Z Transformation for solving Differential Equations</i>	• Ketepatan menggunakan tahapan dalam penyelesaian PD dengan Transformasi Laplace • Ketepatan menggunakan tahapan dalam penyelesaian PD dengan Transformasi Fourier, Transformasi Z • Ketepatan membedakan ke tiga konsep transformasi untuk penyelesaian PD sesuai dengan ciri-ciri PD • Ketepatan menyimpulkan perbedaan dalam	Kuis Esay Menyelesaikan soal PD dengan Transformasi Fourier, Transformasi Laplace, dan Transformasi Z, Tugas 2 • Membuat resume perbedaan tiga metode Transformasi untuk penyelesaian PD dengan contoh kasus • Presentasi hasil Resume Essay Quiz <i>Solve PD problems with Fourier transform, Laplace transform, and Z transform,</i> Task 2 • <i>Make a resume of the differences in the three Transformation methods for solving PD with case examples.</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	• Deret Fourier, Integral Fourier, Transformasi Fourier: Diskrit dan Transformasi Fast Fourier - FFT • Penyelesaian PD dengan Transformasi Fourier, Penyelesaian PD satu dimensi dan dua dimensi • Persamaan Laplace dalam koordinat Cartesian, Polar dan silinder • Transformasi Laplace, Penyelesaian PD dengan Transformasi Laplace • Konsep digitalisasi, Transformasi Z, Penyelesaian PD dengan Transformasi Z • <i>Fourier Series, Fourier Integral, Fourier Transform: Discrete and Fast Fourier Transform - FFT</i> • <i>Solving PD with Fourier Transform, One-dimensional and two-dimensional PD solving</i> • <i>Laplace's equations in Cartesian, Polar and cylindrical coordinates</i>	5% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)

		menggunakan ketiga transformasi untuk penyelesaian PD • <i>The accuracy of using steps in solving PD with Laplace Transform</i> • <i>The accuracy of using steps in solving PD with Fourier transform, Z . transform</i> • <i>The accuracy of distinguishing the three transformation concepts for PD completion according to the characteristics of PD</i> • <i>The accuracy of the conclusion of differences in using the three transformations for solving PD</i>	• <i>Presentation of the results of the Resume</i>		• <i>Laplace Transform, PD Solving with Laplace Transform</i> • <i>Concept of digitization, Z Transformation, PD Solution with Z Transformation</i>	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK1) 5% (CP-MK2)

9-10	Mahasiswa mampu membedakan dan menerapkan bentuk PD orde tinggi dan nonlinier sebagai modeling system <i>Students are able to distinguish and apply high-order and nonlinear PD forms as system modeling</i>	Ketepatan mendefinisikan PD dari sebuah model sistem dalam kategori PD orde tinggi dan PD non linier <i>The precision of defining the PD of a system model in the categories of high-order PD and non-linear PD</i>	Tugas 3 Menyusun dan mempresentasikan secara team, review jurnal, berbagai pemodelan sistem dinamik dalam kategori PD orde tinggi dan PD non-linier. Task 3 <i>Develop and present as a team, review journals, various dynamic system models in the categories of high-order PD and non-linear PD.</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	• PD orde tinggi • PD non linier • <i>High order PD</i> • <i>Non-linear PD</i>	10% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)
11-15	Mahasiswa mampu menggunakan dan menganalisa konsep ruang keadaan dengan fungsi alih dari sebuah sistem <i>Students are able to use and analyze the concept of state space with the transfer function of a system</i>	▪ Ketepatan medeskripsikan setiap variabel dalam ruang keadaan, menentukan sifat-sifat matriks sistem ▪ Ketepatan menentukan variabel keadaan dari sebuah fungsi transfer dan menggunakan tahapan dalam merubah fungsi transfer menjadi persamaan ruang keadaan	Tugas 4 • Menyelesaikan soal operasi yang terjadi pada matriks • Menyelesaikan persamaan ruang keadaan dengan menggunakan metod integrasi Tugas 5 1. Menghitung fungsi transformasi berdasarkan persamaan ruang keadaan 2. Menentukan nilai variabel keadaan dengan menggunakan sifat-sifat fungsi transformasi 3. Merubah sebuah fungsi transfer menjadi persamaan ruang keadaan	Kuliah, brainstorming dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	• Matriks, Sifat-sifat matriks, Operasi pada matriks, Fungsi transfer orde tinggi • Variabel keadaan, Fungsi Tranformasi , Solusi PD dengan integrasi, Sifat – sifat fungsi transformasi • Persamaan kanonik, Penyelesaian variabel keadaan dengan menggunakan sifat fungsi transformasi • <i>Matrices, Properties of matrices, Operations on matrices, Higher order transfer functions</i> • <i>State Variables, Transformation Functions, PD Solution with</i>	10% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)

		▪ <i>The accuracy of describing each variable in the state space, determines the properties of the system matrix</i> ▪ <i>The precision of determining the state variable of a transfer function and using steps in converting the transfer function into a state space equation</i>	Tugas 6 Studi kasus: 1. Mencari sebuah plant 2. Menurunkan persamaan plant dalam bentuk persamaan differensial 3. Menyelesaikan PD plant dengan menggunakan metode pendekatan Persamaan Ruang Keadaan dengan bantuan software 4. Presentasi Hasil dengan membuat PPT 5. Membuat makalah hasil studi kasus Task 4 • <i>Solve operations that occur on matrices</i> • <i>Solve state space equations using the integration method</i> Task 5 1. <i>Calculating the transformation function based on the state space equation.</i> 2. <i>Determine the value of the state variable using the properties of the transformation function.</i> 3. <i>Converting a transfer function into a state space equation</i> Task 6		<i>Integration, Properties of Transformation Functions</i> • <i>Canonical equations, Solving state variables using the properties of transformation functions</i>	
--	--	---	--	--	--	--

			<i>Case study:</i> <i>Looking for a plant</i> 1. <i>Deriving the plant equation in the form of a differential equation</i> 2. <i>Solving the PD plant by using the Equation of State equation approach with the help of software</i> 3. <i>Presentation of Results by making PPT</i> 4. <i>Making case study papers</i>			
16	Evaluasi Akhir Semester (ETS) <i>Final Examination</i>					5% (CP-MK1) 5% (CP-MK2)

Catatan :

Note

2. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTIRS ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Matematika Teknik Lanjut Advanced Engineering Mathematics			RA&E
				Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185102	Bobot sks (T/P): (3/0) <i>Credits (T/P): (3/0)</i>	Rumpun MK: Wajib <i>Field of Specialization: compulsory</i>	Smt: 1 <i>Semester: 1</i>	
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>Contact Person – Assessment & Evaluation Plan</i> Dr. Gunawan Nugroho	Koordinator RMK <i>Field Coordinator</i> Head of Master Program	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)
1-3	Mahasiswa mampu menjelaskan variabel kompleks dalam fenomena fisika <i>Students are able to explain complex variables in physical phenomena</i>	Tugas 1 - Mencari literatur / jurnal untuk aplikasi dari penggunaan konsep fungsi variabel kompleks pada fenomena fisika - Presentasi hasil penjejakan literatur, dalam bentuk: makalah singkat dan ppt pendukung <i>COGNITIVE - ASSIGNMENT 1:</i>	5%	5%	5%

		• <i>Search literature/journals for application of the use of the concept of complex variable functions to physical phenomena</i> • <i>Presentation of the results of the literature tracking, in the form of: short papers and supporting ppt</i>			
4-7	Mahasiswa mampu membedakan dan menerapkan konsep Transformasi Fourier, Transformasi Laplace, dan Transformasi Z untuk penyelesaian Persamaan Differensial <i>Students are able to distinguish and apply the concepts of Fourier Transform, Laplace Transform, and Z Transformation for solving Differential Equations</i>	Kuis Esay Menyelesaikan soal PD dengan Transformasi Fourier, Transformasi Laplace, dan Transformasi Z, Tugas 2 • Membuat resume perbedaan tiga metode Transformasi untuk penyelesaian PD dengan contoh kasus • Presentasi hasil Resume Essay Quiz <i>Solve PD problems with Fourier transform, Laplace transform, and Z transform,</i> COGNITIVE - ASSIGNMENT 2: • <i>Make a resume of the differences in the three Transformation methods for solving PD with case examples.</i> • <i>Presentation of the results of the Resume</i>	5%	5%	5%
8	Evaluasi Tengah Semester (ETS) Mid Term Examination		5%	5%	5%
9-10	Mahasiswa mampu membedakan dan menerapkan bentuk PD orde tinggi dan nonlinier sebagai modeling system <i>Students are able to distinguish and apply high-order and nonlinear PD forms as system modeling</i>	Tugas 3 • Menyusun dan mempresentasikan secara team, review jurnal berbagai pemodelan sistem dinamik dalam kategori PD orde tinggi dan PD non-linier. CASE-BASED - ASSIGNMENT 3:	10%	5%	5%

		• <i>Prepare and present as a team, review journals of various dynamic system models in the categories of high-order PD and non-linear PD.</i>			
11-15	Mahasiswa mampu menggunakan dan menganalisa konsep ruang keadaan dengan fungsi alih dari sebuah sistem <i>Students are able to use and analyze the concept of state space with the transfer function of a system</i>	Tugas 4 • Menyelesaikan soal operasi yang terjadi pada matriks • Menyelesaikan persamaan ruang keadaan dengan menggunakan metod integrasi Tugas 5 1. Menghitung fungsi transformasi berdasarkan persamaan ruang keadaan 2. Menentukan nilai variabel keadaan dengan menggunakan sifat-sifat fungsi transformasi 3. Merubah sebuah fungsi transfer menjadi persamaan ruang keadaan Tugas 6 Studi kasus: 1. Mencari sebuah plant 2. Menurunkan persamaan plant dalam bentuk persamaan differensial 3. Menyelesaikan PD plant dengan menggunakan metode pendekatan Persamaan Ruang Keadaan dengan bantuan software 4. Presentasi Hasil dengam membuat PPT 5. Membuat makalah hasil studi kasus <i>COGNITIVE - ASSIGNMENT 4:</i> • <i>Solve operations that occur on matrices</i> • <i>Solve state space equations using the integration method</i> <i>COGNITIVE - ASSIGNMENT 5:</i>	10%	5%	5%

		1. Calculating the transformation function based on the state space equation 2. Determine the value of the state variable using the properties of the transformation function 3. Converting a transfer function into a state space equation CASE-BASED - ASSIGNMENT 6: 1. Looking for a plant 2. Deriving the plant equation in the form of a differential equation 3. Solving the PD plant by using the Equation of State equation approach with the help of software 4. Presentation of Results by making PPT 5. Make a case study paper			
16	Evaluasi Akhir Semester Final Examination		5%	5%	5%
Total Bobot Penilaian (%) Total Point (%)			40%	30%	30%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Metodologi Penelitian dan Proposal Tesis <i>Research Methodology and Thesis Proposal</i>		RP Edisi: Agt 2018 Edition: Aug 2018
Kode (Code): TF185271	Bobot sks (T/P): (3/0) Credits (T/P): (3/0)	Rumpun MK: Wajib Field of Specialization: compulsory	Smt: 2 Semester: 2
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Prof. Dr. Ir. Aulia S.A, MT	Koordinator RMK Field Coordinator Head of Master Program	Ka PRODI Head of Master Program Aulia M T Nasution
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta menganalisis dan mengevaluasi data penelitian dan rekayasa. (30%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data.</i> CP-5 Mampu berkomunikasi secara efektif dalam lisan dan format tulisan. (20%) <i>Are able to effectively communicate in both oral and written format.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (50%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	4. Mahasiswa mampu merumuskan masalah dan menyusun hipotesis penelitian (CP-3) (20%)	

	<i>Students are able to formulate problems and develop research hypotheses.</i> 5. Mahasiswa mampu menjelaskan berbagai metode penelitian dalam rekayasa teknik(CP-3) (20%) <i>Students are able to explain various research methods in engineering</i> 6. Mahasiswa mampu mengumpulkan, mengolah data dan menginterpretasi hasilnya secara logis dan sistematis (CP-3, CP-6) (40%) <i>Students are able to collect, process data and interpret the results logically and systematically.</i> 7. Mahasiswa mampu menyusun proposal penelitian dan mempresentasikan (CP-5) (20%) <i>Students are able to prepare research proposals and presentation.</i>						
Diskripsi Singkat MK <i>Course Description</i>	Mahasiswa belajar tentang prinsip-prinsip dan metoda penelitian yang akan digunakan untuk melakukan penelitian tesis. Mahasiswa belajar pengertian pengetahuan, ilmu dan filsafat dan etika dalam penelitian, merumuskan permasalahan, membuat hipotesa, membuat rancangan penelitian sesuai dengan metode yang dipilih nya, mengumpulkan dan mengolah data hasil pengukuran dan menyusun proposal penelitian. <i>Students learn about the principles and research methods that will be used to conduct thesis research. Students learn the meaning of knowledge, science and philosophy and ethics in research, formulate problems, make hypotheses, make research designs according to the chosen method, collect and process measurement data and prepare research proposals.</i>						
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Pengetahuan, ilmu dan filsafat; pengertian pengetahuan, ilmu dan filsafat, pendekatan ilmiah dan non ilmiah, tugas ilmu dan penelitian. 2. Perumusan masalah dan tinjauan pustaka; identifikasi permasalahan, tinjauan pustaka, perumusan masalah. 3. Metode Penelitian; penelitian historis, penelitian deskriptif, penelitian perkembangan, penelitian kasus dan lapangan, penelitian korelasional, penelitian kausal komparatif, penelitian eksperimental sungguhan, penelitian eksperimental semu, penelitian tindakan. 4. Kerangka Teoritis dan Penyusunan Hipotesis; dasar teori, variabel, hipotesis. 5. Pemilihan Sampel; terminologi yang sering digunakan, alasan pemilihan sampel, karakteristik sampel, metode penentuan sampel, desain sampel. <i>5. Knowledge, science, and philosophy; understanding of knowledge, science and philosophy, scientific and non-scientific approaches, scientific and research assignments.</i> <i>6. Problem formulation and literature review; problem identification, literature review, problem formulation.</i> <i>7. Research Methods; historical research, descriptive research, developmental research, case and field research, correlational research, comparative causal research, real experimental research, quasi-experimental research, action research.</i> <i>8. Theoretical Framework and Formulation of Hypotheses; basic theory, variables, hypotheses.</i> <i>9. Sample Selection; frequently used terminology, reasons for selecting samples, sample characteristics, sampling methods, sample design.</i>						
Pustaka <i>Reading Materials</i>	<table border="1"> <tr> <td>Utama: <i>Main</i></td> <td></td> </tr> <tr> <td></td> <td> - Creswell, J. W. (2012). Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research (4 ed.). Boston: PEARSON. - Katz, M. (2006). From Research to Manuscript: A Guide to Scientific Writing. London: Springer. - Kothari, C. R. (2004). Research Methodology: Methods and Techniques (Second Revised ed.). New Delhi: New Age International (P) Limited. - Singh, Y. (2006). Fundamental of Research Methodology and Statistics. New York: New Age International. - Tuckman, B. W., & Harper, B. E. (February 9, 2012). Conducting Educational Research (6 ed.). Maryland, USA: Rowman & Littlefield Publishers. </td> </tr> <tr> <td>Pendukung:</td> <td></td> </tr> </table>	Utama: <i>Main</i>			- Creswell, J. W. (2012). Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research (4 ed.). Boston: PEARSON. - Katz, M. (2006). From Research to Manuscript: A Guide to Scientific Writing. London: Springer. - Kothari, C. R. (2004). Research Methodology: Methods and Techniques (Second Revised ed.). New Delhi: New Age International (P) Limited. - Singh, Y. (2006). Fundamental of Research Methodology and Statistics. New York: New Age International. - Tuckman, B. W., & Harper, B. E. (February 9, 2012). Conducting Educational Research (6 ed.). Maryland, USA: Rowman & Littlefield Publishers.	Pendukung:	
Utama: <i>Main</i>							
	- Creswell, J. W. (2012). Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research (4 ed.). Boston: PEARSON. - Katz, M. (2006). From Research to Manuscript: A Guide to Scientific Writing. London: Springer. - Kothari, C. R. (2004). Research Methodology: Methods and Techniques (Second Revised ed.). New Delhi: New Age International (P) Limited. - Singh, Y. (2006). Fundamental of Research Methodology and Statistics. New York: New Age International. - Tuckman, B. W., & Harper, B. E. (February 9, 2012). Conducting Educational Research (6 ed.). Maryland, USA: Rowman & Littlefield Publishers.						
Pendukung:							

	Supporting	
	- Blessing, L. C. (2009). <i>DRM a Design Research Methodology</i>. London: Springer. - Soetriono, & Rita. (2007). <i>Filsafat Ilmu dan Metodologi Penelitian</i>. Yogyakarta: Andi Offset. - Sugiyono. (2012). <i>Statistika untuk penelitian</i>. Bandung: Alfabeta. - Sugiyono. (2013). <i>Metode Penelitian Kombinasi (Mixed Methods)</i>. Bandung: Alfabeta. - Suryabrata, & Sumadi. (2008). <i>Metodologi Penelitian</i>. Jakarta: Rajawali Press.	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras: <i>Hardware</i>
	-	<i>Private Computer</i>
Tim Pengajar <i>Team Teaching</i>	Prof. Aulia S.A., Dr.Ing. Doty D. Risanti	
Matakuliah syarat <i>Entry requirement</i>	-	

Mg Ke-Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessment point (%) (7)
1,2	Mahasiswa mampu menjelaskan ciri-ciri originalitas hasil penelitian <i>Students are able to explain the characteristics of the originality of research results</i>	• Ketepatan menjelaskan ciri-ciri originalitas penelitian yang tertuang dalam jurnal internasional • Ketepatan mengusulkan hipotesa dalam penelitian • <i>Accuracy in explaining the characteristics of originality of research contained in international journals</i>	Tugas 1: • Review literatur (minimal 20 jurnal) • Mengidentifikasi oroginalitas dari semua jurnal yang direview <i>Task 1:</i> • <i>Review literature (minimum 20 journals)</i> • <i>Identify the originality of all reviewed journals</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Ciri originalitas • Metode dalam mengembangkan ilmu melalui penelitian • <i>Characteristics of originality</i> • <i>Methods in developing knowledge through research</i>	5% (CP-MK1) 5% (CP-MK2)

		<i>The accuracy of proposing hypotheses in research</i>				
3,4	Mahasiswa mampu menganalisis perkembangan keilmuan dalam bidang yang akan ditelitinya <i>Students are able to analyze scientific developments in the field to be researched</i>	- Ketajaman penggunaan konsep dalam menganalisis hasil penelitian dari peneliti lain - Ketrampilan dalam mendemonstrasikan hasil kritikan, analisis terhadap subyek penelitian <i>Sharp use of concepts in analyzing research results from other researchers</i> <i>Skills in demonstrating the results of criticism, analysis of research subjects</i>	Tugas 2: Penyusunan makalah tentang Studi kajian pengembangan keilmuan dalam bidang yang diteliti <i>Task 2: Compilation of papers on the study of scientific development studies in the researched field</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Pengumpulan data dan informasi hasil penelitian dari peneliti lain. - Tool untuk membuat data base hasil penelitian dari peneliti lain. - Contoh-contoh hasil analisis perkembangan keilmuan <i>Collecting data and information on research results from other researchers.</i> <i>Tool to create a data base of research results from other researchers.</i> <i>Examples of the results of scientific development analysis</i>	5% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)
5,6,7	Mahasiswa mampu menjelaskan state of the art dari penelitian nya <i>Students are able to explain the</i>	- Ketrampilan dalam menentukan state of the art dari sebuah penelitian <i>Skills in determining the state of the art of a research</i>	Tugas 3: Penyusunan makalah untuk mengorganisasikan dalam bentuk pola / sekuense konsep / metode / teori dan / atau dalam perkembangan teknologi sebagai tool dalam penyelesaian masalah di lapangan	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Observasi saintifik - Observasi perkembangan teknologi dalam bidang rekayasa instrumentasi dan rekayasa energi - Ciri-ciri Kreativitas dalam redesain atau	5% (CP-MK1) 5% (CP-MK2) 5% (CP-MK3)

	<i>state of the art from their research</i>		- Penyusunan ppt hasil tugas 3, dengan didukung oleh literatur terkini (5 tahun terakhir) <i>Task 3:</i> <i>Preparation of papers to organize in the form of patterns / sequences of concepts / methods / theories and / or in technological developments as a tool in solving problems in the field</i> <i>Preparation of ppt results of assignment 3, supported by the latest literature (last 5 years)</i>		perkembangan teknologi - Hubungan antara sains, teknologi dan inovasi <i>Scientific observations</i> <i>Observation of technological developments in the field of instrumentation engineering and energy engineering</i> <i>Characteristics of Creativity in redesign or technological development</i> <i>The relationship between science, technology and innovation</i>	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK2) 10% (CP-MK3) 5% (CP-MK4)
9,10,11	Mahasiswa mampu menggunakan tahapan penelitian untuk mendukung pelaksanaan penelitian yang bersifat original	- Ketepatan dalam penggunaan argumen setiap tahap penelitian yang diusulkan <i>Accuracy in the use of arguments at each stage of the proposed research</i>	Tugas 4: - Menyusun tahapan penelitian, dengan didukung oleh argumen konsep/teori / teknologi pada setiap tahapan penelitian (penggunaan literatur jurnal 5 tahun terkini) <i>Task 4:</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Penelitian eksperimen dan non eksperimen - Penelitian kualitatif dan kuantitatif - Tahapan dalam penelitian - Uji Hipotesa - Validitas Data	5% (CP-MK1) 5% (CP-MK3)

	<i>Students are able to use the stages of research to support the implementation of original research</i>		• <i>Develop research stages, supported by conceptual/theoretical/technology arguments at each stage of the research</i> • <i>(use of the latest 5 years of journal literature)</i>		• Penggunaan tool matematik dan statistik dalam penelitian • <i>Experimental and non-experimental research</i> • <i>Qualitative and quantitative research</i> • <i>Stages in research</i> • <i>Hypothesis Test</i> • <i>Data Validity</i> • <i>Use of mathematical and statistical tools in research</i>	
11,12,13	Mahasiswa mampu menuliskan luaran dari sebagian tahap penelitian dalam bentuk makalah seminar internasional <i>Students are able to explain the outcomes of some stages of research in the form of international seminar papers</i>	• Ketrampilan menyusun makalah untuk seminar internasional • Ketepatan penggunaan bahasa ilmiah • Ketelitian dalam menggunakan pustaka untuk cek plagiarisme • Kemampuan menggunakan etika ilmiah di dalam bentuk hasil tulisan dalam makalah • <i>Skills in preparing papers for international seminars</i> • <i>Accurate use of scientific language</i>	Tugas 5: Penyusunan draft paper untuk publikasi internasional <i>Task 5: Preparation of draft papers for international publications</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	• Plagiarisme • Bahasa Ilmiah • Tool untuk memeriksa plagiarisme • Praktek menggunakan tool untuk menghindari plagiarisme • <i>Plagiarism</i> • <i>Scientific Language</i> • <i>Tool to check plagiarism</i> • <i>Practice using tools to avoid plagiarism</i>	5% (CP-MK3) 5% (CP-MK4)

		• <i>Accuracy in using the library to check for plagiarism</i> • <i>Ability to use scientific ethics in the form of written results in papers</i>				
14-15	Mahasiswa mampu menuliskan luaran dari setiap tahap penelitian dalam bentuk draft jurnal <i>Students are able to explain the outputs of each stage of research in the form of a draft journal</i>	• Kemampuan menyajikan ide penelitian dalam bahasa ilmiah (standar jurnal) yang baik dan benar • <i>Ability to present research ideas in good and correct scientific language (journal standards)</i>	Non-test: Diskusi draft paper yang telah disusun <i>Non-test: Discussion of the draft paper that has been prepared</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Anatomi jurnal internasional • Teknik mencari publisher jurnal teindeks • Gaya selingkung • <i>Anatomy of international journals</i> • <i>Techniques for finding indexed journal publishers</i> • <i>Surround style</i>	-
16	Evaluasi Akhir Semester (ETS) <i>Final Examination</i>					10% (CP-MK3) 10% (CP-MK4)

Catatan :

Note

3. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTIRS ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	Metodologi Penelitian dan Proposal Tesis Research Methodology and Thesis Proposal		Edisi (<i>Edition</i>): Agt 2018 Aug 2018
Kode (<i>Code</i>): TF185271	Bobot sks (T/P): (3/0) Credits (T/P): (3/0)	Rumpun MK: Wajib Field of Specialization: compulsory	Smt: 2 Semester: 2
OTORISASI (<i>Authorization</i>)	Penyusun RA & E Contact Person – Assessment & Evaluation Plan Prof. Dr. Ir. Aulia S.A, MT	Koordinator RMK Field Coordinator Head of Master Program	Ka PRODI Head of Master Program Aulia M T Nasution

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (7)
1,2	Mahasiswa mampu menjelaskan ciri-ciri originalitas hasil penelitian <i>Students are able to explain the characteristics of the originality of research results</i>	Tugas 1: - Review literatur (minimal 20 jurnal) - Mengidentifikasi oroginalitas dari semua jurnal yang direview Task 1: <i>Literature review (minimum 20 journals)</i> <i>Identify the originality of all reviewed journals</i>	5%	5%		
3,4	Mahasiswa mampu menganalisis perkembangan keilmuan dalam bidang yang akan ditelitinya	Tugas 2: Penyusunan makalah tentang Studi kajian pengembangan keimuan dalam bidang yang diteliti	5%	5%	5%	

	<i>Students are able to analyze scientific developments in the field to be researched</i>	Task 2: <i>Preparation of papers on the study of scientific development studies in the researched field</i>				
5,6,7	Mahasiswa mampu menjelaskan state of the art dari penelitian nya <i>Students are able to explain the state of the art from their research</i>	Tugas 3: - Penyusunan makalah untuk mengorganisasikan dalam bentuk pola / sekuense konsep / metode / teori dan / atau dalam perkembangan teknologi sebagai tool dalam penyelesaian masalah di lapangan - Penyusunan ppt hasil tugas 3, dengan didukung oleh literatur terkini (5 tahun terakhir) Task 3: <i>Preparation of papers to organize in the form of patterns / sequences of concepts / methods / theories and / or in technological developments as a tool in solving problems in the field</i> <i>Preparation of ppt results of assignment 3, supported by the latest literature (last 5 years)</i>	5%	5%	5%	
8	Evaluasi Tengah Semester (ETS) Mid Term Examination			5%	10%	5%
9,10,11	Mahasiswa mampu menggunakan tahapan penelitian untuk mendukung pelaksanaan penelitian yang bersifat original <i>Students are able to use the stages of research to support the implementation of original research</i>	Tugas 4: - Menyusun tahapan penelitian, dengan didukung oleh argumen konsep/teori / teknologi pada setiap tahapan penelitian (penggunaan literatur jurnal 5 tahun terkini) Task 4: <i>Develop research stages, supported by conceptual/theoretical/technology arguments at each stage of the research</i> <i>(use of the latest 5 years of journal literature)</i>	5%		5%	
11,13	Mahasiswa mampu menuliskan luaran dari sebagian tahap penelitian dalam bentuk makalah seminar internasional	Tugas 5: Penyusunan draft paper untuk publikasi internasional			5%	5%

	<i>Students are able to explain the outcomes of some stages of research in the form of international seminar papers</i>	<i>Task 5: Preparation of draft papers for international publications</i>				
16	Evaluasi Akhir Semester dan Seminar proposal <i>Final Examination and Proposal Seminar</i>				10%	10%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			20%	20%	40%	20%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Kerja Praktek <i>Internship</i>		RP Edisi: Agt 2018 Edition: Aug 2018
Kode (Code): TF185371	Bobot sks (T/P)/ ECTS: (2/0) / 3.2 Credits (T/P)/ ECTS : (2/0)/ 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol dan Rekayasa Energi Terbarukan Field of Specialization: <i>Instrumentation and Control Engineering and Renewable Energy Engineering</i>	Smt: 2 Semester: 2
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Ridho Hantoro	Koordinator RMK Field Coordinator Dr. Ridho Hantoro	Ka PRODI Head of Master Program Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-3: Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (50%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i> CP-4: Mampu bekerja dalam tim interdisiplin dan multicultural sesuai dengan etika profesi. (30%) <i>Are able to work in an interdisciplinary and multicultural team within their professional ethics</i> CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (20%) <i>Are able to effectively communicate in both oral and written format</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	a. Mahasiswa mampu mengidentifikasi permasalahan sesuai aspek kasus internship (CP-3) (25%) <i>Students are able to identify problems according to the aspects of the internship case.</i>	

	b. Mahasiswa mampu membuat proposal internship. (CP-3)(CP-5) (25%) <i>Students are able make internship proposals.</i> c. Mahasiswa mampu memberikan solusi sesuai aspek kasus internship (CP-4) (25%) <i>Students are able to provide solutions according to the aspects of the internship case.</i> d. Mahasiswa mampu membuat laporan internship. (CP-3)(CP-5) (25%) <i>Students are able to make internship reports.</i>					
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini mempelajari tentang identifikasi permasalahan sesuai aspek kasus internship, pembuatan proposal internship, memberikan solusi sesuai aspek kasus internship, serta pembuatan laporan internship. <i>This course learns about identifying problems according to the internship case aspect, making internship proposals, providing solutions according to the internship case aspects, as well as making internship reports.</i>					
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Identifikasi permasalahan sesuai aspek kasus internship <i>Identification of problems according to the aspects of the internship case</i> 2. Penyusunan proposal internship <i>Preparation of internship proposals</i> 3. Solusi sesuai aspek kasus internship <i>Solutions according to the aspects of the internship case</i> 4. Penyusunan laporan internship <i>Preparation of internship reports</i>					
Pustaka <i>Reading Materials</i>	Utama:					
	Main					
	disesuaikan					
	Pendukung :					
	Supporting					
	disesuaikan					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak:			Perangkat keras :		
	Software			Hardware		
	disesuaikan			disesuaikan		
Team Teaching	Dr. Ridho Hantoro					
Matakuliah syarat	-					
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-2	Mahasiswa mampu mengidentifikasi	Ketepatan dalam mengidentifikasi	Penyusunan makalah tentang identifikasi	Kuliah Diskusi E-learning	Identifikasi permasalahan sesuai aspek kasus internship	25% (CPMK-1)

	permasalahan sesuai aspek kasus internship <i>Students are able to identify problems according to the aspects of the internship case. .</i>	permasalahan sesuai aspek kasus internship <i>Accuracy in identifying problems according to the aspects of the internship case</i>	permasalahan sesuai aspek kasus internship <i>Preparation of papers on identification of problems according to the aspects of the internship case</i>	• TM = 2 mg x 2 sks x 50' • BT = 2 mg x 2 sks x 60' • BM = 2 mg x 2 sks x 60'	<i>Identification of problems according to the aspects of the internship case</i>	
3-4	Mahasiswa mampu membuat proposal internship. <i>Students are able make internship proposals</i>	Kesesuaian proposal internship. <i>Suitability of the internship proposal.</i>	Penyusunan proposal internship. <i>Preparation of internship proposals.</i>	Kuliah Diskusi E-learning • TM = 2 mg x 2 sks x 50' • BT = 2 mg x 2 sks x 60' • BM = 2 mg x 2 sks x 60'	Penyusunan proposal internship <i>Preparation of internship proposals</i>	25% (CPMK-2)
5-7	Mahasiswa mampu memberikan solusi sesuai aspek kasus internship <i>Students are able to provide solutions according to the aspects of the internship case.</i>	Ketepatan dalam memberikan solusi sesuai aspek kasus internship <i>Accuracy in providing solutions according to the aspects of the internship case</i>	Penyusunan makalah tentang solusi sesuai aspek kasus internship <i>Preparation of papers on solutions according to the aspects of the internship case</i>	Kuliah Diskusi E-learning • TM = 2 mg x 2 sks x 50' • BT = 2 mg x 2 sks x 60' • BM = 2 mg x 2 sks x 60'	Solusi sesuai aspek kasus internship <i>Solutions according to the aspects of the internship case</i>	5% (CPMK-3)
8	Evaluasi Tengah Semester Mid Term Exam					
9-13	Mahasiswa mampu memberikan	Ketepatan dalam memberikan solusi	Penyusunan makalah tentang solusi sesuai aspek kasus internship	Kuliah Diskusi E-learning	Solusi sesuai aspek kasus internship	20% (CPMK-3)

	solusi sesuai aspek kasus internship <i>Students are able to provide solutions according to the aspects of the internship case.</i>	sesuai aspek kasus internship <i>Accuracy in providing solutions according to the aspects of the internship case</i>	<i>Preparation of papers on solutions according to the aspects of the internship case</i>	• TM = 5 mg x 2 sks x 50' • BT = 5 mg x 2 sks x 60' • BM = 5 mg x 2 sks x 60'	<i>Solutions according to the aspects of the internship case</i>	
14-15	Mahasiswa mampu membuat laporan internship <i>Students are able to make internship reports.</i>	Kesesuaian laporan internship. <i>Suitability of the internship report.</i>	Penyusunan laporan internship. <i>Preparation of internship reports.</i>	Kuliah Diskusi E-learning • TM = 2 mg x 2 sks x 50' • BT = 2 mg x 2 sks x 60' • BM = 2 mg x 2 sks x 60'	Penyusunan laporan internship <i>Preparation of internship reports</i>	25% (CPMK-4)
16	Evaluasi Akhir Semester <i>Final Exam</i>					

Catatan :

4. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			RA&E
	Kerja Praktek Internship			Edisi: Agt 2018 Edition: Aug 2018
Kode (Code): TF185371	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol dan Rekayasa Energi Terbarukan Field of Specialization: Instrumentation and Control Engineering and Renewable Energy Engineering	Smt: 2 Semester: 2	
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Ridho Hantoro	Koordinator RMK Field Coordinator Dr. Ridho Hantoro	Ka PRODI Head of Master Program Dr. Ridho Hantoro	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (7)
1-2	Mahasiswa mampu mengidentifikasi permasalahan sesuai aspek kasus internship <i>Students are able to identify problems according to the aspects of the internship case. .</i>	Penyusunan makalah tentang identifikasi permasalahan sesuai aspek kasus internship <i>Preparation of papers on identification of problems according to the aspects of the internship case</i>	25%			
3-4	Mahasiswa mampu membuat proposal internship. <i>Students are able make internship proposals</i>	Penyusunan proposal internship. <i>Preparation of internship proposals.</i>		25%		
5-7	Mahasiswa mampu memberikan solusi sesuai aspek kasus internship	Penyusunan makalah tentang solusi sesuai aspek kasus internship			5%	

	<i>Students are able to provide solutions according to the aspects of the internship case.</i>	<i>Preparation of papers on solutions according to the aspects of the internship case</i>				
8	Evaluasi Tengah Semester <i>Mid Term Exam</i>					
9-13	Mahasiswa mampu memberikan solusi sesuai aspek kasus internship <i>Students are able to provide solutions according to the aspects of the internship case.</i>	Penyusunan makalah tentang solusi sesuai aspek kasus internship <i>Preparation of papers on solutions according to the aspects of the internship case</i>			20%	
14-15	Mahasiswa mampu membuat laporan internship <i>Students are able to make internship reports.</i>	Penyusunan laporan internship. <i>Preparation of internship reports.</i>				25%
16	Evaluasi Akhir <i>Final Exam</i>					
Total bobot penilaian			25%	25%	25%	25%

Compulsory Courses (Instrumentation Engineering)

TF185104 RPS RAE Dinamika Sistem Lanjut (*Advanced Dynamic Systems*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Dinamika Sistem Lanjut <i>Advanced Dynamic Systems</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185104	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 1 <i>Semester: 1</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Purwadi Agus Darwito	Koordinator RMK <i>Field Coordinator</i> Dr. Rony Dwi Noriyati	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-1 Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (50%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems.</i> CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (25%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (25%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i>	

	CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu menjelaskan tentang dinamika sebuah sistem dan memodelkannya dalam bentuk persamaan matematis (CP-1, CP-2) (50%) <i>Students are able to explain the dynamics of a system and model it in the form of mathematical equations.</i> 2. Mahasiswa mampu menganalisa bentuk model matematis dari dinamika suatu sistem fisis dalam domain waktu. (CP-2) 25% <i>Students are able to analyze the form of a mathematical model of the dynamics of a physical system in the time domain.</i> 3. Mahasiswa menganalisa respon dinamik suatu sistem fisis dalam domain waktu dan frekuensi serta menyusun dalam bentuk fungsi transfer dan ruang keadaan (CP-3) 25% <i>Students analyze the dynamic response of a physical system in the time and frequency domains and arrange them in the form of a transfer function and state space.</i>
Diskripsi Singkat MK Course Description	Kuliah ini memberikan dasar-dasar pemodelan matematis suatu sistem fisis, serta analisa perilaku dinamikanya. Berbagai contoh sistem dinamik dalam berbagai masalah keteknikan akan digunakan sebagai contoh bahan kajian. <i>This course provides the basics of mathematical modeling of a physical system, as well as analysis of its dynamic behavior. Various examples of dynamic systems in various engineering problems will be used as examples of study material</i>	
Pokok Bahasan / Bahan Kajian Module content	1. Pemodelan sistem mekanik 2. Pemodelan sistem elektrik 3. Pemodelan dengan fungsi transfer 4. Pemodelan sistem termal, dan radiasi, 5. Pemodelan sistem proses, 6. Pemodelan dinamika sistem linier dan non linier, 7. Pemodean dengan ruang keadaan, dan 8. Respon sistem dalam domain waktu dan domain frekuensi. 1. <i>Mechanical system modeling</i> 2. <i>Electrical system modeling</i> 3. <i>Modeling with transfer function</i> 4. <i>Thermal system modeling, and radiation,</i> 5. <i>Process system modeling,</i> 6. <i>Modeling of linear and non-linear system dynamics,</i> 7. <i>Modeling with state space, and</i> 8. <i>System response in time domain and frequency domain.</i>	
Pustaka	Utama:	

Reading Materials		Main				
		1. Harold Klee., Simulation of Dynamic System with MATLAB and Simulink, CRC Press. 2. Malin, T.E., Proses Control, Design Process, and Control System for Dynamic Performance 3. Baba & Haranon, McGrawHill 2000.Process Dynamics : Modelling and Control, McGraw Hill 1992				
		Pendukung: Supporting				
Media Pembelajaran Learning Media		Perangkat lunak: Software			Perangkat keras: Hardware	
		-			Private Computer	
Tim Pengajar Team Teaching		Dr. Purwadi Agus Darwito; Dr Katherin Indriawati; Dr Bambang L. Widjiantoro				
Matakuliah syarat Entry requirement		-			Bahasa pengantar: Languages	Bahasa Indonesia Indonesian
Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessm ent point (%) (7)
1-2	Mahasiswa mampu menjelaskan tentang dinamika sebuah sistem mekanik dan elektrik serta memodelkannya dalam bentuk persamaan matematis. Students are able to explain the dynamics of a mechanical and electrical system and model it in the	Ketepatan menjelaskan tentang dinamika sebuah sistem mekanik dan elektrik serta memodelkannya dalam bentuk persamaan matematis. Accuracy explains the dynamics of a mechanical and electrical system and models it in the form of mathematical equations	TUGAS 1: Mahasiswa melakukan pemodelan matematis dari sistem mekanik dan elektrik dari lingkungan sekitar. ASSIGNMENT 1: Students perform mathematical modeling of mechanical and electrical systems from the surrounding environment.	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Pemodelan sistem mekanik 2. Pemodelan sistem elektrik 1. Mechanical system modeling 2. Electrical system modeling	5% (CP-MK1)

	<i>form of mathematical equations.</i>					
3	Mahasiswa mampu memformulasikan dinamika sebuah sistem mekanik dan elektrik menggunakan fungsi transfer. <i>Students are able to formulate the dynamics of a mechanical and electrical system using the transfer function</i>	Ketepatan memformulasikan dinamika sebuah sistem mekanik dan elektrik menggunakan fungsi transfer <i>Accurately formulate the dynamics of a mechanical and electrical system using the transfer function</i>	TUGAS 2: Mahasiswa melakukan desain fungsi transfer dari sistem fisis yang didapatkan dari lingkungan sekitar dan mengamati respon sistem tersebut dengan MATLAB <i>ASSIGNMENT 2: Students design the transfer function of a physical system obtained from the surrounding environment and observe the response of the system with MATLAB</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Pemodelan fungsi transfer <i>Transfer function modelling</i>	10% (CP-MK1) 2.5% (CP-MK2)
4-7	Mahasiswa mampu menjelaskan tentang dinamika sebuah sistem termal, radiasi dan proses industri serta memodelkannya dalam bentuk persamaan matematis. <i>Students are able to explain the dynamics of a thermal system, radiation and industrial processes and model them in the form of mathematical equations</i>	Ketepatan menjelaskan tentang dinamika sebuah sistem termal, radiasi dan proses industri serta memodelkannya dalam bentuk persamaan matematis. <i>The accuracy of explaining the dynamics of a thermal system, radiation and industrial processes and modeling them in the form of mathematical equations</i>	TUGAS 3: 1. Membahas fenomena fisis dari sistem termal, radiasi dan proses 2. Mahasiswa mencari dan memformulasikan model dinamis sistem termal, radiasi dan proses serta menyusun dalam bentuk fungsi transfer <i>ASSIGNMENT 3: 1. Discuss the physical phenomena of thermal</i>	Kuliah dan diskusi [TM: 4x(2x50'')] [BT: 4x(2x60'')] [BM: 4x(2x60'')]	1. Pemodelan sistem termal 2. Pemodelan sistem radiasi 3. Pemodelan sistem proses <i>1. Thermal system modeling 2. Radiation system modeling 3. Process system modeling</i>	10% (CP-MK1) 2.5% (CP-MK2)

			<i>systems, radiation and processes</i> 2. <i>Students search for and formulate dynamic models of thermal systems, radiation and processes and arrange them in the form of transfer functions.</i>			
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					15% (CP-MK1) 10% (CP-MK2)
9,10	Mahasiswa mampu menjelaskan tentang dinamika sebuah sistem linier dan non-linier serta memodelkannya dalam bentuk persamaan matematis. <i>Students are able to explain the dynamics of a linear and non-linear system and model it in the form of mathematical equations</i>	Ketepatan menjelaskan tentang dinamika sebuah sistem linier dan non-linier serta memodelkannya dalam bentuk persamaan matematis. <i>Accuracy describes the dynamics of a linear and non-linear system and models it in the form of a mathematical equation</i>	TUGAS 4: Mahasiswa mencari dan menurunkan persamaan sistem linier dan non-linier dari jurnal / konferensi internasional <i>ASSIGNMENT 4: Students find and derive equations of linear and non-linear systems from international journals/conferences.</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Pemodelan dinamika sistem linier dan non linier <i>Modeling of linear and non-linear system dynamics</i>	5% (CP-MK1) 2.5% (CP-MK2) 5% (CP-MK3)
11-13	Mahasiswa mampu memformulasikan dinamika sebuah sistem dari mekanik hingga proses menggunakan persamaan ruang keadaan	Ketepatan memformulasikan dinamika sebuah sistem dari mekanik hingga proses menggunakan persamaan ruang keadaan <i>Accurately formulate dynamics of a system from mechanics to</i>	TUGAS BESAR: Mahasiswa mencari model dinamik sistem dari jurnal kemudian mendesain dalam state-space dan fungsi transfer serta menganalisa respon dari sistem tersebut	Kuliah, brainstorming dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Pemodean ruang keadaan <i>State-space modelling</i>	5% (CP-MK1) 2.5% (CP-MK2) 5% (CP-MK3)

	<i>Students are able to formulate the dynamics of a system from mechanics to processes using state space equations</i>	<i>processes using state space equations</i>	<i>FINAL PROJECT: Students look for system dynamics models from journals then design in state-space and transfer functions and analyze the response of the system sistem</i>			
14-15	Mahasiswa mampu menganalisa respon sistem dalam domain waktu dan domain frekuensi <i>Students are able to analyze system response in time domain and frequency domain</i>	Ketepatan menganalisa respon sistem dalam domain waktu dan domain frekuensi <i>Accurately analyze system response in time domain and frequency domain</i>	TUGAS 5: Mahasiswa presentasi dari hasil review suatu sistem dalam domain waktu dan frekuensi <i>ASSIGNMENT 5: Students presenting the results of a system review in the time and frequency domains</i>	Kuliah, brainstorming, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Respon sistem dalam domain waktu dan domain frekuensi. <i>System response in time domain and frequency domain..</i>	2.5% (CP-MK2) 10% (CP-MK3)
16	Evaluasi Akhir Semester <i>Final Examination</i>					2.5% (CP-MK2) 5% (CP-MK3)

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			RA&E	
	Dinamika Sistem Lanjut Advanced Dynamic Systems			Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>	
Kode (<i>Code</i>): TF185104	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: <i>Instrumentation Engineering</i>	Smt: 1 <i>Semester: 1</i>		
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Dr. Purwadi Agus Darwito	Koordinator RMK Field Coordinator Dr. Rony Dwi Noriyati	Ka PRODI Head of Master Program Aulia M T Nasution		

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)
1,2	Mahasiswa mampu menjelaskan tentang dinamika sebuah sistem mekanik dan elektrik serta memodelkannya dalam bentuk persamaan matematis. <i>Students are able to explain the dynamics of a mechanical and electrical system and model it in the form of mathematical equations.</i>	TUGAS 1: Mahasiswa melakukan pemodelan matematis dari sistem mekanik dan elektrik dari lingkungan sekitar. <i>ASSIGNMENT 1:</i> <i>Students perform mathematical modeling of mechanical and electrical systems from the surrounding environment.</i>	5%		
3	Mahasiswa mampu memformulasikan dinamika sebuah sistem mekanik dan elektrik menggunakan fungsi transfer.	TUGAS 2:	10%	2.5%	

	<i>Students are able to formulate the dynamics of a mechanical and electrical system using the transfer function</i>	Mahasiswa melakukan desain fungsi transfer dari sistem fisis yang didapatkan dari lingkungan sekitar dan mengamati respon sistem tersebut dengan MATLAB <i>ASSIGNMENT 2:</i> <i>Students design the transfer function of a physical system obtained from the surrounding environment and observe the response of the system with MATLAB</i>			
4-7	Mahasiswa mampu menjelaskan tentang dinamika sebuah sistem termal, radiasi dan proses industri serta memodelkannya dalam bentuk persamaan matematis. <i>Students are able to explain the dynamics of a thermal system, radiation and industrial processes and model them in the form of mathematical equations</i>	TUGAS 3: 3. Membahas fenomena fisis dari sistem termal, radiasi dan proses 4. Mahasiswa mencari dan memformulasikan model dinamis sistem termal, radiasi dan proses serta menyusun dalam bentuk fungsi transfer <i>ASSIGNMENT 3:</i> <i>3. Discuss the physical phenomena of thermal systems, radiation and processes</i> <i>4. Students search for and formulate dynamic models of thermal systems, radiation and processes and arrange them in the form of transfer functions.</i>	10%	2.5%	
8			15%	10%	
9,10	Mahasiswa mampu menjelaskan tentang dinamika sebuah sistem linier dan non-linier serta memodelkannya dalam bentuk persamaan matematis. <i>Students are able to explain the dynamics of a linear and non-linear system and model it in the form of mathematical equations</i>	TUGAS 4: Mahasiswa mencari dan menurunkan persamaan sistem linier dan non-linier dari jurnal / konferensi internasional <i>ASSIGNMENT 4:</i> <i>Students find and derive equations of linear and non-linear systems from international journals/conferences.</i>	5%	2.5%	5%
11-13	Mahasiswa mampu memformulasikan dinamika sebuah sistem dari mekanik hingga proses menggunakan persamaan ruang keadaan	TUGAS BESAR: Mahasiswa mencari model dinamik sistem dari jurnal kemudian mendesain dalam state-space dan fungsi transfer serta menganalisa respon dari sistem tersebut	5%	2.5%	5%

	<i>Students are able to formulate the dynamics of a system from mechanics to processes using state space equations</i>	<i>FINAL PROJECT: Students look for system dynamics models from journals then design in state-space and transfer functions and analyze the response of the system sistem</i>			
14-15	Mahasiswa mampu menganalisa respon sistem dalam domain waktu dan domain frekuensi <i>Students are able to analyze system response in time domain and frequency domain</i>	TUGAS 5: Mehasiswa presentasi dari hasil review suatu sistem dalam domain waktu dan frekuensi <i>ASSIGNMENT 5: 1. Students presenting the results of a system review in the time and frequency domains</i>		2.5%	10%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)			2.5%	5%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			50%	25%	25%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Instrumentasi Lanjut <i>Advanced Instrumentation</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185103	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 1 <i>Semester: 1</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Ir. Ali Musyafa'	Koordinator RMK <i>Field Coordinator</i> Dr. Rony Dwi Noriyati	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-1 Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems.</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (25%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (50%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i>	

	CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu menjelaskan tentang Sistem instrumentasi untuk monitoring, pengamanan, dan pengendalian (CP-1) (12.5%) <i>Students are able to explain about the instrumentation system for monitoring, security, and control.</i> 2. Mahasiswa mampu menganalisa Sistem instrumentasi monitoring, pengamanan dan pengendalian untuk: level, <i>pressure</i>, temperatur, dan flow. (CP-1, CP-2) 25% <i>Students are able to analyze monitoring, security and control instrumentation systems for: level, pressure, temperature, and flow.</i> 3. Mahasiswa mampu menganalisa sensor dan transmitter konvensional, soft sensor, dan transmitter smart dan intelligent untuk: level, pressure, temperature dan flow. (CP-2, CP-3) 25% <i>Students are able to analyze conventional sensors and transmitters, soft sensors, and smart and intelligent transmitters for: level, pressure, temperature and flow</i> 4. Mahasiswa mampu menganalisa soft sensor berdasar model Neural Network, serta smart and intelligent transmitter (CP-3) 37.5% <i>Students are able to analyze soft sensors based on Neural Network models, as well as smart and intelligent transmitters</i>
Diskripsi Singkat MK Course Description	Kuliah ini membahas tentang teknologi instrumentasi pada sistem otomasi proses industri yaitu, membahas perkembangan terkini instrumentasi di industri: teknologi otomasi proses dan metodologi pengontrolan: elemen – elemen pendukung sistem otomasi proses: pengukuran besaran-besaran industri serta teknologi sensor dan transmitter: perangkat lunak dan perangkat keras sistem otomasi proses: prosedur desain dan rekayasa sistem pada otomasi industri: Aplikasi-aplikasi instrumentasi pada otomasi proses industri. <i>This lecture discusses instrumentation technology in industrial process automation systems, namely, discussing the latest developments of instrumentation in industry: process automation technology and control methodologies: supporting elements of process automation systems: measuring industrial quantities and sensor and transmitter technology: software and devices process automation systems: design and systems engineering procedures in industrial automation: instrumentation applications in industrial process automation</i>	
Pokok Bahasan / Bahan Kajian Module content	1. Sistem instrumentasi untuk monitoring, pengamanan, dan pengendalian 2. Sistem instrumentasi monitoring, pengamanan dan pengendalian untuk: level, <i>pressure</i>, temperatur, dan flow 3. Sensor konvensional dan soft sensor untuk: level, <i>pressure</i>, <i>temperature</i> dan flow 4. Transmitter konvensional, transmitter smart dan intelligent untuk: level, pressure, temperature dan flow 5. Soft sensor berdasar model Neural Network, serta smart and intelligent transmitter. 1. <i>Instrumentation system for monitoring, security, and control</i> 2. <i>Monitoring, security and control instrumentation system for: level, pressure, temperature, and flow</i> 3. <i>Conventional sensors and soft sensors for: level, pressure, temperature and flow</i> 4. <i>Conventional transmitter, smart and intelligent transmitter for: level, pressure, temperature and flow</i>	

	5. <i>Soft sensors based on the Neural Network model, as well as smart and intelligent transmitters.</i>					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	1. Measurement, Instrumentation, and Sensors Handbook CRCnetBase 1999					
	Pendukung: <i>Supporting</i>					
	1. Center for Chemical Process Safety “Layer of Protection Analysis”, SIMPLIFIED PROCESS RISK ASSESSMENT, New York, New York 10016-5991, 2001 2. Dominique Placko , “Fundamentals of Instrumentation and Measurement” ISTE Ltd, 2007 3. Francis Rouessac and Annick Rouessac “Modern Instrumentation Methods and Techniques” by John Wiley & Sons Ltd, 2007. 4. Gregory K. McMillan, Douglas M. Considine “PROCESS / INDUSTRIAL INSTRUMENTS AND CONTROLS HANDBOOK”, Mc GRAW-HILL, 1999					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>		
	-			<i>Private Computer</i>		
Tim Pengajar <i>Team Teaching</i>	Dr. Ir. Ali Musyafa’; Dr Katherin Indriawati; Dr Bambang L. Widjiantoro					
Matakuliah syarat <i>Entry requirement</i>	-			Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>	
Mg Ke-Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessm ent point (%) (7)
1	Mahasiswa mampu menjelaskan tentang Sistim instrumen di Industri <i>Students are able to explain about instrument systems in industry</i>	Ketepatan menjelaskan dengan benar tentang sistem: <i>monitoring</i> , pengamanan, dan pengendalian di industri. <i>Accuracy explains correctly about the system: monitoring, security, and control in the industry</i>	TUGAS 1: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim : monitoring, pengamanan, dan pengendalian di industri. <i>ASSIGNMENT 1:</i>	SCL (Kuliah dan diskusi) [TM: 1x(2x50’)] [BT: 1x(2x60’)] [BM: 1x(2x60’)]	1. Sistim instrumentasi untuk monitoring 2. Sitim instrumentasi untuk pengamanan 3. Sistim instrumentasi untuk pengendalian 1. <i>Instrumentation system for monitoring</i>	2.5% (CP-MK1)

			<i>Students compile papers from journal literature regarding systems: monitoring, security, and control in industry</i>		2. <i>Instrumentation system for security</i> 3. <i>Instrumentation system for control</i>	
2-3	Mahasiswa mampu menjelaskan sistim instrumentasi monitoring di Industri. <i>Students are able to explain the monitoring instrumentation system in Industry.</i>	Ketepatan menjelaskan sistim instrumentasi monitoring secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen <i>Accuracy in explaining the monitoring instrumentation system in detail, both in the form of block diagrams and the working principle of each component</i>	TUGAS 2: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim instrumentasi monitoring secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen <i>ASSIGNMENT 2: Students compile papers from journal literature regarding monitoring instrumentation systems in detail, both in the form of block diagrams and the working principle of each component</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Sistim instrumentasi monitoring untuk: level, <i>pressure</i> , temperatur, dan flow <i>Monitoring instrumentation system for: level, pressure, temperature, and flow</i>	5% (CP-MK2)
4-5	Mahasiswa mampu menjelaskan sistim instrumentasi pengamanan (<i>safety</i>) di industri. <i>Students are able to explain the security instrumentation system (safety) in industr</i>	Ketepatan menjelaskan sistim instrumentasi pengamanan (<i>safety</i>) secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen. <i>Accuracy in explaining the safety instrumentation system in detail, both in the form of</i>	TUGAS 3: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim instrumentasi pengamanan (<i>safety</i>) secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen	Kuliah dan diskusi [TM: 4x(2x50'')] [BT: 4x(2x60'')] [BM: 4x(2x60'')]	Sistim instrumentasi pengamanan (<i>safety</i>) untuk: level, <i>pressure</i> , <i>temperature</i> , dan flow <i>Safety instrumentation system for: level, pressure, temperature, and flow</i>	5% (CP-MK2)

		<i>block diagrams and the working principle of each component.</i>	<i>ASSIGNMENT 3: Students compile papers from journal literature regarding safety instrumentation systems in detail, both in the form of block diagrams and the working principle of each component</i>			
6-7	Mahasiswa mampu menjelaskan sistim instrumentasi pengendalian di industri. <i>Students are able to explain control instrumentation systems in industry.</i>	Ketepatan menjelaskan sistim instrumentasi pengendalian secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen. <i>Accuracy describes the control instrumentation system in detail, both in the form of block diagrams and the working principle of each component.</i>	TUGAS 4: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim instrumentasi pengendalian secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen <i>ASSIGNMENT 4: Students compile papers from journal literature regarding control instrumentation systems in detail, both in the form of block diagrams and the working principle of each component</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Sistim instrumentasi pengendalian untuk: level, pressure, temperature, dan flow <i>Control instrumentation system for: level, pressure, temperature, and flow</i>	5% (CP-MK2)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					10% (CP-MK1) 10% (CP-MK2)

9,10	Mahasiswa mampu menjelaskan tentang sensor konvensional dan soft-sensor <i>Students are able to explain about conventional sensors and soft sensors</i>	Ketepatan menjelaskan tentang teknologi sensor konvensional dan soft sensor <i>Accuracy explains about conventional sensor technology and soft sensor</i>	TUGAS 5: Mahasiswa menyusun makalah dari literatur jurnal mengenai teknologi sensor konvensional dan soft sensor. <i>ASSIGNMENT 5: Students compile papers from journal literature regarding conventional sensor technology and soft sensors.</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Sensor konvensional dan soft sensor untuk: level, <i>pressure</i>, <i>temperature</i> dan flow <i>Conventional sensors and soft sensors for: level, pressure, temperature and flow</i>	5% (CP-MK3) 7.5% (CP-MK4)
11-13	Mahasiswa mampu menjelaskan tentang transmitter konvensional, transmitter smart and intelligent transmitter <i>Students are able to explain about conventional transmitters, smart transmitters and intelligent transmitters</i>	Ketepatan menjelaskan dan menganalisa tentang teknologi transmitter konvensional, transmitter smart dan intelligent <i>Accuracy in explaining and analyzing conventional transmitter technology, smart and intelligent transmitters</i>	TUGAS 6: Mahasiswa menyusun makalah dari literatur jurnal mengenai teknologi transmitter konvensional, transmitter smart dan intelligent <i>ASSIGNMENT 6: Students compile papers from journal literature regarding conventional transmitter technology, smart and intelligent transmitters</i>	Kuliah, brainstorming dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Transmitter konvensional, transmitter smart dan intelligent untuk: level, pressure, temperature dan flow <i>Conventional transmitter, smart and intelligent transmitter for: level, pressure, temperature and flow</i>	5% (CP-MK3) 7.5% (CP-MK4)
14-15	Mahasiswa mampu merancang soft sensor, smart and intelligent transmitter	Ketepatan menganalisa dan menjelaskan tentang arsitektur dan metode pembelajaran dalam Neural Network serta metodologi perancangan smart and intelligent transmitter	TUGAS 7: Mahasiswa menyusun makalah dari literatur jurnal mengenai arsitektur dan metode pembelajaran dalam Neural Network	Kuliah, brainstorming, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Soft sensor berdasar model Neural Network. - Smart and intelligent transmitter.	5% (CP-MK3) 7.5% (CP-MK4)

	<i>Students are able to design soft sensors, smart and intelligent transmitters</i>	<i>Accuracy in analyzing and explaining the architecture and learning methods in Neural Networks as well as the design methodology of smart and intelligent transmitters</i>	metodologi perancangan smart and intelligent transmitter <i>ASSIGNMENT 7: Students compile papers from journal literature regarding architecture and learning methods in the Neural Network smart and intelligent transmitter design methodology</i>		1. <i>Soft sensor based on Neural Network model.</i> 2. <i>Smart and intelligent transmitters.</i>	
16	Evaluasi Akhir Semester <i>Final Examination</i>					10% (CP-MK3) 15% (CP-MK4)

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			RA&E		
	Instrumentasi Lanjut Advanced Instrumentation			Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>		
Kode (<i>Code</i>): TF185103	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: <i>Instrumentation Engineering</i>	Smt: 1 <i>Semester: 1</i>			
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Dr. Ir. Ali Musyafa’	Koordinator RMK Field Coordinator Dr. Rony Dwi Noriyati	Ka PRODI Head of Master Program Aulia M T Nasution			

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1	Mahasiswa mampu menjelaskan tentang Sistim instrumen di Industri <i>Students are able to explain about instrument systems in industry</i>	TUGAS 1: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim : monitoring, pengamanan, dan pengendalian di industri. <i>ASSIGNMENT 1:</i> <i>Students compile papers from journal literature regarding systems: monitoring, security, and control in industry</i>	2.5%			
2,3	Mahasiswa mampu menjelaskan sistim instrumentasi monitoring di Industri.	TUGAS 2: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim instrumentasi monitoring secara detail.		5%		

	<i>Students are able to explain the monitoring instrumentation system in Industry.</i>	baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen <i>ASSIGNMENT 2:</i> <i>Students compile papers from journal literature regarding monitoring instrumentation systems in detail, both in the form of block diagrams and the working principle of each component</i>				
4,5	Mahasiswa mampu menjelaskan sistim instrumentasi pengamanan (<i>safety</i>) di industri. <i>Students are able to explain the security instrumentation system (safety) in industr</i>	TUGAS 3: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim instrumentasi pengamanan (<i>safety</i>) secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen <i>ASSIGNMENT 3:</i> <i>Students compile papers from journal literature regarding safety instrumentation systems in detail, both in the form of block diagrams and the working principle of each component</i>		5%		
6,7	Mahasiswa mampu menjelaskan sistim instrumentasi pengendalian di industri. <i>Students are able to explain control instrumentation systems in industry.</i>	TUGAS 4: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistim instrumentasi pengendalian secara detail, baik dalam bentuk diagram blok dan prinsip kerja masing-masing komponen <i>ASSIGNMENT 4:</i> <i>Students compile papers from journal literature regarding control instrumentation systems in detail, both in the form of block diagrams and the working principle of each component</i>		5%		
8			10%	10%		
9,10	Mahasiswa mampu menjelaskan tentang sensor konvensional dan soft-sensor	TUGAS 5:			5%	7.5%

	<i>Students are able to explain about conventional sensors and soft sensors</i>	Mahasiswa menyusun makalah dari literatur jurnal mengenai teknologi sensor konvensional dan soft sensor. <i>ASSIGNMENT 5:</i> <i>Students compile papers from journal literature regarding conventional sensor technology and soft sensors.</i>				
11-13	Mahasiswa mampu menjelaskan tentang transmitter konvensional , transmitter smart and intelegent transmitter <i>Students are able to explain about conventional transmitters, smart transmitters and intelligent transmitters</i>	TUGAS 6: Mahasiswa menyusun makalah dari literatur jurnal mengenai teknologi transmitter konvensional, transmitter smart dan intelligent <i>ASSIGNMENT 6:</i> <i>Students compile papers from journal literature regarding conventional transmitter technology, smart and intelligent transmitters</i>			5%	7.5%
14-15	Mahasiswa mampu merancang soft sensor, smart and intelligent transmitter <i>Students are able to design soft sensors, smart and intelligent transmitters</i>	TUGAS 7: Mahasiswa menyusun makalah dari literatur jurnal mengenai arsitektur dan metode pembelajaran dalam Neural Network metodologi perancangan smart and intelligent transmitter <i>ASSIGNMENT 7:</i> <i>Students compile papers from journal literature regarding architecture and learning methods in the Neural Network smart and intelligent transmitter design methodology</i>			5%	7.5%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)				10%	15%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			12.5%	25%	25%	37.5%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Kontrol Otomatik Lanjut <i>Advanced Automatic Control</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185201	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 2 <i>Semester: 2</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Prof Dr. Ir. Aulia Siti Aisjah	Koordinator RMK <i>Field Coordinator</i> Dr. Rony Dwi Noriyati	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (25%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (25%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i>	
	CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (12.5%) <i>Are able to effectively communicate in both oral and written format.</i>	
	CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%)	

	<i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i> <table border="1" data-bbox="436 295 705 395"> <tr> <td data-bbox="436 295 705 395"> CP-MK Course Learning Outcome (CLO) </td><td data-bbox="705 295 2114 853"> 1. Mahasiswa mampu menjelaskan dan menganalisa berbagai sistem kontrol mulai dari konvensional hingga modern (CP-1) (25%) <i>Students are able to explain and analyze various control systems ranging from conventional to modern</i> 2. Mahasiswa mampu merumuskan dari referensi dan mengimplementasikan berbagai sistem kontrol mulai dari konvensional hingga modern (CP-1, CP-2) 25% <i>Students are able to formulate from references and implement various control systems ranging from conventional to modern</i> 3. Mahasiswa mampu mempresentasikan dalam bentuk lisan dan tulisan mengenai aplikasi penggunaan sistem kontrol mulai dari konvensional hingga modern. (CP-3) 12.5% <i>Students are able to present in oral and written form regarding applications using control systems ranging from conventional to modern hingga</i> 4. Mahasiswa mampu merumuskan aplikasi sistem kontrol dalam hubungannya dengan industri yang diharapkan dapat memberikan rekomendasi skenario sistem kontrol terbaik dalam sistem tertentu (CP-4) 37.5% <i>Students are able to formulate control system applications in relation to industry which are expected to provide recommendations for the best control system scenarios in certain systems</i> </td></tr> </table>	CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu menjelaskan dan menganalisa berbagai sistem kontrol mulai dari konvensional hingga modern (CP-1) (25%) <i>Students are able to explain and analyze various control systems ranging from conventional to modern</i> 2. Mahasiswa mampu merumuskan dari referensi dan mengimplementasikan berbagai sistem kontrol mulai dari konvensional hingga modern (CP-1, CP-2) 25% <i>Students are able to formulate from references and implement various control systems ranging from conventional to modern</i> 3. Mahasiswa mampu mempresentasikan dalam bentuk lisan dan tulisan mengenai aplikasi penggunaan sistem kontrol mulai dari konvensional hingga modern. (CP-3) 12.5% <i>Students are able to present in oral and written form regarding applications using control systems ranging from conventional to modern hingga</i> 4. Mahasiswa mampu merumuskan aplikasi sistem kontrol dalam hubungannya dengan industri yang diharapkan dapat memberikan rekomendasi skenario sistem kontrol terbaik dalam sistem tertentu (CP-4) 37.5% <i>Students are able to formulate control system applications in relation to industry which are expected to provide recommendations for the best control system scenarios in certain systems</i>
CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu menjelaskan dan menganalisa berbagai sistem kontrol mulai dari konvensional hingga modern (CP-1) (25%) <i>Students are able to explain and analyze various control systems ranging from conventional to modern</i> 2. Mahasiswa mampu merumuskan dari referensi dan mengimplementasikan berbagai sistem kontrol mulai dari konvensional hingga modern (CP-1, CP-2) 25% <i>Students are able to formulate from references and implement various control systems ranging from conventional to modern</i> 3. Mahasiswa mampu mempresentasikan dalam bentuk lisan dan tulisan mengenai aplikasi penggunaan sistem kontrol mulai dari konvensional hingga modern. (CP-3) 12.5% <i>Students are able to present in oral and written form regarding applications using control systems ranging from conventional to modern hingga</i> 4. Mahasiswa mampu merumuskan aplikasi sistem kontrol dalam hubungannya dengan industri yang diharapkan dapat memberikan rekomendasi skenario sistem kontrol terbaik dalam sistem tertentu (CP-4) 37.5% <i>Students are able to formulate control system applications in relation to industry which are expected to provide recommendations for the best control system scenarios in certain systems</i>		
Diskripsi Singkat MK Course Description	Mata kuliah ini memberikan konsep dalam perancangan sistem kontrol otomatis terkini yang banyak diimplementasikan di industri proses dan industri manufaktur. <i>This course provides concepts in the design of the latest automatic control systems which are widely implemented in the process industry and manufacturing industry.</i>		
Pokok Bahasan / Bahan Kajian Module content	1. Persamaan plant dalam ruang keadaan; 2. Sifat plant – controllable dan observable; 3. Pengendali modern dan optimal (LQR, LQG/LTR, H^∞), 4. Pengendali robust dan pengendali Adaptif, 5. Pengendali MPC – Model Predictive Control, 6. Pengendali berbasis pada kepakaran; serta Analisis respon dalam domain frekuensi 1. <i>Equation of the plant in the state space;</i> 2. <i>Plant properties – controllable and observable;</i> 3. <i>Modern and optimized controller (LQR, LQG/LTR, H^∞),</i>		

	4. <i>Robust controller and Adaptive controller,</i> 5. <i>MPC Controller – Model Predictive Control,</i> 6. <i>Expert-based controllers; and Analysis of the response in the frequency domain</i>					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	1. Modul ajar Kontrol Otomatik Lanjut (share.its.ac.id), Aulia siti aisjah, 2017 2. Optimal Control System, Richard C. Dorf, 2003 3. Robust Process Control: Morari, Manfred; Evangelos, Zafriou; 1989 4. Model Predictive Control: Rossiter, 2005 5. Robust Control design with Matlab: Grimbl, Michael; Johnson, Michael; 2003					
	Pendukung: <i>Supporting</i>		1. Adaptive Control: Introduction, Overview, and Applications: Lavretsky, Eugene; 2. International Journal/conference related to control			
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>		
	-			Private Computer		
Tim Pengajar <i>Team Teaching</i>	Prof Dr. Ir. Aulia Siti Aisjah; Dr Katherin Indriawati; Dr Bambang L. Widjiantoro					
Matakuliah syarat <i>Entry requirement</i>	-			Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>	
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessment point</i> (%) (7)
1-2	Mahasiswa mampu menjelaskan tentang model plant linier dan non linier	Ketepatan variabel dan parameter pada model matematis dalam bentuk persamaan keadaan.	TUGAS 1: Penyusunan makalah, berisi materi tentang:	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Persamaan plant dalam ruang keadaan. 2. Sifat plant – controllable dan observable	2.5% (CP-MK1) 2.5% (CP-MK2)

	dalam bentuk persamaan keadaan <i>Students are able to explain about linear and non-linear plant models in the form of equations of state</i>	▪ Ketepatan menentukan (menghitung) sifat dari plant dalam bentuk persamaan keadaan. ▪ <i>The accuracy of the variables and parameters in the mathematical model in the form of equations of state.</i> ▪ <i>The accuracy of determining (calculated) the properties of the plant in the form of an equation of state.</i>	1. Ketepatan variabel dan parameter pada model matematis dalam bentuk persamaan keadaan. 2. Ketepatan menentukan (menghitung) sifat dari plant dalam bentuk persamaan keadaan <i>ASSIGNMENT 1: Create papers, containing material on:</i> 1. <i>The accuracy of the variables and parameters in the mathematical model in the form of equations of state.</i> 2. <i>The accuracy of determining (calculating) the properties of the plant in the form of an equation of state</i>		1. <i>Equation of the plant in the state space.</i> 2. <i>Plant properties – controllable and observable</i>	5% (CP-MK4)
3	Mahasiswa mampu menjelaskan konsep sistem kendali loop tertutup pada plant <i>Students are able to explain the concept of a closed loop control system in a plant</i>	▪ Ketepatan unsur-unsur yang dijelaskan dalam sistem kendali tertutup. ▪ Ketepatan penjelasan fungsi dari setiap komponen pada sistem kendali tertutup.	TUGAS 2: Penyusunan makalah, berisi materi tentang: 1. Ketepatan unsur-unsur yang dijelaskan dalam sistem kendali tertutup.	Kuliah dan diskusi [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	1. Sistem Pengendalian Tertutup. 2. Komponen dalam sistem pengendalian tertutup. <i>1. Closed Control System. 2. Components in a closed control system.</i>	2.5% (CP-MK1) 2.5% (CP-MK2) 5% (CP-MK4)

		▪ Keterampilan dalam mempresentasikan beberapa sistem kendali tertutup pada plant di industri dalam bentuk ppt, konten ppt, dan bahasa komunikasi yang baik ▪ <i>The accuracy of the elements described in the closed control system.</i> ▪ <i>Accurate explanation of the function of each component in a closed control system.</i> ▪ <i>Skill in presenting several closed control systems at industrial plants in ppt form, ppt content, and good communication language</i>	2. Ketepatan penjelasan fungsi dari setiap komponen pada sistem kendali tertutup. 3. Keterampilan dalam mempresentasikan beberapa sistem kendali tertutup pada plant di industri dalam bentuk ppt, konten ppt, dan bahasa komunikasi yang baik <i>ASSIGNMENT 2: Create papers, containing material on:</i> 1. <i>The accuracy of the elements described in the closed control system.</i> 2. <i>The accuracy of the explanation of the function of each component in a closed control system.</i> 3. <i>Skills in presenting several closed control systems at industrial plants in the form of ppt, ppt content, and good communication language</i>			
--	--	---	---	--	--	--

4-7	Mahasiswa mampu membedakan berbagai metode dalam perancangan pengendali pada plant. <i>Students are able to distinguish various methods in the design of plant controllers.</i>	▪ Ketepatan penjelasan tentang metode pengendali modern. ▪ Ketepatan tentang penjelasan tahapan / prosedur dalam desain. ▪ Ketepatan dalam membedakan beberapa metode pengendali modern (minimal 5 metode) ▪ <i>Accuracy of explanation of modern control methods.</i> ▪ <i>The accuracy of the explanation of the stages / procedures in the design.</i> ▪ <i>Accuracy in differentiating several control methods</i>	TUGAS 3: Penyusunan makalah, berisi materi tentang: 1. Ketepatan penjelasan tentang metode pengendali modern. 2. Ketepatan tentang penjelasan tahapan / prosedur dalam desain. 3. Ketepatan dalam membedakan beberapa metode pengendali modern (minimal 5 metode) <i>ASSIGNMENT 3: Create papers, containing material on:</i> 1. <i>Accuracy of explanation of modern control methods.</i> 2. <i>The accuracy of the explanation of the stages / procedures in the design.</i> 3. <i>Accuracy in distinguishing several modern control methods (minimum 5 methods)</i>	Kuliah dan diskusi [TM: 4x(2x50'')] [BT: 4x(2x60'')] [BM: 4x(2x60'')]	Pengendali modern: 1. Pengendali optimal (LQR, LQG/LTR, H~) 2. Pengendali robust 3. Pengendali Adaptif <i>Modern controllers:</i> 1. <i>Optimal controller (LQR, LQG/LTR, H~)</i> 2. <i>Robust controller</i> 3. <i>Adaptive Controller</i>	2.5% (CP-MK1) 2.5% (CP-MK2) 5% (CP-MK4)	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>						10% (CP-MK1)

						10% (CP-MK2)
9-11	Mahasiswa mampu merancang dengan tahapan yang benar, salah satu metode kendali modern <i>Students are able to design with the correct stages, one of the modern control methods</i>	▪ Ketepatan dalam membuat algoritma perancangan sistem pengendalian. ▪ Ketepatan dalam menentukan parameter dalam sistem kendali. ▪ Ketrampilan menggunakan software Matlab sebagai alat bantu rancangan. ▪ <i>Accuracy in making control system design algorithms.</i> ▪ <i>Accuracy in determining the parameters in the control system.</i> ▪ <i>Ability to use Matlab software as a design tool bantu</i>	TUGAS 4: Penyusunan makalah, berisi materi tentang: 1. Ketepatan dalam membuat algoritma perancangan sistem pengendalian. 2. Ketepatan dalam menentukan parameter dalam sistem kendali. 3. Ketrampilan menggunakan software Matlab sebagai alat bantu rancangan. <i>ASSIGNMENT 4: Create papers, containing material on:</i> 1. <i>Accuracy in making control system design algorithms.</i> 2. <i>Accuracy in determining the parameters in the control system.</i> 3. <i>Skills in using Matlab software as a design tool.</i>	Kuliah, brainstorming dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Pengendali modern: 1. Pengendali MPC – Model Predictive Control 2. Pengendali berbasis pada kepakaran <i>Modern controllers:</i> 1. <i>MPC Controller – Model Predictive Control</i> 2. <i>Expert-based controller</i>	2.5% (CP-MK1) 2.5% (CP-MK2) 2.5% (CP-MK3) 5% (CP-MK4)

12-13	Mahasiswa mampu menganalisis performansi hasil sistem rancangan kendali pada plant <i>Students are able to analyze the performance of the control design system results on the plant</i>	▪ Ketajaman dalam menganalisis respon sebuah sistem kendali. ▪ Ketepatan menggunakan konsep yang dipilih dalam analisis. ▪ Ketepatan penjelasan ciri-ciri performansi dalam domain waktu dan frekuensi. ▪ <i>Sharpness in analyzing the response of a control system.</i> ▪ <i>The accuracy of using the selected concept in the analysis.</i> ▪ <i>Accurate description of performance characteristics in time and frequency domains.</i>	TUGAS 5: Penyusunan makalah, berisi materi tentang: 1. Ketajaman dalam menganalisis respon sebuah sistem kendali. 2. Ketepatan menggunakan konsep yang dipilih dalam analisis. 3. Ketepatan penjelasan ciri-ciri performansi dalam domain waktu dan frekuensi. <i>ASSIGNMENT 5: Create papers, containing material on:</i> 1. <i>Sharpness in analyzing the response of a control system.</i> 2. <i>The accuracy of using the chosen concept in the analysis.</i> 3. <i>Accuracy of explanation of performance characteristics in time and frequency domains.</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Ess, Time settling, time constant, rise time, max. overshott 2. Respon Domain frekuensi (Bode plot, Nyquist) <i>1. Ess, Time settling, time constant, rise time, max. overshott</i> <i>2. Frequency Domain Response (Bode plot, Nyquist)</i>	2.5% (CP-MK1) 2.5% (CP-MK2) 2.5% (CP-MK3) 5% (CP-MK4)
14-15	Mahasiswa mampu merancang pada plant yang	▪ Ketepatan mengidentifikasi sebuah model non liner.	TUGAS 6:	Kuliah, brainstorming, presentasi dan diskusi	Nonlinier system	2.5% (CP-MK1)

	bersifat non linier dengan metode kendali modern <i>Students are able to design non-linear plants with modern control methods</i>	- Ketepatan merumuskan model plant nonlinier dalam bentuk persamaan fungsi transfer dan persamaan keadaan. <i>The accuracy of identifying a non-linear model.</i> <i>The accuracy of formulating a nonlinear plant model in the form of transfer function equations and equations of state.</i>	Penyusunan makalah, berisi materi tentang: - Ketepatan mengidentifikasi sebuah model non liner. - Ketepatan merumuskan model plant nonlinier dalam bentuk persamaan fungsi transfer dan persamaan keadaan <i>ASSIGNMENT 6: Create papers, containing material on:</i> <i>The accuracy of identifying a non-linear model.</i> <i>The accuracy of formulating a nonlinear plant model in the form of transfer function equations and equations of state</i>	[TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	<i>Nonlinear system</i>	2.5% (CP-MK2) 2.5% (CP-MK3) 5% (CP-MK4)
16	Evaluasi Akhir Semester <i>Final Examination</i>					7.5% (CP-MK4)

Catatan :

Note

- Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			RA&E		
	Kontrol Otomatik Lanjut Advanced Automatic Control			Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>		
Kode (<i>Code</i>): TF185201	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: <i>Instrumentation Engineering</i>		Smt: 2 <i>Semester: 2</i>		
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Prof Dr. Ir. Aulia Siti Aisjah	Koordinator RMK Field Coordinator Dr. Rony Dwi Noriyati		Ka PRODI Head of Master Program Aulia M T Nasution		

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1,2	Mahasiswa mampu menjelaskan tentang model plant linier dan non linier dalam bentuk persamaan keadaan <i>Students are able to explain about linear and non-linear plant models in the form of equations of state</i>	TUGAS 1: Penyusunan makalah, berisi materi tentang: 1. Ketepatan variabel dan parameter pada model matematis dalam bentuk persamaan keadaan. 2. Ketepatan menentukan (menghitung) sifat dari plant dalam bentuk persamaan keadaan <i>ASSIGNMENT 1:</i> <i>Create papers, containing material on:</i> 1. <i>The accuracy of the variables and parameters in the mathematical model in the form of equations of state.</i>	2.5%	2.5%		5%

		<i>2. The accuracy of determining (calculating) the properties of the plant in the form of an equation of state</i>				
3	Mahasiswa mampu menjelaskan konsep sistem kendali loop tertutup pada plant <i>Students are able to explain the concept of a closed loop control system in a plant</i>	TUGAS 2: Penyusunan makalah, berisi materi tentang: 1. Ketepatan unsur-unsur yang dijelaskan dalam sistem kendali tertutup. 2. Ketepatan penjelasan fungsi dari setiap komponen pada sistem kendali tertutup. 3. Ketrampilan dalam mempresentasikan beberapa sistem kendali tertutup pada plant di industri dalam bentuk ppt, konten ppt, dan bahasa komunikasi yang baik <i>ASSIGNMENT 2:</i> <i>Create papers, containing material on:</i> 1. <i>The accuracy of the elements described in the closed control system.</i> 2. <i>The accuracy of the explanation of the function of each component in a closed control system.</i> 3. <i>Skills in presenting several closed control systems at industrial plants in the form of ppt, ppt content, and good communication language</i>	2.5%	2.5%		5%
4-7	Mahasiswa mampu membedakan berbagai metode dalam perancangan pengendali pada plant. <i>Students are able to distinguish various methods in the design of plant controllers.</i>	TUGAS 3: Penyusunan makalah, berisi materi tentang: 1. Ketepatan penjelasan tentang metode pengendali modern. 2. Ketepatan tentang penjelasan tahapan / prosedur dalam desain. 3. Ketepatan dalam membedakan beberapa metode pengendali modern (minimal 5 metode) <i>ASSIGNMENT 3:</i> <i>Create papers, containing material on:</i> 1. <i>Accuracy of explanation of modern control methods.</i>	2.5%	2.5%		5%

		2. <i>The accuracy of the explanation of the stages / procedures in the design.</i> 3. <i>Accuracy in distinguishing several modern control methods (minimum 5 methods)</i>				
8			10%	10%		
9,11	Mahasiswa mampu merancang dengan tahapan yang benar, salah satu metode kendali modern <i>Students are able to design with the correct stages, one of the modern control methods</i>	TUGAS 4: Penyusunan makalah, berisi materi tentang: 1. Ketepatan dalam membuat algoritma perancangan sistem pengendalian. 2. Ketepatan dalam menentukan parameter dalam sistem kendali. 3. Ketrampilan menggunakan software Matlab sebagai alat bantu rancangan. <i>ASSIGNMENT 4:</i> <i>Create papers, containing material on:</i> 1. <i>Accuracy in making control system design algorithms.</i> 2. <i>Accuracy in determining the parameters in the control system.</i> 3. <i>Skills in using Matlab software as a design tool.</i>	2.5%	2.5%	2.5%	5%
12-13	Mahasiswa mampu menganalisis performansi hasil sistem rancangan kendali pada plant <i>Students are able to analyze the performance of the control design system results on the plant</i>	TUGAS 5: Penyusunan makalah, berisi materi tentang: 1. Ketajaman dalam menganalisis respon sebuah sistem kendali. 2. Ketepatan menggunakan konsep yang dipilih dalam analisis. 3. Ketepatan penjelasan ciri-ciri performansi dalam domain waktu dan frekuensi. <i>ASSIGNMENT 5:</i> <i>Create papers, containing material on:</i> 1. <i>Sharpness in analyzing the response of a control system.</i>	2.5%	2.5%	5%	5%

		2. <i>The accuracy of using the chosen concept in the analysis.</i> 3. <i>Accuracy of explanation of performance characteristics in time and frequency domains.</i>				
14-15	Mahasiswa mampu merancang pada plant yang bersifat non linier dengan metode kendali modern <i>Students are able to design non-linear plants with modern control methods</i>	TUGAS 6: Penyusunan makalah, berisi materi tentang: 1. Ketepatan mengidentifikasi sebuah model non liner. 2. Ketepatan merumuskan model plant nonlinier dalam bentuk persamaan fungsi transfer dan persamaan keadaan ASSIGNMENT 6: Create papers, containing material on: 1. <i>The accuracy of identifying a non-linear model.</i> 2. <i>The accuracy of formulating a nonlinear plant model in the form of transfer function equations and equations of state</i>	2.5%	2.5%	5%	5%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)					7.5%
Total Bobot Penilaian (%)			25%	25%	12.5%	37.5%
Total Point (%)						

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Optimisasi Sistem <i>System Optimization</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185202	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 2 <i>Semester: 2</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Totok Ruki Biyanto, S.T., M.T., Ph.D.	Koordinator RMK <i>Course Group Coordinator</i> Dr. Bambang Lelono Widjiantoro, S.T., M.T.	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems</i>
	CP-3: Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (35%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i>	CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (40%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i>
	CP-MK	

	Course Learning Outcome (CLO) a. Mahasiswa mampu memformulasikan permasalahan yang perlu dioptimisasi (CP-2) (CP-3) (25%) <i>Students are able to formulate problems that need to be optimized.</i> b. Mahasiswa mampu memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya. (CP-2) (CP-3) (25%) <i>Students are able to choose the appropriate/accurate model that represents both linear, nonlinear, integer and combination problems.</i> c. Mahasiswa mampu menyelesaikan permasalahan optimisasi menggunakan metode/teknik deterministik dan stokastik. (CP-3) (CP-6.I) (25%) <i>Students are able to solve optimization problems using deterministic and stochastic methods/techniques.</i> d. Mahasiswa mampu memecahkan kasus-kasus optimisasi (CP-6.I) (25%) <i>Students are able to solve optimization cases</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari tentang memformulasikan suatu permasalahan dengan menggunakan model yang akurat dan teknik optimisasi yang sesuai untuk mencari solusi terbaik dalam menyelesaikan permasalahan optimisasi. <i>This course studies about formulating a problem using accurate models and appropriate optimization techniques to find the best solution in solving optimization problems.</i>
Pokok Bahasan / Bahan Kajian Module content	1. Konsep dasar optimisasi: pengertian optimisasi, fungsi obyektif dan constraint, local dan global optimum dan teknik optimisasi. <i>Basic concepts of optimization: understanding of optimization, objective and constraint functions, local and global optimum and optimization techniques.</i> 2. Problem formulasi: fungsi objektif dan constraint. <i>Problem formulation: objective function and constraint.</i> 3. Model: Pemodelan sistem yang sesuai dan penentuan variabel yang dioptimisasi. <i>Model: Appropriate system modeling and optimization of variable determination.</i> 4. Menentukan kelas optimisasi: linier, nonlinier, integer, mixedinteger nonlinier dan mixedinteger linier. <i>Determine the optimization class: linear, nonlinear, integer, nonlinear mixed integer and linear mixed integer.</i> 5. Teknik optimisasi deterministik. dan pemecahan masalah. <i>Deterministic optimization techniques. and problem solving.</i> 6. Teknik optimisasi stokastik. dan pemecahan masalah <i>Stochastic optimization technique. and problem solving</i>
Pustaka Reading Materials	Utama: Main Rao S S, 'Optimization theory and applications', Wiley Eastern, 1987. Edgar T and Lasdon L, 'Optimization of chemical Processes', McGraw Hill, second edition, 2001. Corsano G, Montagna J, Iribarren O and Aguirre P, 'Mathematical Modeling Approaches for Optimization of Chemical Processes', NOVA Science Publisher, 2009. Pendukung : Supporting

		Deb K , 'Optimization for Engineering Design – Algorithms and Examples', Prentice Hall.				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak: <i>Software</i>		Perangkat keras : <i>Hardware</i>		
		Matlab		PC		
Team Teaching		Totok Ruki Biyanto, S.T., M.T., Ph.D., Dr. Bambang Lelono Widjiantoro, S.T., M.T.				
Matakuliah syarat		TF185103 Instrumentasi Lanjut <i>TF185103 Advanced Instrumentation</i>				
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-3	Mahasiswa mampu memformulasikan permasalahan yang perlu dioptimisasi <i>Students are able to formulate problems that need to be optimized.</i>	Ketepatan dalam memformulasikan permasalahan yang perlu dioptimisasi <i>Students are able to formulating problems that need to be optimized</i>	Penyusunan makalah, berisi materi: 1. Pengertian optimisasi, fungsi obyektif dan constraint, local dan global optimum dan teknik optimisasi. 2. Pengertian optimisasi, fungsi obyektif dan constraint, local dan global optimum dan teknik optimisasi. <i>Preparation of the paper, containing the following materials:</i> 1. Definition of optimization, objective and constraint functions, local and global optimum and optimization techniques. 2. Definition of optimization, objective and constraint functions, local and global	Kuliah Diskusi E-learning ● TM = 3 mg x 3 sks x 50' ● BT = 3 mg x 3 sks x 60' ● BM = 3 mg x 3 sks x 60'	● Konsep dasar optimisasi: pengertian optimisasi, fungsi obyektif dan <i>constraint</i> , <i>local</i> dan <i>global optimum</i> dan teknik optimisasi ● Problem formulasi: fungsi obyektif dan <i>constraint</i> ● <i>Basic concepts of optimization: understanding of optimization, objective and constraint functions, local and global optimum and optimization techniques</i> ● <i>Problem formulation: objective function and constraint</i>	10% (CPMK-1) 10% (CPMK-2)

			<i>optimum and optimization techniques.</i>			
4-7	Mahasiswa mampu memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Students are able to choose the appropriate/accurate model that represents both linear, nonlinear, integer and combination problems.</i>	Ketepatan dalam membuat model sistem yang sesuai dan penentuan variabel yang dioptimisasi <i>Students are able to create a suitable system model and determine the optimized variables</i>	Penyusunan makalah, berisi materi tentang pemodelan sistem yang sesuai dan penentuan variabel yang dioptimisasi. <i>Preparation of the paper, containing material on modeling the appropriate system and determining the optimized variables.</i>	Kuliah Diskusi E-learning ● TM = 4 mg x 3 sks x 50' ● BT = 4 mg x 3 sks x 60' ● BM = 4 mg x 3 sks x 60'	Model: Pemodelan sistem yang sesuai dan penentuan variabel yang dioptimisasi <i>Model: Appropriate system modeling and optimization of variable determination</i>	
8	Evaluasi Tengah Semester – Review aktifitas minggu ke 1 sd minggu ke 7 dan evaluasi hasil luaran <i>Mid Term Exam - Review the activities of the 1st week to the 7th week and evaluate the results</i>					10% (CPMK-1) 10% (CPMK-2)
9	Mahasiswa mampu memilih model yang sesuai/akurat yang merepresentasi	Ketepatan dalam menentukan kelas optimisasi	Penyusunan makalah, berisi materi tentang menentukan kelas optimisasi: linier, nonlinier, integer, mixed integer nonlinier dan mixedinteger linier.	Kuliah Diskusi E-learning ● TM = 1 mg x 3 sks x 50' ● BT = 1 mg x 3 sks x 60' ● BM = 1 mg x 3 sks x 60'	Menentukan kelas optimisasi: linier, nonlinier, integer, mixed integer nonlinier dan mixed integer linier	5% (CPMK-1) 5% (CPMK-2) 15% (CPMK-3) 15% (CPMK-4)

	kan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Students are able to choose the appropriate/accurate model that represents both linear, nonlinear, integer and combination problems.</i>	<i>Students are able to define optimization class</i>	<i>Preparation of the paper, contains material on determining the optimization class: linear, nonlinear, integer, mixed integer nonlinear and mixed integer linear.</i>		<i>Determine the optimization class: linear, nonlinear, integer, nonlinear mixed integer and linear mixed integer</i>	
10-12	Mahasiswa mampu menyelesaikan permasalahan optimisasi menggunakan metode/teknik deterministik dan stokastik. <i>Students are able to solve optimization problems using deterministic and stochastic methods/techniques</i>	Ketepatan dalam menyelesaikan permasalahan menggunakan teknik optimisasi deterministik <i>Students are able to solve problems using deterministic optimization techniques teknik</i>	Penyusunan makalah, berisi materi tentang teknik optimisasi deterministik dan pemecahan masalah. <i>Preparation of the paper, containing material on deterministic optimization techniques and problem solving.</i>	Kuliah Diskusi E-learning ● TM = 3 mg x 3 sks x 50' ● BT = 3 mg x 3 sks x 60' ● BM = 3 mg x 3 sks x 60'	Teknik optimisasi deterministik dan pemecahan masalah <i>Deterministic optimization techniques. and problem solving</i>	

13-15	Mahasiswa mampu memecahkan kasus-kasus optimisasi <i>Students are able to solve optimization cases</i>	Ketepatan dalam menyelesaikan permasalahan menggunakan teknik optimisasi stokastik <i>Students are able to solve problems using stochastic optimization techniques teknik</i>	Penyusunan makalah, berisi materi Teknik optimisasi stokastik dan pemecahan masalah. <i>Preparation of the paper, containing material on stochastic optimization techniques and problem solving.</i>	Kuliah Diskusi E-learning • TM = 3 mg x 3 sks x 50' • BT = 3 mg x 3 sks x 60' • BM = 3 mg x 3 sks x 60'	Teknik optimisasi stokastik dan pemecahan masalah <i>Stochastic optimization technique. and problem solving</i>	
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam - Review the activities of the 9th week to the 15th week and evaluate the results</i>					10% (CPMK-3) 10% (CPMK-4)

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Optimisasi Sistem System Optimization		RA&E
			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185202	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: <i>Instrumentation and Control Engineering</i>	Smt: 2 <i>Semester: 2</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Totok Ruki Biyanto, S.T., M.T., Ph.D.	Koordinator RMK Field Coordinator Dr. Bambang Lelono Widjiantoro, S.T., M.T.	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (4)	Bobot CP-MK4 (5)
1-3	Mahasiswa mampu memformulasikan permasalahan yang perlu dioptimisasi <i>Students are able to formulate problems that need to be optimized.</i>	Non-Tes: Penyusunan makalah tentang aplikasi process safety management serta employee participation. Preparation of papers on the application of process safety management and employee participation Presentasi Assignment Presentation	5%	5%		
4-7	Mahasiswa mampu memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya	Non-Tes: Penyusunan makalah tentang kajian Process Safety Information serta Process Hazard Analysis.	5%	5%		

	<i>Students are able to choose the appropriate/accurate model that represents both linear, nonlinear, integer and combination problems</i>	<i>Preparation of papers on the study of Process Safety Information and Process Hazard Analysis</i> Presentasi <i>Assignment Presentation</i>				
8	Evaluasi Tengah Semester <i>Mid Term Exam</i>	Review Aktivitas Minggu ke 1 sd Minggu ke 7 dan evaluasi hasil luaran <i>Review the activities of the 1st week to the 7th week and evaluate the results</i>	10%	10%		
9-10	Mahasiswa mampu memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Students are able to choose the appropriate/accurate model that represents both linear, nonlinear, integer and combination problems.</i>	Penyusunan makalah, berisi materi tentang menentukan kelas optimisasi: linier, nonlinier, integer, mixed integer nonlinier dan mixedinteger linier. <i>Preparation of the paper, contains material on determining the optimization class: linear, nonlinear, integer, mixed integer nonlinear and mixed integer linear.</i>	5%	5%		
11-12	Mahasiswa mampu menyelesaikan permasalahan optimisasi menggunakan metode/teknik deterministik dan stokastik. <i>Students are able to solve optimization problems using deterministic and stochastic methods/techniques</i>	Penyusunan makalah, berisi materi tentang teknik optimisasi deterministik dan pemecahan masalah. <i>Preparation of the paper, containing material on deterministic optimization techniques and problem solving.</i>			7.5%	7.5%
13-15	Mahasiswa mampu memecahkan kasus-kasus optimisasi <i>Students are able to solve optimization cases</i>	Penyusunan makalah, berisi materi Teknik optimisasi stokastik dan pemecahan masalah. <i>Preparation of the paper, containing material on stochastic optimization techniques and problem solving.</i>			7.5%	7.5%
16	Evaluasi Akhir <i>Final Exam</i>	Review Aktivitas Minggu ke 9 sd Minggu ke 15 dan evaluasi hasil luaran <i>Review the activities of the 9th week to the 15th week and evaluate the results</i>			10%	10%
Total bobot penilaian			25%	25%	25%	25%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS</i>			RP
	Pemrosesan Sinyal <i>Signal Processing</i>			Edisi: Agt 2018
Kode (<i>Code</i>): TF18503	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Photonics Engineering</i>	Smt: 2 <i>Semester: 2</i>	
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Dhany Arifianto	Koordinator RMK <i>Field Coordinator</i> Dr. Dhany Arifianto	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan kerekayasaan dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu (25%) <i>PLO-2 Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian (50%) <i>PLO-3 Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data.</i> CP-6. Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (25%) <i>PLO-6 Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i> CP-MK CPMK 1 Mahasiswa mampu menerapkan konsep dasar pengolahan sinyal (CP2) 10% <i>Students are able to apply the basic concepts of signal processing</i>			

	CPMK 2 Mahasiswa mampu menerapkan penapisan/pemfilteran adaptif sinyal digital (CP-2, CP-3) 10% <i>Students are able to apply digital signal adaptive filtering</i> CPMK 3 Mahasiswa mampu menerapkan sparse sampling dan sparse filter (CP3, CP6) 40% <i>Students are able to apply sparse sampling and filters</i> CPMK 4 Mahasiswa mampu menggunakan perangkat lunak untuk mensimulasikan pemrosesan sinyal pada sistem LTI (CP3, CP6) 40% <i>Students are able to use software to simulate signal processing in LTI systems</i>	
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini mempelajari teknik Sparse Sampling/Compressive Sensing, Machine Learning, Ultra-Wideband Modulation. <i>In this course, Student study the techniques of Sparse Sampling/Compressive Sensing, Machine Learning, Ultra-Wideband Modulation</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	Dalam Matakuliah ini mahasiswa akan mempelajari pokok bahasan-pokok bahasan sebagai berikut: 1. Pengantar sinyal: Konvolusi dan Fourier Transform 2. Pengantar systems: Sparse Matrices, Norm, Orthogonal & Orthonormal 3. Sparse Sampling: Nyquist Sampling rate, Finite Rate of Innovation, Donoho-Candes-Tao Sampling 4. Inverse Problem 5. Filter Adaptif : Sparse Filter 6. Inverse Problem <i>In this course, students will study the following topics:</i> 1. <i>Introduction to signals: Convolution and Fourier Transform</i> 2. <i>Introduction to systems: Sparse Matrices, Norm, Orthogonal & Orthonormal</i> 3. <i>Sparse Sampling: Nyquist Sampling rate, Finite Rate of Innovation, Donoho-Candes-Tao Sampling</i> 4. <i>Inverse Problem</i> 5. <i>Adaptive Filter : Sparse Filter</i>	
Pustaka <i>Reading Materials</i>	Utama:	1. Stephane Mallat, "A Wavelet Tour of Signal Processing The Sparse Way, 3Ed.", Academic Press, 2009. 2. AY Carmi, LS. Mihaylova, SJ. Godsill, "Compressed Sensing & Sparse Filtering", Springer, 2014. 3. YC. Eldar & G. Kutyniok, "Compressed Sensing : Theory and Applications", Cambridge University Press, 2012.
	Pendukung :	IEEE trans Signal Processing, Eurasip Signal Processing : relevant journal articles
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak :	Perangkat keras :
	Matlab, Labview	DAQ Board, PC & LCD Projector
Tim Pengajar <i>Team Teaching</i>	Dhany Arifianto	
Matakuliah syarat <i>Prerequisite courses</i>	Identifikasi Sistem, <i>System Identification</i> Matematika Teknik Lanjut, <i>Advanced Engineering Mathematics</i>	

Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode / Strategi Pembelajaran (5)	Materi Pembelajaran (6)	Bobot Penilaian (%) (7)
1	Mampu menggunakan operator konvolusi pada sinyal kontinu dan diskrit <i>Able to use convolution operators on continuous and discrete signals</i>	Ketepatan menggunakan konvolusi diskrit secara kognitif dan secara algoritma <i>Appropriateness in using discrete convolution cognitively and algorithmically</i> Ketepatan menggunakan konvolusi kontinu secara kognitif dan secara algoritma <i>Appropriateness in using continuous convolution cognitively and algorithmically</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a short paper</i> TUGAS 1: Mahasiswa melakukan review tentang konvolusi <i>ASSIGNMENT 1: Students review the convolution principle</i>	SCL (Kuliah dan diskusi) [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Konvolusi Diskrit Konvolusi Kontinu <i>Discrete Convolution Continuous Convolution</i>	10% (CPMK1)
2-3	Mampu menerapkan Transformasi Fourier pada analisis sinyal pada sistem LTI <i>Able to apply Fourier transform to signal analysis on LTI system</i>	Ketepatan dalam menurunkan transformasi Fourier dan transformasi Fourier balik <i>Appropriateness in applying Fourier transform and inverse Fourier transform</i> Kemampuan desain algoritma FT & IFT	Non-test: Penulisan makalah singkat <i>Non-test: Writing a short paper</i> TUGAS 2: Mahasiswa menerapkan transformasi fourier untuk beberapa kasus pemrosesan sinyal. <i>ASSIGNMENT 2:</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Fungsi Transformasi Fourier dan Transformasi Balik Prinsip Orthogonalitas Transformasi Fourier Diskrit <i>Fourier Transform and Inverse Transform Functions Principle of Orthogonality Discrete Fourier Transform</i>	10% (CPMK2)

		<i>FT & IFT algorithm design capability</i>	<i>Students apply Fourier transforms to some signal processing cases</i>			
4-5	Mampu menerapkan prinsip dasar norm, orthogonalitas dan orthonormalitas dan sparse matrices <i>Able to apply the basic principles of norm, orthogonality and orthonormality and sparse matrices</i>	Ketepatan menggunakan aljabar matriks dan algoritma <i>Appropriateness in applying matrix algebra and algorithms</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a short paper</i> TUGAS 3: Mahasiswa menerapkan menerapkan prinsip dasar norm, orthogonalitas dan orthonormalitas dan sparse matrices pada suatu kasus pemrosesan sinyal <i>ASSIGNMENT 3: Students apply the basic principles of norm, orthogonality and orthonormality and sparse matrices in a signal processing case</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Orthogonalitas dan Orthonormalitas Norm Basis Function Frames <i>Orthogonality and Orthonormality norm Base Function Frames</i>	10% (CPMK3) 10% (CPMK4)
6-9	Mampu menerapkan teknik sparse sampling <i>Able to apply sparse sampling technique</i>	Ketepatan dalam menurunkan ekspansi dan dekomposisi dengan fungsi basis dan redundant dictionary <i>Appropriateness in applying expansion and decomposition with basis functions and redundant dictionaries</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a short paper</i> TUGAS 4: Mahasiswa menerapkan menerapkan menerapkan teknik sparse sampling pada suatu kasus pemrosesan sinyal	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Overcomplete Sampling Aliasing Sparsity <i>Overcomplete Sampling Aliasing sparsity</i>	10% (CPMK3) 10% (CPMK4)

			<i>ASSIGNMENT 4: Students apply applying sparse sampling technique to a signal processing case</i>			
10-13	Mampu menerapkan inverse problem dan blind source separation <i>Able to apply Compressed Sensing to digital filters/filters</i>	Ketepatan dalam aplikasi inverse problems dan blind source separation <i>Appropriateness in applying inverse problems and blind source separation</i>	TUGAS 5: Mahasiswa menerapkan menerapkan inerse problem dan BSS <i>ASSIGNMENT 5: Students apply the inverse problem and BSSS</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Inverse Problem Blind Source Separation <i>Inverse Problem Blind Source Separation</i>	10% (CPMK3) 10% (CPMK4)
14-16	Mampu menerapkan Sparse Sampling <i>Able to apply Sparse Sampling</i>	Ketepatan dalam penerapan strategi sparse sampling <i>Appropriateness in Spare Sampling</i> Kesesuaian desain untuk pengambilan data (ADC/DAC) <i>Design suitability for data retrieval (ADC/DAC)</i>	TUGAS 6: Mahasiswa menerapkan metode Sparse Sampling <i>ASSIGNMENT 6: Students apply the Sparse Sampling method</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Frekuensi Sampling Nyquist Criterion OFDM <i>Sampling Frequency Nyquist Criterion OFDM</i>	10% (CPMK3) 10% (CPMK4)

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS		RA&E
	Pemrosesan Sinyal <i>Signal Processing</i>		Edisi: Agt 2018
Kode (Code): TF18503	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: <i>Photonics Engineering</i>	Smt: 2 <i>Semester: 2</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Dhany Arifianto	Koordinator RMK Field Coordinator Dr. Dhany Arifianto	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub Capaian Pembelajaran (2)	Bentuk Asesmen /Penilaian (3)	Bobot CPMK1 (4)	Bobot CPMK2 (5)	Bobot CPMK3 (6)	Bobot CPMK (7)
1	Mampu menggunakan operator konvolusi pada sinyal kontinyu dan diskrit <i>Able to use convolution operators on continuous and discrete signals</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a short paper</i> TUGAS 1: Mahasiswa melakukan review tentang konvolusi <i>ASSIGNMENT 1: Students review the convolution principle</i>	10%			
2-3	Mampu menerapkan Transformasi Fourier pada analisis sinyal pada sistem LTI	Non-test: Penulisan makalah singkat		10%		

	<i>Able to apply Fourier transform to signal analysis on LTI system</i>	<i>Non-test:</i> <i>Writing a short paper</i> TUGAS 2: Mahasiswa menerapkan transformasi fourier untuk beberapa kasus pemrosesan sinyal. <i>ASSIGNMENT 2:</i> <i>Students apply Fourier transforms to some signal processing cases</i>				
4-5	Mampu menerapkan prinsip dasar norm, orthogonalitas dan orthonormalitas dan sparse matrices <i>Able to apply the basic principles of norm, orthogonality and orthonormality and sparse matrices</i>	Non-test: Penulisan makalah singkat <i>Non-test:</i> <i>Writing a short paper</i> TUGAS 3: Mahasiswa menerapkan menerapkan prinsip dasar norm, orthogonalitas dan orthonormalitas dan sparse matrices pada suatu kasus pemrosesan sinyal <i>ASSIGNMENT 3:</i> <i>Students apply the basic principles of norm, orthogonality and orthonormality and sparse matrices in a signal processing case</i>			10%	10%
6-9	Mampu menerapkan teknik sparse sampling <i>Able to apply sparse sampling technique</i>	Non-test: Penulisan makalah singkat <i>Non-test:</i> <i>Writing a short paper</i> TUGAS 4: Mahasiswa menerapkan menerapkan menerapkan teknik sparse sampling pada suatu kasus pemrosesan sinyal <i>ASSIGNMENT 4:</i>			10%	10%

		<i>Students apply applying sparse sampling technique to a signal processing case</i>				
10-13	Mampu menerapkan inverse problem dan blind source separation <i>Able to apply Compressed Sensing to digital filters/filters</i>	TUGAS 5: Mahasiswa menerapkan menerapkan inerse problem dan BSS <i>ASSIGNMENT 5: Students apply the inverse problem and BSSS</i>			10%	10%
14-16	Mampu menerapkan Sparse Sampling <i>Able to apply Sparse Sampling</i>	TUGAS 5: Mahasiswa menerapkan metode Sparse Sampling <i>ASSIGNMENT 5: Students apply the Sparse Sampling method</i>			10%	10%
Total			10%	10%	40%	40%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Rekayasa Desain <i>Design Engineering</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185301	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Totok Ruki Biyanto, PhD	Koordinator RMK <i>Field Coordinator</i> Dr. Rony Dwi Noriyati	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-1 Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems</i> CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (50%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (25%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i>	

	CP-MK Course Learning Outcome (CLO) 1. Mampu menjelaskan tahapan-tahapan penting dalam suatu proses rekayasa desain dan aspek-aspek penting yang perlu dielaborasikan dalam setiap pentahapannya. (CP-1) (12.5%) <i>Students are able to explain the important stages in a design engineering process and important aspects that need to be elaborated in each stage</i> 2. Mampu mengidentifikasi serta mendeskripsikan detail dari berbagai persyaratan yang dibutuhkan suatu produk, serta mengelaborasikannya dalam suatu draft rancangan Spesifikasi Desain dari Produk. (CP-1, CP-3) (25%) <i>Students are able to identify and describe the details of the various requirements needed for a product, and elaborate it in a draft of the Design Specifications of the Product</i> 3. Mampu merancang tahapan proses desain suatu produk baru, atau perbaikan desain dari suatu existing design yang memerlukan penyempurnaan. (CP-3) (25%) <i>Students are able to design stages of the design process of a new product, or design improvement of an existing design that requires improvement</i> 4. Mampu memilih dan menggunakan metode, konsep, serta tools desain yang sesuai dengan karakteristik rancangan desain yang akan diselesaikannya, serta menentukan berbagai tahapan pengujian yang diperlukan untuk menguji rancangan desain yang dihasilkan, serta mengidentifikasi permasalahan yang muncul dalam rancangan desainnya untuk dilakukan proses penyempurnaan selanjutnya. (CP-3, CP-6) (25%) <i>Students are able to choose and use methods, concepts, and design tools that are in accordance with the characteristics of the design design that will be completed, as well as determine the various stages of testing required to test the resulting design, as well as identify problems that arise in the design design for further refinement processes.</i> 5. Mampu menginternalisasi proses kreatif dan imajinatif, mengkomunikasikan gagasan desainnya dengan baik kepada tim, kemampuan manajemen ide serta elaborasi berbagai ide untuk menghasilkan konsep rancangan desain terbaik, serta mempresentasikan blueprint dari rancangan desain yang dihasilkan untuk meyakinkan pendengarnya akan keunggulan dari rancangan desain yang dihasilkannya. (CP-6) (12.5%) <i>Students are able to internalize creative and imaginative processes, communicate design ideas well to the team, idea management skills and elaboration of various ideas to produce the best design concepts, and present blueprints of the resulting designs to convince listeners of the superiority of the designs they produce</i>
Diskripsi Singkat MK Course Description	Desain Rekayasa yang baik merupakan kunci sukses dari proses manufaktur suatu produk komersial. Beberapa tahapan penting dalam proses rekayasa suatu desain meliputi aspek kreativitas, kemampuan teknis, kemampuan komunikasi yang luas, kemampuan manajerial yang baik, serta kepiawaian dalam merangkai seluruh aspek kemampuan sebelumnya dalam suatu tim kerja yang solid dan . Proses desain suatu produk bersifat <i>unique</i>, sehingga upaya pengujian konsep desain yang teliti dan terus menerus akan menjadi kunci penting keberhasilan proses desain. MK Rekayasa Desain (Engineering Design) ini memberikan dasar-dasar yang kuat dari suatu proses rekayasa desain yang baik. Berbagai contoh yang mencerahkan dari beberapa permasalahan riil dalam desain serta <i>best practice</i> dari proses penyempurnaan <i>design</i> diberikan untuk meningkatkan pemahaman mahasiswa akan pentingnya suatu proses desain yang baik <i>Good engineering design is the key to the success of the manufacturing process of a commercial product. Several important stages in the engineering process of a design include aspects of creativity, technical ability, broad communication skills, good managerial skills, and expertise in assembling all</i>

	<i>aspects of previous abilities in a solid and efficient work team. The design process of a product is unique, so careful and continuous effort to test the design concept will be an important key to the success of the design process. MK Engineering Design (Engineering Design) provides a solid foundation of a good engineering design process. Various enlightening examples of some real problems in design as well as best practices from the design improvement process are given to increase students' understanding of the importance of a good design process.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Pendahuluan Konsep Rekayasa Desain: Definisi, Permasalahan, Proses & Tahapan / <i>Introduction to Design Engineering Concepts: Definition, Problems, Process & Stages</i> 2. Identifikasi Permasalahan dan Persyaratan suatu Desain atau Product Design Specification / <i>Identification of Problems and Requirements of a Design or Product Design Specification</i> 3. Overview berbagai kasus kegagalan rekayasa desain / <i>Overview of various design engineering failure cases</i> 4. Imajinasi dan proses kreatif dalam desain / <i>Imagination and creative process in design</i> 5. Tahapan-tahapan penting dalam suatu proses desain: / <i>Important stages in a design process:</i> • Prosedur Desain / <i>Design Procedure</i> • Identifikasi Peluang / <i>Identify Opportunities</i> • Penajaman Tujuan Desain / <i>Sharpening Design Goals</i> • Pemilahan fungsi komponen dalam desain / <i>Sorting function of components in design</i> • Penetapan persyaratan spesifikasi dan karakteristik setiap komponen / <i>Determination of the specification requirements and characteristics of each component</i> • Menentukan berbagai alternatif desain / <i>Determine various design alternatives</i> • Evaluasi atas berbagai alternatif desain yang ditetapkan / <i>Evaluation of various design alternatives</i> • Memperbaiki detail desain yang dihasilkan / <i>Improve the resulting design details</i> 6. Metode, konsep, serta <i>tools</i> dalam proses rekayasa desain / <i>Methods, concepts, and tools in the design engineering process</i> 7. Manajemen dalam proses desain / <i>Management in the design process</i> 8. Kemampuan dan strategi komunikasi yang efektif dalam suatu proses desain / <i>Effective communication skills and strategies in a design process</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	
	1. Ken Hurst, Engineering Desain Principles, University of Hull. Elsevier Ltd, 2004 2. Nigel Cross, Engineering Design Methods, Strategies for Product Design, Third edition. John Wiley & Sons, Ltd. 2000	
	Pendukung: <i>Supporting</i>	-
Media Pembelajaran	Perangkat lunak:	Perangkat keras:

Learning Media		Software		Hardware		
		- OS:Windows; Office, Video demo		Private Computer + LCD		
Tim Pengajar Team Teaching		Dr.rer.nat. Ir. Aulia Nasution, M.Sc. Totok Ruki Bianto, ST, MT, Ph.D				
Matakuliah syarat Entry requirement		-		Bahasa pengantar: Languages	Bahasa Indonesia Indonesian	
Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessm ent point (%) (7)
1	Mampu menjelaskan tahapan-tahapan penting dalam suatu proses rekayasa desain dan aspek-aspek penting yang perlu dielaborasikan kedalam setiap pentahapannya. Students are able to explain the important stages in a design engineering process and the important aspects that need to be elaborated into each stage	Ketepatan menjelaskan tahapan-tahapan penting dalam suatu proses rekayasa desain dan aspek-aspek penting yang perlu dielaborasikan kedalam setiap pentahapannya. Accuracy in explaining the important stages in a design engineering process and the important aspects that need to be elaborated into each stage	Quiz Quiz	SCL (Kuliah dan diskusi) [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Pendahuluan Konsep Rekayasa Desain: Definisi, Permasalahan, Proses & Tahapan / Introduction to Design Engineering Concepts: Definition, Problems, Process & Stages	5% (CP-MK1)
2	Mampu menjelaskan tahapan-tahapan penting dalam suatu proses rekayasa desain dan aspek-aspek penting yang perlu dielaborasikan	Ketepatan menjelaskan tahapan-tahapan penting dalam suatu proses rekayasa desain dan aspek-aspek penting yang perlu dielaborasikan Accuracy in explaining important stages in a design	Pembuatan Makalah 1 + Presentasi Paper-work 1 + Presentation	Kuliah dan diskusi [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Identifikasi Permasalahan dan Persyaratan suatu Desain atau Product Design Spesification / Identification of Problems and Requirements of a Design or Product Design Specification	5% (CP-MK2) 5% (CP-MK3) 2.5% (CP-MK4) 2.5% (CP-MK5)

	<i>Students are able to explain important stages in a design engineering process and important aspects that need to be elaborated</i>	<i>engineering process and important aspects that need to be elaborated</i>				
3-5	Mampu merancang tahapan proses desain suatu produk baru, atau perbaikan desain dari suatu existing design yang memerlukan penyempurnaan, memilih dan menggunakan metode, konsep, serta tools desain yang sesuai dengan karakteristik rancangan desain yang akan diselesaikannya, serta menentukan berbagai tahapan pengujian yang diperlukan untuk menguji rancangan desain yang dihasilkan, serta mengidentifikasi permasalahan yang muncul dalam rancangan desainnya untuk dilakukan proses penyempurnaan selanjutnya. <i>Students are able to design the stages of the design process of a new product, or improve the design of an existing design that requires refinement, select and use</i>	Ketepatan merancang tahapan proses desain suatu produk baru, atau perbaikan desain dari suatu existing design yang memerlukan penyempurnaan, memilih dan menggunakan metode, konsep, serta tools desain yang sesuai dengan karakteristik rancangan desain yang akan diselesaikannya, serta menentukan berbagai tahapan pengujian yang diperlukan untuk menguji rancangan desain yang dihasilkan, serta mengidentifikasi permasalahan yang muncul dalam rancangan desainnya untuk dilakukan proses penyempurnaan selanjutnya <i>Accuracy in designing the stages of the design process of a new product, or improve the design of an existing design that requires refinement, select and use methods, concepts, and design tools that are in accordance with the characteristics of the design to</i>	Pembuatan Makalah 2 + Presentasi <i>Paper-work 2 + Presentation</i>	Kuliah dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Overview berbagai kasus kegagalan rekayasa desain / <i>Overview of various design engineering failure cases</i> Imajinasi dan proses kreatif dalam desain / <i>Imagination and creative process in design</i>	5% (CP-MK2) 5% (CP-MK3) 5% (CP-MK4) 2.5% (CP-MK5)

	<i>methods, concepts, and design tools that are in accordance with the characteristics of the design to be completed, and determine the various stages of testing required to test the design the resulting design, and identify problems that arise in the design for further refinement processes.</i>	<i>be completed, and determine the various stages of testing required to test the design the resulting design, and identify problems that arise in the design for further refinement processes.</i>				
6-7	Mampu menginternalisasi proses kreatif dan imajinatif, mengkomunikasikan gagasan desainnya dengan baik kepada tim, kemampuan manajemen ide serta elaborasi berbagai ide untuk menghasilkan konsep rancangan desain terbaik, serta mempresentasikan blueprint dari rancangan desain yang dihasilkan untuk meyakinkan pendengarnya akan keunggulan dari rancangan desain yang dihasilkannya. <i>Students are able to internalize creative and imaginative processes,</i>	Ketepatan menginternalisasi proses kreatif dan imajinatif, mengkomunikasikan gagasan desainnya dengan baik kepada tim, kemampuan manajemen ide serta elaborasi berbagai ide untuk menghasilkan konsep rancangan desain terbaik, serta mempresentasikan blueprint dari rancangan desain yang dihasilkan untuk meyakinkan pendengarnya akan keunggulan dari rancangan desain yang dihasilkannya <i>Accuracy in internalizing creative and imaginative processes, communicate design ideas well to the team, idea management skills and elaboration of various ideas to produce the best design concepts, and present</i>	Pembuatan Makalah 3 + Presentasi <i>Paper-work 3 + Presentation</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Tahapan-tahapan penting dalam suatu proses desain: / <i>Important stages in a design process:</i> • Prosedur Desain / <i>Design Procedure</i> • Identifikasi Peluang / <i>Identify Opportunities</i> • Penajaman Tujuan Desain / <i>Sharpening Design Goals</i> • Pemilahan fungsi komponen dalam desain / <i>Sorting function of components in design</i> • Penetapan persyaratan spesifikasi dan karakteristik setiap komponen / <i>Determination of the specification requirements and characteristics of each component</i> • Menentukan berbagai alternatif desain /	5% (CP-MK2) 5% (CP-MK3) 5% (CP-MK4) 2.5% (CP-MK5)

	<i>communicate design ideas well to the team, idea management skills and elaboration of various ideas to produce the best design concepts, and present blueprints of the resulting designs to convince listeners of the superiority of the designs they produce.</i>	<i>blueprints of the resulting designs to convince listeners of the superiority of the designs they produce.</i>			<i>Determine various design alternatives</i> • Evaluasi atas berbagai alternatif desain yang ditetapkan / <i>Evaluation of various design alternatives</i> • Memperbaiki detil desain yang dihasilkan / <i>Improve the resulting design details</i>	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					2.5% (CP-MK1) 5% (CP-MK2) 2.5% (CP-MK4)
9-15	Mampu menganalisa kasus proses rekayasa desain, dengan mengelaborasi materi pembelajaran dalam paruh semester pertama diatas. Tema kasus desain mengarah lebih spesifik terkait desain sistem instrumentasi untuk keperluan peningkatan performansi proses, penghematan energi, proses yang ramah lingkungan, serta sistem keselamatan pada proses industry <i>Students are able to analyze the case of the design</i>	Ketepatan menganalisa kasus proses rekayasa desain, dengan mengelaborasi materi pembelajaran dalam paruh semester pertama diatas. Tema kasus desain mengarah lebih spesifik terkait desain sistem instrumentasi untuk keperluan peningkatan performansi proses, penghematan energi, proses yang ramah lingkungan, serta sistem keselamatan pada proses industry <i>Accuracy in analyzing the case of the design engineering process, by elaborating the learning materials in the first half of the semester above. The</i>	Proyek + Presentasi <i>Final Project + Presentation</i>	Kuliah, brainstorming dan diskusi [TM: 7x(2x50'')] [BT: 7x(2x60'')] [BM: 7x(2x60'')]	<i>Metode, konsep, serta tools dalam proses rekayasa desain / Methods, concepts, and tools in the design engineering process</i> <i>Manajemen dalam proses desain / Management in the design process</i> <i>Kemampuan dan strategi komunikasi yang efektif dalam suatu proses desain / Effective communication skills and strategies in a design process</i>	5% (CP-MK2) 5% (CP-MK3) 5% (CP-MK4) 5% (CP-MK5)

	<i>engineering process, by elaborating the learning materials in the first half of the semester above. The theme of the design case is more specific regarding the design of instrumentation systems for the purposes of improving process performance, saving energy, environmentally friendly processes, and safety systems in industrial processes.</i>	<i>theme of the design case is more specific regarding the design of instrumentation systems for the purposes of improving process performance, saving energy, environmentally friendly processes, and safety systems in industrial processes.</i>				
16	Evaluasi Akhir Semester <i>Final Examination</i>					5% (CP-MK1) 5% (CP-MK3) 5% (CP-MK4)

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Rekayasa Desain Design Engineering			RA&E Edisi (<i>Edition</i>): Agt 2018 Aug 2018		
	Kode (<i>Code</i>): TF185301	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: Instrumentation Engineering	Smt: 3 Semester: 3		
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Totok Ruki Biyanto, PhD	Koordinator RMK Field Coordinator Dr. Rony Dwi Noriyati			Ka PRODI Head of Master Program Aulia M T Nasution	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot (%) CP-MK4 (7)	Bobot (%) CP-MK5 (8)
1	Mampu menjelaskan tahapan-tahapan penting dalam suatu proses rekayasa desain dan aspek-aspek penting yang perlu dielaborasi kedalam setiap pentahapannya. <i>Students are able to explain the important stages in a design engineering process and the important aspects that need to be elaborated into each stage</i>	Quiz <i>Quiz</i>	5%				

2	Mampu menjelaskan tahapan-tahapan penting dalam suatu proses rekayasa desain dan aspek-aspek penting yang perlu dielaborasi <i>Students are able to explain important stages in a design engineering process and important aspects that need to be elaborated</i>	Pembuatan Makalah 1 + Presentasi <i>Paper-work 1 + Presentation</i>		5%	5%	2.5%	2.5%
3-5	Mampu merancang tahapan proses desain suatu produk baru, atau perbaikan desain dari suatu existing design yang memerlukan penyempurnaan, memilih dan menggunakan metode, konsep, serta tools desain yang sesuai dengan karakteristik rancangan desain yang akan diselesaikannya, serta menentukan berbagai tahapan pengujian yang diperlukan untuk menguji rancangan desain yang dihasilkan, serta mengidentifikasi permasalahan yang muncul dalam rancangan desainnya untuk dilakukan proses penyempurnaan selanjutnya. <i>Students are able to design the stages of the design process of a new product, or improve the design of an existing design that requires refinement, select and use methods, concepts, and design tools that are in accordance with the characteristics of the design to be completed, and determine the various stages of testing required to test the design the resulting design, and identify problems that arise in the design for further refinement processes.</i>	Pembuatan Makalah 2 + Presentasi <i>Paper-work 2 + Presentation</i>		5%	5%	5%	2.5%
6-7	Mampu menginternalisasi proses kreatif dan imajinatif, mengkomunikasikan gagasan desainnya dengan baik kepada tim, kemampuan manajemen ide serta elaborasi berbagai ide untuk menghasilkan konsep rancangan desain	Pembuatan Makalah 3 + Presentasi <i>Paper-work 3 + Presentation</i>		5%	5%	5%	2.5%

	terbaik, serta mempresentasikan blueprint dari rancangan desain yang dihasilkan untuk meyakinkan pendengarnya akan keunggulan dari rancangan desain yang dihasilkannya. <i>Students are able to internalize creative and imaginative processes, communicate design ideas well to the team, idea management skills and elaboration of various ideas to produce the best design concepts, and present blueprints of the resulting designs to convince listeners of the superiority of the designs they produce.</i>						
8	Evaluasi Tengah Semester (<i>Mid-Term Examination</i>)	2.5%	5%		2.5%		
9-15	Mampu menganalisa kasus proses rekayasa desain, dengan mengelaborasi materi pembelajaran dalam paruh semester pertama diatas. Tema kasus desain mengarah lebih spesifik terkait desain sistem instrumentasi untuk keperluan peningkatan performansi proses, penghematan energi, proses yang ramah lingkungan, serta sistem keselamatan pada proses industry <i>Students are able to analyze the case of the design engineering process, by elaborating the learning materials in the first half of the semester above. The theme of the design case is more specific regarding the design of instrumentation systems for the purposes of improving process performance, saving energy, environmentally friendly processes, and safety systems in industrial processes.</i>	Proyek + Presentasi <i>Final Project + Presentation</i>		5%	5%	5%	5%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)	5%		5%	5%		
Total Bobot Penilaian (%) <i>Total Point (%)</i>		12.5%	25%	25%	25%	12.5%	

Compulsory Courses (*Energy Engineering and Environmental Conditioning*)

TF185140 RPS RAE Pemetaan Potensi Energi (*Energy Potential Mapping*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Pemetaan Potensi Energi <i>Energy Potential Mapping</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185140	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization:</i> <i>Energy Engineering and Environmental Conditioning</i>	Smt: 1 <i>Semester: 1</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Ridho Hantoro	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-1 Lulusan mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Graduates are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems.</i>	
	CP-2 Lulusan mampu mengembangkan dan menerapkan berpikir kritis, dan kreatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (50%) <i>Graduates are able to develop a critical and creative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format.</i>	

	CP-MK <i>Course Learning Outcome (CLO)</i> 1. Mahasiswa mampu menjelaskan dan menyarikan tentang karakteristik masing-masing potensi energi dengan baik (CP-1) (20%) <i>Students are able to explain and summarize the characteristics of various energy potentials.</i> 2. Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan (CP-1, CP-2) 10% <i>Students are able to identify and arrange the renewable energy balance</i> 3. Mahasiswa mampu memberikan alternatif dan penyelesaian aspek teknis dalam mengkuantifikasi dan memetakan potensi energi. (CP-2) 20% <i>Students are able to develop an alternative solution of technical aspects to quantify and map energy potentials.</i> 4. Mahasiswa mampu melakukan perhitungan untuk prediksi potensi energi dan beban energi serta mempresentasikannya (CP-2, CP-5) 50% <i>Students are able to predict the energy potential as well as the energy demand and to present their resulting prediction.</i>
Diskripsi Singkat MK <i>Course Description</i>	Karakteristik energi terbarukan yang berfluktuasi periodik terhadap waktu memberikan tantangan mengetahui karakteristik masing-masing potensi energi dengan baik. Pengetahuan tersebut akan menentukan kemampuan pemenuhan beban dalam kapasitas dan waktu yang diperlukan. Mata kuliah ini bertujuan menyampaikan materi terkait upaya mengidentifikasi dan memetakan potensi dan lokasi sumber-sumber energi terbarukan. Aspek teknis untuk mengkuantifikasi dan memetakan dipelajari sehingga potensi energi yang dapat digunakan dapat diprediksi lebih baik untuk dimanfaatkan. Studi mengenai profil dan beban listrik pada suatu wilayah juga dilakukan sebagai pendekatan penyediaan energi melalui metode “demand side”. Kombinasi dari lebih dari satu sumber energi terbarukan menjadi menarik untuk dikaji terkait kelayakan ekonomi secara system untuk diimplementasikan. <i>Renewable energy characteristic is known for its intermittency and hence, it is challenging to assess characteristics of each energy potential. Knowledge on renewable energy characteristics shall determine the capacity to meet the load demand for certain period. This course is aiming at delivering knowledge on how to identify and to spatially map the location of renewable energy sources. Technical aspects to quantify and to build energy potential map will be learned to predict the net and useful energy potential. A case study on the electricity profile and load in a certain area will be carried out using demand side method for energy supply approach. Particularly, special attention will be directed to the assess the economic feasibility for the implementation of combined renewable energy sources.</i>
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Kebijakan Energi Nasional, Potensi Energi Nasional, Bauran Energi Nasional, Peraturan Feed in Tarif, 2. Pola peredaran bumi terhadap Surya dan efeknya terhadap intensitas radiasi, Mekanisme radiasi (direct, beam, diffuse), Perpindahan panas oleh radiasi matahari. 3. Pola peredaran bumi terhadap Surya dan efeknya terhadap peredaran angin, Mekanisme ekstraksi energi angin, pengolahan distribusi data angin. 4. Tipe dan ketersediaan biomassa, Nilai kalor biomassa 5. Siklus hidrologi, Tipe dan ketersediaan energi air, Mekanisme ekstraksi energi air 6. Bumi dan lapisannya, Sumber panas dalam bumi, Tipe dan ketersediaan energi geothermal, Mekanisme ekstraksi energi geothermal 7. Menentukan potensi energi terbarukan berdasarkan kasus yang diangkat, Mengetahui beban kebutuhan dan profil energi, Melakukan disain dan analisa penyediaan kebutuhan energi.

	1. National energy policy, national energy potential, national energy mix, feed in tariff regulation. 2. Earth revolution and its effect to local or regional solar irradiance, radiation mechanism (direct, beam, diffuse), solar irradiated heat transfer 3. Earth revolution and its effect to local or regional wind profile, extraction mechanism of wind energy, evaluation of wind distribution data 4. Biomass type and availability, calorific value of biomass 5. Hydrological cycles, hydro energy type and availability, extraction mechanism of hydro energy. 6. Earth and its crust, geothermal source, geothermal energy type and availability, extraction mechanism of geothermal energy 7. Case based renewable energy potential assessment, energy profile and load demand analysis, design and analysis of energy supply					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	- Renewable Energy ResourcesJohn Twidell and Tony Weir, Taylor & Francis 2005 - Renewable and Efficient Electric Power Systems by Gilbert M. Masters, 2d edition, Wiley, 2004 ISBN 0-471-28060-7					
	Pendukung: <i>Supporting</i>					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>		
	-			Private Computer		
Tim Pengajar <i>Team Teaching</i>	Dr. Ridho Hantoro; Gunawan Nugroho, PhD					
Matakuliah syarat <i>Entry requirement</i>	-			Bahasa pengantar: <i>Languages</i>		Bahasa Indonesia <i>Indonesian</i>
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment</i> <i>Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> <i>[Work load]</i> (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessm</i> <i>ent point</i> (%) (7)
1	Mahasiswa memahami kebijakan energi nasional dan bauran energi terbarukan dalam tahun-tahun terakhir, serta	●Ketepatan memahami kebijakan energi nasional dan bauran energi terbarukan ●Ketepatan memahami rantai penyediaan energi terbarukan	Non-test: Diskusi kebijakan energi nasional dan bauaran energi	SCL (Kuliah dan diskusi) [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	1. Kebijakan Energi Nasional 2. Potensi Energi Nasional 3. Bauran Energi Nasional 4. Peraturan Feed in Tarif	5% (CP-MK1)

	memahami rantai penyediaan energi terbarukan. <i>Students understand and are aware of the recent national energy policy and energy mix and are able to explain the renewable energy supply chain.</i>	dari bahan potensial sampai dengan pengguna energi • <i>Appropriate understanding on the recent national energy policy and energy mix</i> • <i>Appropriate understanding of renewable energy supply-demand chain</i>	TUGAS 1: Mahasiswa melakukan review tentang kebijakan energi nasional dan bauran energi terbarukan dalam tahun-tahun terakhir. <i>ASSIGNMENT 1: Students carry out a comprehensive review on the recent national energy policy and mix.</i>		1. <i>National Energy Policy</i> 2. <i>National Energy Potential</i> 3. <i>National Energy Mix</i> 4. <i>Feed in Tarif Regulation</i>	
2,3	• Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan surya dalam rantai pasok. • Mahasiswa memahami teknologi konversi energi surya (PV dan Solar thermal). • <i>Students are able to identify and develop solar energy balance.</i> • <i>Students can explain solar energy conversion technology</i>	• Ketepatan menghitung dan menjelaskan pola peredaran bumi terhadap Surya dan efeknya terhadap intensitas radiasi. • Ketepatan mengidentifikasi dan menyusun kesetimbangan energi terbarukan Surya. • Pemahaman teknologi konversi energi surya (PV dan Solar thermal). • <i>Accurate calculation and explanation on the earth revolution and its effect to the irradiance profile</i> • <i>Accurate identification and calculation of solar energy balance</i>	TUGAS 2: Mahasiswa mengerjakan soal konversi energi surya dari buku text utama dan mempresentasikan jawaban serta mendiskusikannya dalam kelas <i>ASSIGNMENT 2: Students solve the exercise problems of solar energy conversion from the main handbook, present and discuss their solution in the class</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Pola peredaran bumi terhadap Surya dan efeknya terhadap intensitas radiasi. 2. Mekanisme radiasi (direct, beam, diffuse) 3. Perpindahan panas oleh radiasi matahari. 4. Teknologi konversi energi Surya (PV dan Thermal) 1. <i>Earth revolution and its effect to local or regional solar irradiance</i> 2. <i>Radiation mechanism (direct, beam, diffuse)</i> 3. <i>Heat transfer by solar irradiation</i> 4. <i>Solar energy conversion technology (PV and Solar Thermal)</i>	2.5% (CP-MK1) 1% (CP-MK2) 2.5% (CP-MK3) 2.5% (CP-MK4)

		• <i>Appropriate understanding of the solar energy conversion technology</i>				
4,5	• Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan angin. • Mahasiswa memahami teknologi konversi energi angin • <i>Students are able to identify and develop wind energy balance.</i> • <i>Students can explain wind energy conversion technology</i>	• Ketepatan menghitung dan menjelaskan energi angin. • Ketepatan mengidentifikasi dan menyusun kesetimbangan energi terbarukan angin. • Pemahaman teknologi konversi energi angin. • <i>Accurate calculation and explanation on the wind energy potential</i> • <i>Accurate identification and calculation of wind energy balance</i> • <i>Appropriate understanding of the wind energy conversion technology</i>	Non-test: Diskusi perkembangan konversi energi angin <i>Non-Test: Discussion on the development of wind conversion</i> TUGAS 3: Mahasiswa membuat simulasi sederhana mengenai turbine angin dengan menggunakan CFD dan melakukan analisa terhadap hasil simulasi <i>ASSIGNMENT 3: Students carry out simple simulation of wind turbine using CFD software package and analyze the simulation results.</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Pola peredaran bumi terhadap Surya dan efeknya terhadap peredaran angin 2. Mekanisme ekstraksi energi angin 3. Teknologi konversi energi angin <i>1. Earth revolution and its effect to local or regional wind profile</i> <i>2. Extraction mechanism of wind energy</i> <i>3. Wind energy conversion technology</i>	2.5% (CP-MK1) 1% (CP-MK2) 2.5% (CP-MK3) 2.5% (CP-MK4)
6,7	• Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan biomassa. • Mahasiswa memahami teknologi konversi energi biomassa.	• Ketepatan menghitung dan menjelaskan jenis energi biomassa. • Ketepatan mengidentifikasi dan menyusun kesetimbangan energi terbarukan Biomassa. • Pemahaman teknologi konversi energi Biomassa.	Non-Test: Diskusi perkembangan konversi biomassa <i>Non-Test: Discussion on the development of biomass conversion</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Tipe dan ketersediaan biomassa 2. Nilai kalor biomassa 3. Teknologi konversi energi biomassa <i>1. Biomass type and availability</i> <i>2. Calorific value of biomass</i>	5% (CP-MK1) 1% (CP-MK2) 2.5% (CP-MK3) 2.5% (CP-MK4)

	• <i>Students are able to identify and develop hydro energy balance.</i> • <i>Students can explain biomass energy conversion technology</i>	• <i>Accurate calculation and explanation on the biomass energy potential</i> • <i>Accurate identification and calculation of biomass energy balance</i> • <i>Appropriate understanding of the biomass energy conversion technology</i>	TUGAS 4: 1. Mahasiswa membuat review perkembangan teknologi konversi biomassa 2. Mahasiswa mengerjakan soal dari buku text utama ASSIGNMENT 4: 1. <i>Students write a comprehensive review on the development of biomass energy conversion technology</i> 2. <i>Students solve the exercise problems of biomass energy in the main handbook</i>		3. <i>Biomass energy conversion technology</i>	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK1) 4% (CP-MK2) 8% (CP-MK3)
9,10	• Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan air. • Mahasiswa memahami teknologi konversi energi air.	• Ketepatan menghitung dan menjelaskan poyensi energi air (terjunan dan arus). • Ketepatan mengidentifikasi dan menyusun kesetimbangan energi terbarukan geothermal. • Pemahaman teknologi konversi energi air.	TUGAS 5: Mahasiswa membuat review perkembangan teknologi konversi energi air dan didiskusikan di kelas ASSIGNMENT 5: <i>Students write a comprehensive review on</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Siklus hidrologi 2. Tipe dan ketersediaan energi air 3. Mekanisme ekstraksi energi air 4. Teknologi konversi energi air 1. <i>Hydrological cycles</i>	1% (CP-MK2) 1.5% (CP-MK3) 5% (CP-MK4)

	• <i>Students are able to identify and develop hydro energy balance.</i> • <i>Students can explain hydro energy conversion technology</i>	• <i>Accurate calculation and explanation on the hydro energy potential</i> • <i>Accurate identification and calculation of hydro energy balance</i> <i>Appropriate understanding of the hydro energy conversion technology</i>	<i>the development of hydro energy conversion technology and present their review in the class.</i>		2. <i>Hydro energy type and availability</i> 3. <i>Extraction mechanism of hydro energy</i> 4. <i>Hydro energy conversion technology</i>	
11,12	• Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan geothermal. • Mahasiswa memahami teknologi konversi energi geothermal. • <i>Students are able to identify and develop geothermal energy balance.</i> • <i>Students can explain the geothermal energy conversion technology.</i>	• Ketepatan menghitung dan menjelaskan poyensi energi geothermal • Ketepatan mengidentifikasi dan menyusun kesetimbangan energi terbarukan geothermal. • Pemahaman teknologi konversi energi geothermal. • <i>Accurate calculation and explanation on the geothermal energy potential</i> • <i>Accurate identification and calculation of wind energy balance</i> <i>Appropriate understanding of the wind energy conversion technology</i>	TUGAS 6: Mahasiswa membuat review perkembangan teknologi konversi energi geothermal dan didiskusikan di kelas <i>ASSIGNMENT 6: Students write a comprehensive review on the technology development for geothermal energy conversion, and present dan discuss their review in the class.</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Bumi dan lapisannya 2. Sumber panas dalam bumi 3. Tipe dan ketersediaan energi geothermal 4. Mekanisme ekstraksi energi geothermal 5. Teknologi konversi energi geothermal 1. <i>Earth and its crust</i> 2. <i>Geothermal source</i> 3. <i>Geothermal energy type and availability</i> 4. <i>Extraction mechanism of geothermal energy</i> 5. <i>Geothermal energy conversion technology</i>	2% (CP-MK2) 1.5% (CP-MK3) 5% (CP-MK4)
13-15	Mahasiswa mampu membuat konsep dan menghitung kebutuhan energi pada sebuah kasus dan penyediaan energi terbarukan sesuai lokasi kasus.	Ketepatan mahasiswa dalam membuat dan mengevaluasi manajemen energi dan proses detailnya.. • <i>Accurate calculation and analysis of the renewable</i>	TUGAS BESAR: 1. Mahasiswa memilih studi kasus pada suatu daerah tertentu 2. Mahasiswa melakukan perhitungan kebutuhan energi pada daerah tersebut	Kuliah, brainstorming, presentasi dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	1. Potensi energi terbarukan berdasarkan kasus yang diangkat 2. Beban kebutuhan dan profil energi 3. Desain dan analisis penyediaan kebutuhan energi.	1.5% (CP-MK3) 17.5% (CP-MK4)

	<i>Students are able to develop a conceptual calculation of energy demand and renewable energy supply based on a studied area</i>	<i>energy potential on a certain case</i> ● <i>Accurate identification and calculation of energy balance using supply-demand approach</i>	3. Mahasiswa melakukan pemetaan potensi energi terbarukan di daerah tersebut 4. Mahasiswa membuat rencana penyediaan energi terbarukan pada daerah tersebut 5. Mahasiswa membuat laporan dan presentasi <i>FINAL PROJECT:</i> 1. <i>Students pick a case study in a certain area</i> 2. <i>Students calculate the energy demand in the studied area</i> 3. <i>Students develop renewable energy potential map in the studied area</i> 4. <i>Students create a plan for renewable energy supply in the studied area</i> 5. <i>Students write a final report and present their design and analysis of energy demand and supply</i>		1. Case-based renewable energy potential 2. Load demand and energy profile 3. Design and analysis of energy demand and supply.	
16	Evaluasi Akhir Semester <i>Final Examination</i>					15% (CP-MK4)

Catatan :
Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			RA&E		
	PEMETAAN POTENSI ENERGI ENERGY POTENTIAL MAPPING			Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>		
Kode (<i>Code</i>): TF185140	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>	Smt: 1 <i>Semester: 1</i>			
OTORISASI (<i>Authorization</i>)	Penyusun RA & E Contact Person – Assessment & Evaluation Plan Dr. Ridho Hantoro	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Aulia M T Nasution			

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (6)
1	Mahasiswa memahami kebijakan energi nasional dan bauran energi terbarukan dalam tahun-tahun terakhir, serta memahami rantai penyediaan energi terbarukan. <i>Students understand and are aware of the recent national energy policy and energy mix and are able to explain the renewable energy supply chain.</i>	TUGAS 1: Mahasiswa melakukan review tentang kebijakan energi nasional dan bauran energi terbarukan dalam tahun-tahun terakhir. <i>COGNITIVE - ASSIGNMENT 1:</i> <i>Students carry out a comprehensive review on the recent national energy policy and mix.</i>	5%			

2,3	● Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan surya dalam rantai pasok. ● Mahasiswa memahami teknologi konversi energi surya (PV dan Solar thermal). ● <i>Students are able to identify and develop solar energy balance.</i> ● <i>Students can explain solar energy conversion technology</i>	TUGAS 2: Mahasiswa mengerjakan soal konversi energi surya dari buku text utama dan mempresentasikan jawaban serta mendiskusikannya dalam kelas <i>COGNITIVE - ASSIGNMENT 2: Students solve the exercise problems of solar energy conversion from the main handbook, present and discuss their solution in the class</i>	2.5%	1%	2.5%	2.5%
4,5	● Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan angin. ● Mahasiswa memahami teknologi konversi energi angin ● <i>Students are able to identify and develop wind energy balance.</i> ● <i>Students can explain wind energy conversion technology</i>	TUGAS 3: Mahasiswa membuat simulasi sederhana mengenai turbine angin dengan menggunakan CFD dan melakukan analisa terhadap hasil simulasi <i>CASE-BASED ASSIGNMENT 3: Students carry out simple simulation of wind turbine using CFD software package and analyze the simulation results.</i>	2.5%	1%	2.5%	2.5%
6,7	● Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan biomassa. ● Mahasiswa memahami teknologi konversi energi biomassa. ● <i>Students are able to identify and develop hydro energy balance.</i> ● <i>Students can explain biomass energy conversion technology</i>	TUGAS 4: 1. Mahasiswa membuat review perkembangan teknologi konversi biomassa 2. Mahasiswa mengerjakan soal dari buku text utama <i>COGNITIVE - ASSIGNMENT 4: 1. Students write a comprehensive review on the development of biomass energy conversion technology 2. Students solve the exercise problems of biomass energy in the main handbook</i>	5%	1%	2.5%	2.5%
8			5%	4%	8%	
9,10	● Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan air. ● Mahasiswa memahami teknologi konversi energi air.	TUGAS 5: Mahasiswa membuat review perkembangan teknologi konversi energi air dan didiskusikan di kelas <i>COGNITIVE - ASSIGNMENT 5:</i>		1%	1.5%	5%

	• <i>Students are able to identify and develop hydro energy balance.</i> • <i>Students can explain hydro energy conversion technology</i>	<i>Students write a comprehensive review on the development of hydro energy conversion technology and present their review in the class</i>				
11,12	• Mahasiswa mampu mengidentifikasi dan menyusun kesetimbangan energi terbarukan geothermal. • Mahasiswa memahami teknologi konversi energi geothermal. • <i>Students are able to identify and develop geothermal energy balance.</i> • <i>Students can explain the geothermal energy conversion technology.</i>	TUGAS 6: Mahasiswa membuat review perkembangan teknologi konversi energi geothermal dan didiskusikan di kelas <i>COGNITIVE - ASSIGNMENT 6:</i> <i>Students write a comprehensive review on the technology development for geothermal energy conversion, and present dan discuss their review in the class.</i>		2%	1.5%	5%
13-15	Mahasiswa mampu membuat konsep dan menghitung kebutuhan energi pada sebuah kasus dan penyediaan energi terbarukan sesuai lokasi kasus. <i>Students are able to develop a conceptual calculation of energy demand and renewable energy supply based on a studied area</i>	TUGAS BESAR: 1. Mahasiswa memilih studi kasus pada suatu daerah tertentu 2. Mahasiswa melakukan perhitungan kebutuhan energi pada daerah tersebut 3. Mahasiswa melakukan pemetaan potensi energi terbarukan di daerah tersebut 4. Mahasiswa membuat rencana penyediaan energi terbarukan pada daerah tersebut 5. Mahasiswa membuat laporan dan presentasi <i>PROJECT-BASED ASSIGNMENT:</i> 1. <i>Students pick a case study in a certain area</i> 2. <i>Students calculate the energy demand in the studied area</i> 3. <i>Students develop renewable energy potential map in the studied area</i> 4. <i>Students create a plan for renewable energy supply in the studied area</i> 5. <i>Students write a final report and present their design and analysis of energy demand and supply</i>			1.5%	17.5%

16	Evaluasi Akhir Semester (<i>Final Examination</i>)				15%
	Total Bobot Penilaian (%) <i>Total Point (%)</i>	20%	10%	20%	50%

TF185130 RPS RAE Statistik Energi (*Energy Statistics*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>			RP
	Statistik Energi <i>Energy Statistics</i>			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185130	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 1 <i>Semester: 1</i>	
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Syamsul Arifin	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro	

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-1 Lulusan memiliki pemahaman mendalam tentang matematika, fisika, dan teknik lanjutan untuk memecahkan masalah yang kompleks. (17%) <i>Graduates possess in depth comprehension of advanced mathematics, physics, and engineering in order to solve complex problems.</i> CP-2 Lulusan mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra-maupun multidisiplin ilmu. (17%)	

	<i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis</i> CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (66%) <i>Graduates are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i> CP-MK Course Learning Outcome (CLO) 1. Mahasiswa mampu menjelaskan dan menerapkan prinsip-prinsip variabel acak dalam sumber daya dan produk energi (CP-1, CP-3) (25%) <i>Students are able to explain and apply the principles of random variables in energy resources and products.</i> 2. Mahasiswa mampu menganalisa dan menyusun bentuk distribusi statistik dari data sumber daya dan produk energi (CP-1, CP-3) 25% <i>Students are able to analyze and compile statistical distribution forms from data on energy resources and products.</i> 3. Mahasiswa mampu menganalisa dan menentukan peluang pemanfaatan dan dampak sumber daya dan produk energi. (CP-3) 50% <i>Students are able to analyze and determine opportunities for utilization and impact of energy resources and products.</i>
Diskripsi Singkat MK Course Description	Membahas dan mempelajari teknik dalam pengolahan dan analisis data serta inteprestasi data yang terkait dengan variabel-variabel dan parameter-parameter bidang energi dengan pendekatan inter disiplin dan multi disiplin. Dalam mengikuti mata kuliah ini mahasiswa akan belajar menyelesaikan kasus-kasus statistik dengan subjek bidang energi, baik secara mandiri maupun dalam kelompok, serta mempresentasikannya.. <i>Discussing and studying techniques in data processing and analysis as well as data interpretation related to variables and parameters in the energy sector with an inter-disciplinary and multi-disciplinary approach. In following this course, students will learn to solve statistical cases with the subject of the energy field, either independently or in groups, and present them.</i>
Pokok Bahasan / Bahan Kajian Module content	1. Statistik dan Penyajian Data; 2. Penentuan variabel Penelitian, dan parameter statistik; 3. Penentuan populasi, sampel, distribusi data, dan pengujian normalitas data; 4. Konsep & pengujian hipotesis; 5. Analisis Korelasi; 6. Analisis Regresi; 7. Analisis Varian; 8. Analisis jalur (path analisis) 9. Uji validitas & reliabilitas instrumen penelitian; 10. Statistik no-parametris <i>1. Statistics and Data Presentation;</i> <i>2. Determination of research variables, and statistical parameters;</i> <i>3. Determination of population, sample, data distribution, and data normality testing;</i> <i>4. Concept & hypothesis testing;</i>

	5. <i>Correlation Analysis</i> ; 6. <i>Regression Analysis</i> ; 7. <i>Analysis of Variance</i> ; 8. <i>Path analysis (path analysis)</i> 9. <i>Test the validity & reliability of research instruments</i> ; 10. <i>No-parametric statistics</i> .					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). Probability & Statistics for Engineers & Scientists (9 ed.). New York: Prentice Hall 2. Johnson, R. A., & Bhattacharyya, G. K. (2010). Statistics: Principles and Methods (6 ed.). Hoboken, NJ: John Wiley & Sons, Inc. 3. Sugiyono. (2012). Statistika untuk penelitian. Bandung: Alfabeta.					
	Pendukung: <i>Supporting</i>					
	1. Bohm, G., & Zech, G. (2010). Introduction to Statistics and Data Analysis for Physicists. Hamburg: Deutsches Elektronen-Synchrotron. 2. Rawlings, J. O., Pantula, S. G., & Dickey, D. A. (1998). Applied Regression Analysis: A Research Tool (2 ed.). New York: Springer-Verlag New York, Inc.					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>		
	Microsoft Office			Private Computer		
Tim Pengajar <i>Team Teaching</i>	Dr. Syamsul Arifin, Prof Aulia Siti Aisjah					
Matakuliah syarat <i>Entry requirement</i>	-			Bahasa pengantar: <i>Languages</i>		Bahasa Indonesia <i>Indonesian</i>
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessment point (%)</i> (7)
1-2	Mahasiswa mampu menjelaskan lingkup bahasan tentang variabel acak	Ketepatan mhs memahami wawasan mengenai variabel acak.	Non-test: Diskusi kebijakan energi nasional dan bauaran energi	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Variabel acak <i>Random Variable</i>	5% (CP-MK1)

	<i>Students are able to explain the scope of the discussion about random variables</i>	<i>The accuracy of students understanding insight about random variables</i>	<i>Non-test: Discussion of national energy policy and energy mix</i>			
3-4	Mahasiswa mampu memahami dan menjelaskan konsep-konsep peluang <i>Students are able to understand and explain the concepts of probability.</i>	Ketepatan mhs memahami konsep-konsep dasar peluang <i>The accuracy of students understanding the basic concepts of probability</i>	Non-Test: Mahasiswa mengerjakan soal dari buku text utama <i>Non-Test: Students work on questions from the main textbook</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Konsep-konsep dasar peluang <i>The basic concepts of probability</i>	5% (CP-MK1)
5-6	1. Mahasiswa mampu memahami dan menjelaskan distribusi normal 2. Mahasiswa mampu memahami tentang distribusi student 1. <i>Students are able to understand and explain the normal distribution</i> 2. <i>Students are able to understand about student distribution</i>	• Ketepatan mhs memahami distribusi normal • Ketepatan mhs memahami dstribusi student. • <i>The accuracy of students understanding the normal distribution</i> • <i>The accuracy of students understanding the distribution of students.</i>	Non-Test: Diskusi mengenai distribusi normal dan student TUGAS 1: 3. Mengumpulkan / mencari data yang berkaitan tentang energi 4. Mengerjakan soal dari buku text utama <i>Non-Test: Discussion about normal distribution and student</i> <i>ASSIGNMENT 1:</i> 1. <i>Collecting / searching for data related to energy</i> 2. <i>Doing questions from the main text book</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Distribusi normal 2. Distriusi Student 1. <i>Normal distribution</i> 2. <i>Student Distribution</i>	10% (CP-MK2)

7	Mahasiswa mampu memahami dan menjelaskan distribusi bernoulli dan distribusi poisson. <i>Students are able to understand and explain Bernoulli distribution and Poisson distribution.</i>	Ketepatan mhs memahami distribusi student dan distribusi poisson. <i>Students understand the student distribution and the Poisson distribution.</i>	Non-test: Diskusi mengenai distribusi student dan poisson TUGAS 2: Menyajikan data mengenai distribusi normal, student, dan poisson terkait bidang energi <i>Non-test: Discussion about student and poisson distribution</i> <i>ASSIGNMENT 2: Presenting data regarding normal, student, and Poisson distributions related to the energy field</i>	Kuliah dan diskusi [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Distribusi student dan distribusi poisson. <i>Student distribution and Poisson distribution.</i>	5% (CP-MK2)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					10% (CP-MK1) 10% (CP-MK2)
9-11	Mahasiswa mampu memahami dan melakukan pemilahan data <i>Students are able to understand and perform data sorting.</i>	Ketepatan mhs memahami dan melakukan pemilahan data. <i>The accuracy of students understanding and sorting data.</i>	TUGAS 3 : Mengolah data energi yang sudah ada, dan menarik kesimpulan hipotesis. <i>ASSIGNMENT 3: Processing existing energy data, and drawing hypothetical conclusions.</i>	Kuliah dan diskusi [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Identifikasi data <i>Data identification</i>	5% (CP-MK3)

12-13	Mahasiswa mampu melakukan regresi data. <i>Students are able to perform data regression.</i>	Ketepatan mhs melakukan regresi data. <i>The accuracy of students doing data regression</i>	TUGAS 4: Mahasiswa mengolah data menggunakan teknik regresi data. <i>ASSIGNMENT 4: Students process data using data regression techniques</i>	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Data regresi <i>Regression data</i>	5% (CP-MK3)
14-15	Mahasiswa mampu menerapkan konsep statistik pada data sumber daya dan produk energi. <i>Students are able to apply statistical concepts to data on energy resources and products.</i>	Ketepatan mahasiswa menerapkan dalam sumber daya dan produk energi. <i>The accuracy of students applying in energy resources and products</i>	TUGAS 5: Mahasiswa membuat review dan pengolahan data statistik energi. <i>ASSIGNMENT 5: Students review and process energy statistical data</i>	Kuliah, brainstorming, dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Penerapan pada sumber daya dan produk energi <i>Application to energy resources and products</i>	20%
16	Evaluasi Akhir Semester <i>Final Examination</i>					25% (CP-MK3)

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	Statistik Energi Energy Statistics		Edisi (<i>Edition</i>): Agt 2018 Aug 2018
Kode (<i>Code</i>): TF185130	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>	Smt: 1 <i>Semester: 1</i>
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Dr. Syamsul Arifin	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)
1-2	Mahasiswa mampu menjelaskan lingkup bahasan tentang variabel acak <i>Students are able to explain the scope of the discussion about random variables</i>	Non-test: Diskusi kebijakan energi nasional dan bauran energi <i>Non-test: Discussion of national energy policy and energy mix</i>	5%		
3-4	Mahasiswa mampu menjelaskan lingkup bahasan tentang variabel acak <i>Students are able to explain the scope of the discussion about random variables</i>	Non-Test: Mahasiswa mengerjakan soal dari buku text utama <i>Non-Test: Students work on questions from the main textbook</i>	5%		

5-6	Mahasiswa mampu menjelaskan lingkup bahasan tentang variabel acak <i>Students are able to explain the scope of the discussion about random variables</i>	Non-Test: Diskusi mengenai distribusi normal dan student TUGAS 1: 1. Mengumpulkan / mencari data yang berkaitan tentang energi 2. Mengerjakan soal dari buku text utama <i>Non-Test: Discussion about normal distribution and student</i> <i>ASSIGNMENT 1: 1. Collecting / searching for data related to energy 2. Doing questions from the main text book</i>		10%	
7	Mahasiswa mampu menjelaskan lingkup bahasan tentang variabel acak <i>Students are able to explain the scope of the discussion about random variables</i>	Non-test: Diskusi mengenai distribusi student dan poisson TUGAS 2: Menyajikan data mengenai distribusi normal, student, dan poisson terkait bidang energi <i>Non-test: Discussion about student and poisson distribution</i> <i>ASSIGNMENT 2: Presenting data regarding normal, student, and Poisson distributions related to the energy field</i>		5%	
8			10%	10%	
9-11	Mahasiswa mampu memahami dan melakukan pemilahan data <i>Students are able to understand and perform data sorting.</i>	TUGAS 3 : Mengolah data energi yang sudah ada, dan menarik kesimpulan hipotesis. <i>ASSIGNMENT 3: Processing existing energy data, and drawing hypothetical conclusions.</i>			5%

12-13	Mahasiswa mampu melakukan regresi data. <i>Students are able to perform data regression.</i>	TUGAS 4: Mahasiswa mengolah data menggunakan teknik regresi data. <i>ASSIGNMENT 4:</i> <i>Students process data using data regression techniques</i>			5%
14-15	Mahasiswa mampu menerapkan konsep statistik pada data sumber daya dan produk energi. <i>Students are able to apply statistical concepts to data on energy resources and products.</i>	TUGAS 5: Mahasiswa membuat review dan pengolahan data statistik energi. <i>ASSIGNMENT 5:</i> <i>Students review and process energy statistical data</i>			20%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)				25%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			20%	25%	55%

TF185210 RPS RAE Teknologi Konversi Energi (*Energy Conversion Technology*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Teknologi Konversi Energi <i>Energy Conversion Technology</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185210	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization:</i> <i>Energy Engineering and Environmental Conditioning</i>	Smt: 2 Semester: 2
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr.Eng. Nur Laila Hamidah	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i>

			Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-1 Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems.</i> CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta menganalisis dan mengevaluasi data penelitian dan data engineering. (25%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data.</i> CP-6 Mampu mengembangkan metode inovatif, keterampilan dan alat secara mandiri untuk merancang dan mengoptimalkan sistem energi terbarukan dan berkelanjutan dalam berbagai kondisi parameter (50%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing renewable and sustainable energy system under various parameter condition.</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	8. Mahasiswa mampu menjelaskan tentang prinsip-prinsip konversi energi dan menurunkan dalam bentuk persamaan matematis (CP-1) (25%) <i>Students are able to explain the principles of energy conversion and derive them into mathematical model.</i> 9. Mahasiswa mampu menganalisa bentuk model matematis dan optimisasi system konversi energi. (CP-3) 25% <i>Students are able to analyze mathematical models and optimization of energy conversion systems</i> 10. Mahasiswa mampu menganalisa pengambilan keputusan dalam ekonomi energi (CP-3, CP-6) 50% <i>Students are able to analyze the decision making in energy economy</i>	
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini bertujuan untuk menyampaikan materi terkait Jenis-jenis sumber energi, konversi energi konvensional, konversi energi langsung, optimisasi proses, pengambilan keputusan dalam ekonomi energi. Kombinasi dari lebih dari satu sumber energi terbarukan menjadi menarik untuk dikaji terkait kelayakan ekonomi secara system untuk diimplementasikan.		

	<i>This course is aiming at delivering knowledge on the types of energy sources, conventional energy conversion, direct energy conversion, process optimization, and decision making in energy economics. Particularly, special attention will be directed to the assess the economic feasibility for the implementation of combined renewable energy sources.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	5. Jenis-jenis sumber energi 6. Review siklus termodinamika dan fisika kuantum 7. Heat transfer: identifikasi kehilangan energy dalam peralatan dan system termal 8. Konversi energi konvensional 9. Konversi energi langsung 10. Pengambilan keputusan dalam ekonomi energi <i>10. The types of energy sources</i> <i>11. Review of thermodynamic cycles and quantum physics</i> <i>12. Heat transfer: identification of energy losses in thermal equipment and systems</i> <i>13. Conventional energy conversion</i> <i>14. Direct energy conversion</i> <i>15. The decision making in energy economy</i>	
Pustaka <i>Reading Materials</i>	Utama: Main - Weston K.C., Energy Conversion 1st Edition, PWSPublishers, 1992. - Angrist S.W., Direct Energy Conversion, 1972. - MoranM.J.& H.N.Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons, 1998. - Thumann A. & Dunning S., Plant Engineers and Managers Guide to Energy Conservation 9th Edition, Taylor & Francis Group, 2008. Pendukung: Supporting	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: Software	Perangkat keras: Hardware
	-	Private Computer
Tim Pengajar <i>Team Teaching</i>	Dr. Ridho Hantoro; Dr.Eng Nur Laila Hamidah, Dr. Gunawan Nugroho, Harsono Hadi, PhD	
Matakuliah syarat <i>Entry requirement</i>	-	

Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessment point (%) (7)
1-4	Mahasiswa mampu menjelaskan tentang prinsip- prinsip konversi energi dan menurunkan dalam bentuk persamaan matematis <i>Students are able to explain the principles of energy conversion and derive them into mathematical model.</i>	- Ketepatan mhs memahami dan menjelaskan sirkuit listrik dan magnet <i>Appropriate understanding and explanation on electric and magnetic circuit</i>	Non-Tes: TUGAS 1 - Menurunkan model matematis dari sistem energi yang dipilih - Menentukan parameter dan variabel sistem di atas berdasarkan hukum-hukum fisika - Membuat diagram - Membuat grafik - Membuat Program MATLAB: grafik hasil perhitungan untuk sistem energi yang dipilih Test: Kuis <i>Non- Test : ASSIGNMENT 1:</i> <i>Deriving a mathematical model of the selected energy system</i> <i>Determining the parameters and variables of the above</i>	SCL (Kuliah dan diskusi) [TM: 4x(2x50'')] [BT: 4x(2x60'')] [BM: 4x(2x60'')]	- Introduction of Electrical Circuits - Definitions of Key Electrical Quantities - Idealized Voltage and Current Source - Electrical Resistance - Capacitance - Magnetic Circuits - Inductance - Transformers <i>Introduction of Electrical Circuits</i> <i>Definitions of Key Electrical Quantities</i> <i>Idealized Voltage and Current Source</i> <i>Electrical Resistance</i> <i>Capacitance</i> <i>Magnetic Circuits</i> <i>Inductance</i> <i>Transformers</i>	15% (CP-MK1)

			<i>system based on the laws of physics</i> • <i>Developing the diagrams</i> • <i>Constructing the graphics</i> • <i>Developing MATLAB Program: graph of calculation results for the selected energy system</i> <i>Test : Kuiz</i>			
5-7	Mahasiswa mampu menganalisa bentuk model matematis dan optimisasi system konversi energi <i>Students are able to analyze mathematical models and optimization of energy conversion systems</i>	Ketepatan mhs dlm memahami dan menjelaskan dasar-dasar power elektrik <i>Accurate understanding and explanation on the basic principle of electric power</i>	Non-test : TUGAS 2: • Menganalisis grafik hasil perhitungan dengan membandingkan dengan referensi lain baik dari makalah maupun buku • Menentukan hal-ha yang mempengaruhi efisiensi energi dan menganalisis bagaimana performa dapat ditingkatkan dalam bentuk fungsi objektif • Menyusun diskripsi hasil peningkatan efisiensi/performa untuk sistem energi yang dipilih <i>Non-test:</i>	Kuliah dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	1. Effective value of voltage and current 2. Idealized components subjected to sinusoidal voltage 3. Power Factor 4. The power triangle and power factor correction 5. Three-Wire, single-Phase Residential Wiring 6. Three-Phase Systems 7. Power Supplies 8. Power Quality 1. <i>Effective value of voltage and current</i> 2. <i>Idealized components subjected to sinusoidal voltage</i> 3. <i>Power Factor</i> 4. <i>The power triangle and power factor correction</i>	15% (CP-MK2)

			ASSIGNMENT 2: - Analyzing the graph of the calculation results by comparing with other references from both papers and books - Determining the factors affecting energy efficiency and analyzing on how performance can be improved by objective functions - Developing the efficiency/ performance improvement results for the selected energy system		- Three-Wire, single-Phase Residential Wiring - Three-Phase Systems - Power Supplies - Power Quality	
8	Evaluasi Tengah Semester (ETS) Mid Term Examination					10% (CP-MK1) 10% (CP-MK2)
9-15	- Mahasiswa mampu memahami dan menjelaskan sumber energi dan keberlanjutan energi - Mahasiswa mampu menganalisa dalam pengambilan keputusan dalam ekonomi energi <i>Students are able to understand and explain</i>	- Ketepatan mahasiswa memahami dan menjelaskan sumber energi dan keberlanjutan energi - Ketepatan mhs dalam menjelaskan pengambilan keputusan dalam ekonomi energi <i>Accurate understanding and explanation on energy resource and sustainable energy</i>	Non-test : TUGAS 3: Menentukan satu proyek energi di industri beserta latar belakang teknologi dan demand pasar TUGAS 4 : Menentukan dan menganalisa design awal dari proyek energi yang diajukan	Kuliah, brainstorming dan diskusi [TM: 7x(2x50'')] [BT: 7x(2x60'')] [BM: 7x(2x60'')]	- Criteria for sustainable energy - The geological Limits of Fossil fuel - The environmental Limits of fossil fuel - Opportunity and Limits of non- fossil energy - Energy Future <i>1. Criteria for sustainable energy</i>	30% (CP-MK3)

	<i>the energy sources and sustainable energy.</i> • <i>Students are able to analyze the decision making in energy economy</i>	<i>Accurate explanation on the decision making in energy economy</i>	• Menentukan daftar harga peralatan yang akan dipasang TUGAS 5 • Membuat analisa ekonomi dari proyek energi (BEP, NPV, IRR) • Membuat proposal proyek energi <i>Non-test:</i> <i>ASSIGNMENT 3:</i> <i>Determining an energy project in the industry along with the technology background and market demand</i> <i>ASSIGNMENT 4:</i> • <i>Determining and analyzing the initial design of the proposed energy project</i> • <i>Determining the price list of installed equipment</i> <i>ASSIGNMENT 5:</i> • <i>Analyzing the economic based energy projects (BEP, NPV, IRR)</i> • <i>Writing the proposal of energy project</i>		2. <i>The geological Limits of Fossil fuel</i> 3. <i>The environmental Limits of fossil fuel</i> 4. <i>Opportunity and Limits of non- fossil energy</i> 5. <i>Energy Future</i>	
--	--	---	---	--	--	--

16	Evaluasi Akhir Semester <i>Final Examination</i>	20 % (CP-MK3)
----	---	------------------

Catatan :

Note

5. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) <i>ASSESSMENT & EVALUATION PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Teknologi Konversi Energi	RA&E
		Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>

	Energy Conversion Technology		
Kode (Code): TF185210	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi Field of Specialization: Energy Engineering and Environmental Conditioning	Smt: 2 Semester: 2
OTORISASI (Authorization)	Penyusun RA & E Contact Person – Assessment & Evaluation Plan Dr.Eng. Nur Laila Hamidah	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Dr.Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)
1-4	Mahasiswa mampu menjelaskan tentang prinsip-prinsip konversi energi dan menurunkan dalam bentuk persamaan matematis <i>Students are able to explain the principles of energy conversion and derive them into mathematical model.</i>	TUGAS 1 : - Menurunkan model matematis dari sistem energi yang dipilih - Menentukan parameter dan variabel sistem di atas berdasarkan hukum-hukum fisika - Membuat diagram - Membuat grafik - Membuat Program MATLAB: grafik hasil perhitungan untuk sistem energi yang dipilih COGNITIVE - ASSIGNMENT 1: <i>Deriving a mathematical model of the selected energy system</i> <i>Determining the parameters and variables of the above system based on the laws of physics</i> <i>Developing the diagrams</i> <i>Constructing the graphics</i> <i>Developing MATLAB Program: graph of calculation results for the selected energy system</i>	15%		
5-7	Mahasiswa mampu menganalisa bentuk model matematis dan optimisasi system konversi energi	TUGAS 2: Menganalisis grafik hasil perhitungan dengan membandingkan dengan referensi lain baik dari makalah maupun buku		15%	

	<i>Students are able to analyze mathematical models and optimization of energy conversion systems</i>	• Menentukan hal-ha yang mempengaruhi efisiensi energi dan menganalisis bagaimana performa dapat ditingkatkan dalam bentuk fungsi objektif • Menyusun deskripsi hasil peningkatan efisiensi/performa untuk sistem energi yang dipilih <i>COGNITIVE - ASSIGNMENT 2:</i> • <i>Analyzing the graph of the calculation results by comparing with other references from both papers and books</i> • <i>Determining the factors affecting energy efficiency and analyzing on how performance can be improved by objective functions</i> • <i>Developing the efficiency/ performance improvement results for the selected energy system</i>			
8	Evaluasi Tengah Semester (ETS) Mid Term Examination		10%	10%	
9-15	• Mahasiswa mampu memahami dan menjelaskan sumber energi dan keberlanjutan energi • Mahasiswa mampu menganalisis dalam pengambilan keputusan dalam ekonomi energi • <i>Students are able to understand and explain the energy sources and sustainable energy.</i> • <i>Students are able to analyze the decision making in energy economy</i>	TUGAS 3: Menentukan satu proyek energi di industri beserta latar belakang teknologi dan demand pasar TUGAS 4 : • Menentukan dan menganalisis design awal dari proyek energi yang diajukan • Menentukan daftar harga peralatan yang akan dipasang TUGAS 5 : • Membuat analisis ekonomi dari proyek energi (BEP, NPV, IRR) • Membuat proposal proyek energi <i>COGNITIVE - ASSIGNMENT 3:</i> <i>Determining an energy project in the industry along with the technology background and market demand</i>			30%

		COGNITIVE - ASSIGNMENT 4: • <i>Determining and analyzing the initial design of the proposed energy project</i> • <i>Determining the price list of installed equipment</i> COGNITIVE - ASSIGNMENT 5: • <i>Analyzing the economic based energy projects (BEP, NPV, IRR)</i> • <i>Writing the proposal of energy project</i>				
16	Evaluasi Akhir Semester (<i>Final Examination</i>)				20%	
Total Bobot Penilaian (%) <i>Total Point (%)</i>				25%	25%	50%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>			RP
	Optimasi Sistem Energi <i>Energy System Optimization</i>			Edisi: Agt 2018 Edition: Aug 2018
Kode (<i>Code</i>): TF185220	Bobot sks (T/P): (2/0) <i>Credits</i> (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 2 Semester: 2	
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Gunawan Nugroho	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan kerekayasaan dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (25%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis</i> CP-3 Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (37.5%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i>		

	CP-MK Course Learning Outcome (CLO) 1. Mahasiswa mampu mengidentifikasi, menghitung dan menganalisa biaya energi, perhitungan ekonomi dasar, dan ekonomi ketidakpastian menggunakan simulasi Monte Carlo (CP-2) (25%) <i>Students are able to identify, calculate, and analyse energy cost, basic energy calculation, and economic uncertainty using Monte Carlo simulation.</i> 2. Mahasiswa mampu melakukan pendekatan sistematis yang menggunakan metodologi modular sekuensial atau simultan dikembangkan untuk solusi proses keseimbangan massa dan energi (CP-3, CP-6) (37.5%) <i>Students are able to perform systematic approach employing either sequential or simultaneous modular technology to develop a solution for energy and mass balance process.</i> 3. Mahasiswa mampu menghitung dan menganalisa rekonsiliasi data dan deteksi kesalahan dan diterapkan pada sistem termodinamika pembangkitan aktual. (CP-3, CP-6) (37.5%) <i>Students are able to calculate and analyze data reconciliation, to detect faults which are applied in actual thermodynamic system for power plant.</i>
Diskripsi Singkat MK Course Description	Pada mata kuliah ini dibahas teknik formulasi permasalahan menggunakan model yang akurat dan teknik optimisasi yang sesuai untuk mencari solusi terbaik dalam menyelesaikan permasalahan optimisasi pada system/ proses yang melibatkan konsumsi energi. <i>This course allows students to learn problems formulation using accurate model and optimization technique appropriate for the best solution to solve optimization problems in a system/process involving energy consumption.</i>
Pokok Bahasan / Bahan Kajian Module content	• Menyediakan platform terpadu untuk perbaikan proses melalui analisis dari sisi permintaan energi — pabrik pemrosesan — dan sisi pasokan energi — sumber panas dan daya yang tersedia. Penekanan ditempatkan pada kuantifikasi pertama aliran material dan energi dalam suatu proses. • Kebutuhan energi dari proses memandu desain optimal dari sistem utilitas. Teknik-teknik juga disajikan untuk memastikan bahwa operasi sistem utilitas yang paling hemat biaya dipelihara. • Baik insinyur yang berlatih maupun mahasiswa teknik dapat menggunakan informasi yang disajikan di sini. Untuk insinyur yang berlatih, buku ini menyediakan pendekatan yang sistematis dan mandiri untuk meminimalkan penggunaan energi dan biaya di fasilitas operasional. Untuk siswa, berikan evaluasi terinci analisis energi, desain, dan optimisasi. <i>• Providing comprehensive platform to improve process through analysis on the energy demand side – processing plant – energy supply side – the available power source.</i> <i>• Energy needs of a certain process guide the optimal design of utility system. Techniques should be appropriate to ensure that the operation of utility system requires the most efficient maintenance.</i> <i>• Engineers or engineering students are capable of using information to develop systematic approach to minimize energy usage and cost in operational facility, and to perform detailed evaluation of energy analysis, design and optimization.</i>

Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	F. Carl Knopf, Modeling, Analysis and Optimization of Process and Energy Systems, John Wiley & Sons, Inc. 2012 - Singiresu S. Rao, Engineering Optimization-Theory and Practice, Fourth Edition, John Wiley & Sons, Inc. 2009 - Panos M. Pardalos, Optimization in the Energy Industry, 2009 Springer-Verlag Berlin Heidelberg					
	Pendukung: <i>Supporting</i>					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras: <i>Hardware</i>				
	-	Private Computer				
Tim Pengajar <i>Team Teaching</i>	Dr. Ridho Hantoro; Gunawan Nugroho, PhD					
Matakuliah syarat <i>Entry requirement</i>	-					
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment</i> <i>Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> <i>[Work load]</i> (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessm ent point</i> (%) (7)
1-3	Mahasiswa dapat memformulasikan permasalahan yang perlu dioptimisasi <i>Students are able to define problem formulation for optimization</i>	Ketepatan dalam formulasi permasalahan optimasi <i>Accurate problem formulation on optimization</i>	TUGAS 1: Penyusunan makalah, berisi materi: Pengertian optimisasi, fungsi obyektif dan constraint, local dan global optimum dan teknik optimisasi. <i>COGNITIVE ASSIGNMENT 1: Writing a review article of definition of optimization, objective function and</i>	SCL (Kuliah dan diskusi) [TM: 3x(2x100'')] [BT: 3x(2x120'')] [BM: 3x(2x120'')] <i>SCL (Course/seminar and discussion)</i> <i>[CS: 3x(2x100'')]</i> <i>[EX: 3x(2x120'')]</i> <i>[SL: 3x(2x120'')]</i> TM (CS): Tatap Muka (<i>Course/Seminar</i>)	Konsep dasar optimisasi: pengertian optimisasi, fungsi obyektif dan <i>constraint</i>, <i>local dan global optimum</i> dan teknik optimisasi Problem formulasi: fungsi obyektif dan <i>constraint</i> <i>Basic concept of optimization: definition of optimization, objective function and constraints, local and global</i>	10% (CP-MK1)

			<i>constraints, local and global optimum, and optimization technique</i>	BT (EX): Belajar Terstruktur (<i>Exercise</i>) BM (SL): Belajar Mandiri (<i>Self Learning</i>)	<i>optimum, and optimization technique</i> • <i>Problem formulation: Objective function and constraints</i>	
4-7	Mahasiswa dapat memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Students are able to utilize accurate model that is representative of linear, non-linear, integer and combined problems.</i>	Ketepatan memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Accurate model that is representative of linear, non-linear, integer and combined problems</i>	TUGAS 2: Penyusunan makalah, berisi materi Pemodelan sistem yang sesuai dan penentuan variabel yang dioptimisasi. <i>COGNITIVE ASSIGNMENT 2: Writing a review article of system modeling and determination of optimization variables</i>	SCL (Kuliah dan diskusi) [TM: 4x(2x100'')] [BT: 4x(2x120'')] [BM: 4x(2x120'')] <i>SCL (Course/seminar and discussion)</i> [CS: 4x(2x100'')] [EX: 4x(2x120'')] [SL: 4x(2x120'')]	Model: Pemodelan sistem yang sesuai dan penentuan variabel yang dioptimisasi <i>Model: System modeling and determination of optimization variables</i>	10% (CP-MK1) 7.5% (CP-MK2) 7.5% (CP-MK3)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK1) 7.5% (CP-MK2) 7.5% (CP-MK3)
9	Mahasiswa dapat memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Students are able to utilize accurate model that is representative of linear, non-linear, integer and combined problems.</i>	Ketepatan memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Accurate model that is representative of linear, non-linear, integer and combined problems</i>	TUGAS 3: Penyusunan makalah, berisi materi Menentukan kelas optimisasi: linier, nonlinier, integer, mixedinteger nonlinier dan mixedinteger linier. <i>COGNITIVE ASSIGNMENT 5: Students write a comprehensive review on</i>	SCL (Kuliah dan diskusi) [TM: 1x(2x100'')] [BT: 1x(2x120'')] [BM: 1x(2x120'')] <i>SCL (Course/seminar and discussion)</i> [CS: 1x(2x100'')] [EX: 1x(2x120'')] [SL: 1x(2x120'')]	Menentukan kelas optimisasi: linier, nonlinier, integer, mixed integer nonlinier dan mixed integer linier <i>Determination of optimization class: linear, non-linear, integer, mixed integer-nonlinear, and mixed integer-linear.</i>	2.5% (CP-MK2) 2.5% (CP-MK3)

			<i>the determination of optimization class: linear, non-linear, integer, mixed integer-nonlinear, and mixed integer-linear.</i>			
10-12	Mahasiswa mampu memecahkan permasalahan yang membutuhkan teknik optimisasi deterministik <i>Students are able to solve problems requiring deterministic optimization</i>	Ketepatan penyelesaian permasalahan dengan optimisasi deterministik <i>Accurate solution for problems requiring deterministic optimization</i>	TUGAS 4: Penyusunan makalah, berisi materi Teknik optimisasi deterministik dan pemecahan masalah. <i>CASED-BASED ASSIGNMENT 4: Students write a comprehensive review on the technique for deterministic optimization and problem solving</i>	SCL (Kuliah dan diskusi) [TM: 3x(2x100'')] [BT: 3x(2x120'')] [BM: 3x(2x120'')] <i>SCL (Course/seminar and discussion) [CS: 3x(2x100'')] [EX: 3x(2x120'')] [SL: 3x(2x120'')]</i>	Teknik optimisasi deterministik dan pemecahan masalah <i>Technique for deterministic optimization and problem solving</i>	5% (CP-MK2) 5% (CP-MK3)
13-15	Mahasiswa mampu memecahkan permasalahan yang membutuhkan teknik optimisasi stokastik <i>Students are able to solve problems requiring stochastic optimization</i>	Ketepatan penyelesaian permasalahan dengan optimisasi stokastik. <i>Accurate solution for problems requiring stochastic optimization</i>	TUGAS 5: Penyusunan makalah, berisi materi Teknik optimisasi stokastik dan pemecahan masalah. <i>CASED-BASED ASSIGNMENT 5: Students write a comprehensive review on the technique for stochastic optimization and problem solving</i>	SCL (Kuliah dan diskusi) [TM: 3x(2x100'')] [BT: 3x(2x120'')] [BM: 3x(2x120'')] <i>SCL (Course/seminar and discussion) [CS: 3x(2x100'')] [EX: 3x(2x120'')] [SL: 3x(2x120'')]</i>	Teknik optimisasi stokastik dan pemecahan masalah <i>Technique for stochastic optimization and problem solving</i>	5% (CP-MK2) 5% (CP-MK3)
16	Evaluasi Akhir Semester <i>Final Examination</i>					10% (CP-MK2) 10% (CP-MK3)

Catatan :

Note

Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> OPTIMASI SISTEM ENERGY ENERGY SYSTEM OPTIMIZATION		RA&E
			Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185220	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Energi <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 2 <i>Semester: 2</i>
OTORISASI <i>(Authorization)</i>	Penyusun RA & E <i>Contact Person – Assessment & Evaluation Plan</i> Gunawan Nugroho, PhD	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)
1-3	Mahasiswa dapat memformulasikan permasalahan yang perlu dioptimisasi <i>Students are able to define problem formulation for optimization</i>	TUGAS 1: Penyusunan makalah, berisi materi: Pengertian optimisasi, fungsi obyektif dan constraint, local dan global optimum dan teknik optimisasi. <i>COGNITIVE ASSIGNMENT 1:</i>	10%		

		<i>Writing a review article of definition of optimization, objective function and constraints, local and global optimum, and optimization technique</i>			
4-7	Mahasiswa dapat memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Students are able to utilize accurate model that is representative of linear, non-linear, integer and combined problems.</i>	TUGAS 2: Penyusunan makalah, berisi materi Pemodelan sistem yang sesuai dan penentuan variabel yang dioptimisasi. <i>COGNITIVE ASSIGNMENT 2: Writing a review article of system modeling and determination of optimization variables</i>	10%	7.5%	7.5%
8	Evaluasi Tengah Semester (<i>Mid Term Examination</i>)		5%	7.5%	7.5%
9	Mahasiswa dapat memilih model yang sesuai/akurat yang merepresentasikan permasalahan baik yang linier, nonlinier, integer dan kombinasinya <i>Students are able to utilize accurate model that is representative of linear, non-linear, integer and combined problems.</i>	TUGAS 3: Penyusunan makalah, berisi materi Menentukan kelas optimisasi: linier, nonlinier, integer, mixedinteger nonlinier dan mixedinteger linier. <i>COGNITIVE ASSIGNMENT 5: Students write a comprehensive review on the determination of optimization class: linear, non-linear, integer, mixed integer-nonlinear, and mixed integer-linear.</i>		2.5%	2.5%
10-12	Mahasiswa mampu memecahkan permasalahan yang membutuhkan teknik optimisasi deterministik <i>Students are able to solve problems requiring deterministic optimization</i>	TUGAS 4: Penyusunan makalah, berisi materi Teknik optimisasi deterministik dan pemecahan masalah. <i>CASED-BASED ASSIGNMENT 4: Students write a comprehensive review on the technique for deterministic optimization and problem solving</i>		5%	5%
13-15	Mahasiswa mampu memecahkan permasalahan yang membutuhkan teknik optimisasi stokastik <i>Students are able to solve problems requiring stochastic optimization</i>	TUGAS 5: Penyusunan makalah, berisi materi Teknik optimisasi stokastik dan pemecahan masalah. <i>CASED-BASED ASSIGNMENT 5: Students write a comprehensive review on the technique for stochastic optimization and problem solving</i>		5%	5%

16	Evaluasi Akhir Semester (<i>Final Examination</i>)		10%	10%
	Total Bobot Penilaian (%) <i>Total Point (%)</i>	25%	37.5%	37.5%

TF185210 RPS RAE Sistem Energi Terbarukan (*Renewable Energy System*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>			RP
	Sistem Energi Terbarukan <i>Renewable Energy System</i>			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185210	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>		Smt: 2 <i>Semester: 2</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Suyanto	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD		Ka PRODI Head of Master Program Dr. rer.nat Aulia Nasution
Capaian Pembelajaran (CP) Learning Outcome (LO)	CP-PRODI Program Learning Outcome (PLO)	CP-1: Mampu mengaplikasikan pengetahuan matematika, fisika, dan kerekayasaan tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems</i> CP-3: Mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (50%) <i>Are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i> CP-6.E: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi pameter (25%)		

	<i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing renewable and sustainable energy system under various parameter condition</i>
	CP-MK Course Learning Outcome (CLO) e. Mahasiswa mampu mengidentifikasi sistem energi terbarukan menggunakan prinsip dan metodologi yang tepat. (CP-1) (CP-3) (50%) <i>Students are able to identify the system of renewable energy technologies using appropriate principle and methodologies</i> f. Mahasiswa mampu menghitung, merancang alternatif serta menyelesaikan kriteria dalam kuantisasi dan penyediaan energi terbarukan (CP-6.E) (25%) <i>Students are able to calculate and design alternatives and resolve criteria in quantifying and providing renewable energy</i> g. Mahasiswa mampu menganalisa dan memberikan rekomendasi dalam penyediaan energi terbarukan (CP-3) (25%) <i>Students are able to analyze and provide recommendations for the provision of renewable energy</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari kontribusi energi terbarukan dalam hal energi yang dapat ditetapkan pada profil energi regional/nasional. Teknologi yang digunakan untuk memanfaatkan sumber daya ini akan dijelaskan. Pentingnya dan relevansi hukum termodinamika bagi hubungan antara lingkungan energi, krisis energi, dan penggunaan energi dalam aspek kebutuhan manusia (transportasi, industri, komersial, rumah tangga, dll). Mempelajari hubungan antara ketersediaan, teknologi konversi, dan distribusi/konsumsi energi. Menggunakan metode Multi-Criteria Decision Making (MCDM) sebagai alat untuk membangun hubungan dan memberikan bobot untuk pertimbangan keputusan kebijakan energi. <i>This course studies the contribution of renewable energy in energy terms that can be assigned to a regional/national energy profile. The technology used to utilize these resources will be described. The importance and relevance of the laws of thermodynamics for the relationship between the energy environment, the energy crisis, and the use of energy in aspects of human needs (transportation, industry, commercial, household, etc.). Studying the correlation between availability, conversion technology, and energy distribution/consumption. Using the Multi-Criteria Decision Making (MCDM) method as a tool to build relationships and provide weighting for consideration of energy policy decisions.</i>
Pokok Bahasan / Bahan Kajian Module content	1. Dasar sirkuit listrik dan magnet <i>Basic Electric and Magnetic Circuits</i> 2. Dasar power elektrik <i>Fundamentals of Electric Power</i> 3. Power Elektrik di Industri <i>The Electric Power Industry</i> 4. Pembangkit terdistribusi <i>Distributed Generation</i>
Pustaka Reading Materials	Utama: Main Renewable and Efficient Electric Power Systems by Gilbert M. Masters, 2d edition, Wiley, 2004 ISBN 0-471-28060-7 (Ch. 1-4) Renewable Energy Systems, Henrik Lund, 2010 ELSEVIER Inc.

		Energy For Sustainability Technology, Planning, Policy, Gilbert M. Masters, Island Press 2008				
		Pendukung : Supporting				
Media Pembelajaran Learning Media		Perangkat lunak: Software			Perangkat keras : Hardware	
		-			PC	
Team Teaching		Harsono Hadi, PhD, Dr. Suyanto, Dr. Ridho Hantoro, Gunawan Nugroho, PhD				
Matakuliah syarat		TF195101 Advanced Engineering Physics TF195102 Advanced Engineering Mathematics				
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-4	Mahasiswa mampu mengidentifikasi sistem energi terbarukan dengan menggunakan prinsip listrik dan magnet (CPMK-1) Students are able to identify renewable energy systems using the principles of electricity and magnetism.	Ketepatan mhs memahami dan menjelaskan sirkuit listrik dan magnet The accuracy of students understanding and applied the principle of electric and magnetic circuits. Ketepatan mahasiswa mengidentifikasi sistem energi terbarukan The accuracy of students in identifying renewable energy systems	TUGAS 1 ASSIGNMENT 1 - Menurunkan model matematis dari sistem energi yang dipilih - Menentukan parameter dan variabel sistem di atas berdasarkan hukum-hukum fisika - Membuat diagram - Membuat grafik - Membuat Program MATLAB: grafik hasil perhitungan untuk sistem energi yang dipilih - Tugas diunggah pada http://share.its.ac.id/mod/assign/view.php?id=19826	Kuliah dan diskusi [TM: 4x(2x50'')] [BT: 4x(2x60'')] [BM: 4x(2x60'')]	9. Introduction of Electrical Circuits 10. Definitions of Key Electrical Quantities 11. Idealized Voltage and Current Source 12. Electrical Resistance 13. Capacitance 14. Magnetic Circuits 15. Inductance 16. Transformers	15% (CPMK-1)

			- Derive a mathematical model of the selected energy system - Determine the parameters and system variables above based on the laws of physics - Make a diagram - Make a chart - Creating MATLAB program: graph of calculation results for the selected energy system - Assignments uploaded at http://share.its.ac.id/mod/assign/view.php?id=19826 Test: Kuis 1 Quiz 1			
5-7	Mahasiswa mampu mengidentifikasi sistem energi terbarukan dengan menggunakan prinsip power elektrik (CPMK-1) <i>Students are able to identify renewable energy</i>	Ketepatan mhs memahami dan menjelaskan sistem power elektrik <i>The accuracy of students understanding and applied the principle of electric power.</i> Ketepatan mahasiswa mengidentifikasi sistem energi terbarukan	TUGAS 2 ASSIGNMENT 2 - Menganalisis grafik hasil perhitungan dengan membandingkan dengan referensi lain baik dari makalah maupun buku - Menentukan hal-hal yang mempengaruhi efisiensi energi dan menganalisis bagaimana	Kuliah dan diskusi [TM: 3x(2x50")] [BT: 3x(2x60")] [BM: 3x(2x60")]	9. Effective value of voltage and current 10. Idealized components subjected to sinusoidal voltage 11. Power Factor 12. The power triangle and power factor correction 13. Three-Wire, single-Phase Residential Wiring 14. Three-Phase Systems 15. Power Supplies 16. Power Quality	15% (CPMK-1)

	<i>systems using the principles of electric power.</i>	<i>The accuracy of students in identifying renewable energy systems</i>	performa dapat ditingkatkan dalam bentuk fungsi objektif • Menyusun diskripsi hasil peningkatan efisiensi/performa untuk sistem energi yang dipilih • Tugas diunggah pada: http://share.its.ac.id/mod/assign/view.php?id=43968 Doing Independent Assignments: • <i>Analyze the graph of the calculation results by comparing with other references from both papers and books</i> • <i>Determine the things that affect energy efficiency and analyze how performance can be improved in terms of objective functions</i> • <i>Compile a description of the results of increased efficiency / performance for the selected energy system</i> • <i>Assignments uploaded to: http://share.its.ac.id/mod/assign/view.php?id=43968</i>			
--	--	---	---	--	--	--

			Test Kuis online: Online Quiz 2 http://share.its.ac.id/mod/quiz/view.php?id=19849			
8	Evaluasi Tengah Semester (ETS) Mid-Term Exam					20% (CPMK-1)
9 - 11	Mahasiswa mampu menghitung dan merancang sistem power elektri di Industri <i>Students are able to calculate and design electric power systems in Industry</i>	Ketepatan mahasiswa dalam mengidentifikasi sistem power elektri di Industri <i>Accuracy of students in identifying electrical power systems in Industry</i> Ketepatan mahasiswa dalam melakukan perhitungan dan merancang sistem power elektrik di Industri <i>Accuracy of students in calculating and designing electric power systems in Industry</i>	TUGAS 3 ASSIGNMENT 3 Mahasiswa secara berkelompok lakukan desain sistem power elektrik di Industri <i>Students in a group conduct the design of electrical power systems in Industry</i>	Kuliah dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	1. The early pioneer: Edison, Westinghouse, and Insull 2. The Electric Utility Industry Today 3. Polyphase Synchronous Generators 4. Carnot Efficiency for Heat Engines 5. Steam-Cycle Power Plant 6. Combustion gas turbine 7. Combines-Cycle Power Plant 8. Gas Turbines and Combined-Cycle Cogeneration 9. Baseload, intermediate and peaking power plant 10. Transmission and Distribution 11. Regulatory site of electric power 12. The Emergence of Competitive Markets	15 % (CPMK-2)
12-15	Mahasiswa mampu melakukan analisa dan memberikan rekomendasi terkait permasalahan sistem	Ketepatan mhs memahami dan mengaplikasikan konsep sistem pembangkit terdistribusi <i>Accuracy of students to understand and apply the concept of a distributed generation system.</i>	TUGAS 4 ASSIGNMENT 4 - Mahasiswa mencari studi kasus sistem permbangkit terdistribusi - Mahasiswa melakukan analisa kemudian	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Electricity generation transition 2. Distributed generation with fossil fuel 3. Concentrating Solar Power (CSP) 4. Biomass for Electricity 5. Micro-Hydropower System	15% (CPMK-3)

	pembangkit terdistribusi <i>Students are to analysis and provide recommendation s related to distributed generation system problems</i>	Ketepatan mahasiswa dalam mengidentifikasi dan menganalisa permasalahan sistem energi terdistribusi <i>The accuracy of student in identifying and analyzing distributed energy system problems.</i> Ketepatan mahasiswa dalam memberikan rekomendasi dengan mempertimbangkan batasan yang ada <i>The accuracy of students in providing recommendations by considering existing limitations.</i>	memberikan rekomendasi dengan mempertimbangkan batasan yang ada <i>Students are looking for case studies of distributed generation systems</i> <i>Students conduct an analysis and then provide recommendations by considering the existing limitations</i>		6. Fuel Cell	
16	Evaluasi Akhir Semester <i>Final Exam</i>					20% (CPMK-2: 10%; CMPK-3: 10%)

Catatan :

6. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTIRS ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	Sistem Energi Terbarukan Renewable Energy System		Edisi: Agt 2018 Edition: Aug 2018
Kode (Code): TF185210	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: Energy Engineering and Environmental Conditioning	Smt: 2 Semester: 2
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Suyanto	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Dr. rer.nat Aulia Nasution

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)
1-4	Mahasiswa mampu mengidentifikasi sistem energi terbarukan dengan menggunakan prinsip listrik dan magnet (CPMK-1) <i>Students are able to identify renewable energy systems using the principles of electricity and magnetism.</i>	TUGAS 1 ASSIGNMENT 1 - Menurunkan model matematis dari sistem energi yang dipilih - Menentukan parameter dan variabel sistem di atas berdasarkan hukum-hukum fisika - Membuat diagram - Membuat grafik - Membuat Program MATLAB: grafik hasil perhitungan untuk sistem energi yang dipilih	15%		

		• Tugas diunggah pada http://share.its.ac.id/mod/assign/view.php?id=19826 • <i>Derive a mathematical model of the selected energy system</i> • <i>Determine the parameters and system variables above based on the laws of physics</i> • <i>Make a diagram</i> • <i>Make a chart</i> • <i>Creating MATLAB program: graph of calculation results for the selected energy system</i> • <i>Assignments uploaded at http://share.its.ac.id/mod/assign/view.php?id=19826</i> Test: Kuis 1 Quiz 1			
5-7	Mahasiswa mampu mengidentifikasi sistem energi terbarukan dengan menggunakan prinsip power elektrik (CPMK-1) <i>Students are able to identify renewable energy systems using the principles of electric power.</i>	TUGAS 2 ASSIGNMENT 2 • Menganalisis grafik hasil perhitungan dengan membandingkan dengan referensi lain baik dari makalah maupun buku • Menentukan hal-ha yang mempengaruhi efisiensi energi dan menganalisis bagaimana performa dapat ditingkatkan dalam bentuk fungsi objektif • Menyusun diskripsi hasil peningkatan efisiensi/performa untuk sistem energi yang dipilih • Tugas diunggah pada: http://share.its.ac.id/mod/assign/view.php?id=43968 Doing Independent Assignments: • <i>Analyze the graph of the calculation results by comparing with other references from both papers and books</i>	15%		

		- Determine the things that affect energy efficiency and analyze how performance can be improved in terms of objective functions - Compile a description of the results of increased efficiency / performance for the selected energy system - Assignments uploaded to: http://share.its.ac.id/mod/assign/view.php?id=43968 Test Kuis online: Online Quiz 2 http://share.its.ac.id/mod/quiz/view.php?id=19849			
8	Evaluasi Tengah Semester Mid Term Exam		20%		
9 - 11	Mahasiswa mampu menghitung dan merancang sistem power elektri di Industri <i>Students are able to calculate and design electric power systems in Industry</i>	TUGAS 3 ASSIGNMENT 3 Mahasiswa secara berkelompok lakukan desain sistem power elektrik di Industri <i>Students in a group conduct the design of electrical power systems in Industry</i>		15%	
12-15	Mahasiswa mampu melakukan analisa dan memberikan rekomendasi terkait permasalahan sistem pembangkit terdistribusi <i>Students are to analysis and provide recommendations related to distributed generation system problems</i>	TUGAS 4 ASSIGNMENT 4 - Mahasiswa mencari studi kasus sistem permbangkit terdistribusi - Mahasiswa melakukan analisa kemudian memberikan rekomendasi dengan mempertimbangkan batasan yang ada <i>Students are looking for case studies of distributed generation systems</i> <i>Students conduct an analysis and then provide recommendations by considering the existing limitations</i>		15%	

16	Evaluasi Akhir Semester (EAS) <i>Final Exam</i>		10%	10%
----	--	--	-----	-----

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Audit & Manajemen Energi <i>Energy Audit & Management</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185310	Bobot sks (T/P)/ ECTS: (2/0) / 3.2 <i>Credits (T/P)/ ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization:</i> <i>Energy Engineering and Environmental Conditioning</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Ridho Hantoro	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Dr.Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2 Lulusan mampu mengembangkan dan menerapkan berpikir kritis dan kreatif, dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan kerekayasaan dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (25%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-3 Lulusan mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (50%) <i>Graduates are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data.</i> CP-6 Lulusan mampu mengembangkan metode inovatif, keterampilan dan alat secara mandiri untuk merancang dan mengoptimalkan sistem energi terbarukan dan berkelanjutan dalam berbagai kondisi parameter (25%) <i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing renewable and sustainable energy system under various parameter condition</i>	

	CP-MK <i>Course Learning Outcome (CLO)</i> 1. Mahasiswa mampu mengidentifikasi kesenjangan pasokan permintaan energi (CP-2) <i>Students are able to identify the supply gap of energy demand</i> 2. Mahasiswa mampu melakukan audit energi suatu industri / organisasi (CP-2, CP-3) <i>Students are able to conduct energy audits in industry / organization</i> 3. Mahasiswa mampu menggambarkan diagram alir energi suatu industri dan mengidentifikasi energi yang terbuang (CP-3) <i>Students are able to draw the energy flow diagram of industry and to identify energy waste.</i> 4. Mahasiswa mampu memilih metode konservasi energi yang tepat untuk mengurangi pemborosan energi (CP-3, CP-6) <i>Students are able to choose the right energy conservation method to reduce energy waste</i> 5. Mahasiswa mampu mengevaluasi kelayakan teknoekonomi teknik konservasi energi yang diadopsi (CP-3, CP-6) <i>Students are able to evaluate the technological feasibility of the adopted energy conservation techniques.</i>
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini memiliki tujuan mempelajari dan menerapkan prinsip-prinsip konservasi energi. Konsumsi energi meningkat dari hari ke hari. Salah satu cara untuk mengatasi kenaikan permintaan energi adalah dengan meningkatkan produksi energi yang menuntut investasi lebih banyak dan sebaliknya serta dengan cara menghemat energi karena energi yang dilestarikan/diselamatkan adalah energi yang dihasilkan. Konservasi energi berarti pengurangan konsumsi energi namun tidak berkompromi dengan kualitas atau kuantitas produksi energi. Essensial teoritis dan praktis pengetahuan tentang konsep konservasi energi, manajemen energi, berbagai pendekatan konservasi energi di industri, aspek ekonomi dari proyek konservasi energi dan audit energi dan alat ukur di sektor komersial dan industri akan dicapai melalui Mata kuliah ini. <i>This course is aiming at studying and applying the principles of energy conservation. Energy consumption is increasing day by day. One way to overcome the increase in energy demand is to increase energy production which requires more investment and vice versa and by saving energy because the energy that is conserved is equal to the energy that is produced. Energy conservation means reducing energy consumption but not compromising the quality or quantity of energy production. The outcome of this course is to achieve the essential theoretic and practical knowledge of energy conservation concepts, energy management, various approaches to energy conservation in industry, economic aspects of energy conservation projects and energy audits and measuring instruments in the commercial and industrial sectors.</i>
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. <i>Energy Scenario -Role of Energy Managers in Industries –Energy monitoring, auditing & targeting–Economics of various Energy Conservation schemes. Total Energy Systems</i> 2. <i>Energy Audit -various Energy Conservation Measures in Steam -Losses in Boiler. Energy Conservation in Steam Systems -Case studies.</i> 3. <i>Energy conservation in Centrifugal pumps, Fans & Blowers, Air compressor –energy consumption & energy saving potentials –Design consideration.</i> 4. <i>Refrigeration & Air conditioning -Heat load estimation -Energy conservation in cooling towers & spray ponds –Case studies Electrical Energy - Energy Efficiency in Lighting –Case studies.</i>

		5. <i>Organizational background desired for energy management motivation, detailed process of M&T -Thermostats, Boiler controls-proportional, differential and integral control, optimizers; compensators</i>				
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	- Beggs C. Energy Management, Supply, and Conservation, Published by Elsevier Ltd. All rights reserved, 2009 - Thumann, Albert, Plant engineers and managers guide to energy conservation/ Albert Thumann--8th ed. 2001					
	Pendukung: <i>Supporting</i>					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>		
	-			Private Computer		
Tim Pengajar <i>Team Teaching</i>	Dr. Ridho Hantoro;					
Matakuliah syarat <i>Entry requirement</i>	Fisika Teknik Lanjut, dan Matematika Teknik Lanjut <i>Advanced Engineering Physics, and Advanced Mathematics</i>			Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>	
Mg Ke-Week <i>(1)</i>	Sub-CP-MK <i>Sub-CLO</i> <i>(2)</i>	Indikator Penilaian <i>Assessment Indicator</i> <i>(3)</i>	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> <i>(4)</i>	Metode Pembelajaran <i>[Estimasi Waktu]</i> <i>Learning Method</i> <i>[Work load]</i> <i>(5)</i>	Materi Pembelajaran <i>Course/learning Content</i> <i>(6)</i>	Bobot Penilaian <i>(%)</i> <i>Assesment point (%)</i> <i>(7)</i>
1,2	Mahasiwa mampu mengidentifikasi kesenjangan pasokan permintaan energi (CP-2) <i>Students are able to identify the supply gap of energy demand</i>	● Ketepatan mahasiswa memahami tentang scenario energi, management energi di industri dan monitoring energi <i>Accurate understanding on energy scenarios, energy management in industry and energy monitoring</i>	Tugas 1: ● Review literatur ● Presentasi tentang scenario energi, management energi di industri dan monitoring energi ● Presentasi mengenai Auditing & targeting,	SCL (Kuliah dan diskusi) [TM: 4x(2x50'')] [BT: 4x(2x60'')] [BM: 4x(2x60'')]	1. <i>Energy Scenario</i> 2. <i>Role of Energy Managers in Industries</i> 3. <i>Energy monitoring, auditing & targeting– Economics of various Energy Conservation schemes.</i> 4. <i>Total Energy Systems</i>	5% (CP-MK1)

		Ketepatan mahasiswa dalam memahami dan menjelaskan Auditing & targeting, skema konservasi energi, Total Energy Systems <i>Accurate understanding and explanation on Auditing & targeting in energy conservation schemes and total energy systems</i>	skema konservasi energi, Total Energy Systems <i>ASSIGNMENT 1:</i> <i>Literature review</i> <i>Presentation on energy scenarios, energy management in industry and energy monitoring</i> <i>Presentation on Auditing & targeting in energy conservation schemes and total energy systems</i>		5. <i>Energy Audit</i>	
3-5	Mahasiswa mampu melakukan audit energi suatu industri / organisasi (CP-2, CP-3) <i>Students are able to conduct energy audits of an industry / organization</i>	- Ketepatan mahasiswa memahami dan menganalisa energi audit dan konservasi energi pada steam serta mampu membuat diagram alir energi <i>Accurate understanding and analyzing of energy audits and energy conservation in steam and in making energy flow diagrams</i> - Ketepatan mahasiswa dalam memahami dan mendesain konservasi energi pada centrifugal pump dan	Tugas 2: Non-Test: 1. Review tentang energi audit dan konservasi energi pada steam dan membuat diagram alir energi 2. Review tentang analisa rugi-rugi di boiler dan konservasi energi pada sistem steam; serta membuat diagram alir energi 3. Review mengenai konservasi energi pada centrifugal pump dan menggambarkan diagram alir energinya	Kuliah dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	1. <i>Various Energy Conservation Measures in Steam</i> 2. <i>Losses in Boiler. Energy Conservation in Steam Systems</i> 3. <i>Energy conservation in Centrifugal pumps,</i> 4. <i>Fans & Blowers, Air compressor</i> 5. <i>Case studies.</i>	10% (CP-MK2)

		menggambarkan diagram alir energinya <i>Accurate understanding and designing energy conservation in centrifugal pumps and describing energy flow diagrams</i>	ASSIGNMENT 2: 1. Review on audit energy and energy conservation in steam and making energy flow diagrams 2. Review on losses analysis in the boiler and energy conservation of the steam system; and making energy flow diagrams 3. Review on energy conservation in centrifugal pumps and describing energy flow diagrams			
6.7	Mahasiswa mampu menggambarkan diagram alir energi suatu industri dan mengidentifikasi energi yang terbuang (CP-3) <i>Students are able to draw the energy flow diagram of industry and to identify energy waste.</i>	Ketepatan mahasiswa dalam memahami energi konsumsi dan peluang penghematan energi <i>Accurate understanding of energy consumption and energy saving potential</i>	Non-test: Diskusi energi konsumsi dan peluang penghematan energi angin <i>Non-Test: Discussion energy consumption and energy saving potential</i>	Kuliah dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM:2(2x60")]	1. <i>Energy consumption & energy saving potentials</i> 2. <i>Design consideration.</i>	10% (CP-MK3)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK1) 10% (CP-MK2) 10% (CP-MK3)
9,10	Mahasiswa mampu memilih metode konservasi energi	Ketepatan mhs memahami dan menjeskan menganalisa	TUGAS 3:	Kuliah, brainstorming dan diskusi	1. <i>Refrigeration & Air conditioning</i>	5%

	yang tepat untuk mengurangi pemborosan energi (CP-3, CP-6) <i>Students are able to choose the right energy conservation method to reduce energy waste</i>	peluang penghematan energi di Refrigeration & Air conditioning serta sistem elektrik <i>Appropriate understanding and explanation in analyzing energy saving potential of Refrigeration or Air conditioning and electrical systems</i>	1. Analisa peluang penghematan energi di Refrigeration & Air conditioning 2. Analisa peluang penghematan energi pada sistem elektrik <i>ASSIGNMENT 3:</i> <i>1. The analysis of energy saving potency in Refrigeration & Air conditioning</i> <i>2. The analysis of energy saving potency in electrical systems</i>	[TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	2. <i>Heat load estimation</i> 3. <i>Energy conservation in cooling towers & spray ponds</i> 4. <i>Case studies Electrical Energy</i> 5. <i>Energy Efficiency in Lighting</i> – 6. <i>Case studies</i>	(CP-MK4)
11-13	● Mahasiswa mampu menghitung, menganalisa dan memberikan rekomendasi hasil audit energi yang tepat untuk mengurangi pemborosan energi (CP-3, CP-6) ● <i>Students are able to calculate, analyze and provide appropriate recommendations for energy audit results to reduce energy waste</i>	Ketepatan mahasiswa dalam melakukan analisis dan memberikan rekomendasi dari audit energi di Industri <i>Accurate analysis and appropriate recommendation on the audit energy in industry</i>	TUGAS 4: Tugas Kelompok 1. Mahasiswa memilih studi kasus yang terjadi di Industri 2. Melakukan analisa energi dan lift-cycle assessment 3. Mahasiswa melakukan analisa ekonomi 4. Mahasiswa membuat laporan dan slide presetasi 5. Presentasi hasil diskusi <i>ASSIGNMENT 4: in a group</i> <i>1. Case studies that occur in Industry</i> <i>2. Conduct energy analysis and lift-cycle assessment</i> <i>3. Conduct economic analysis</i> <i>4. Make reports and presentation slides</i>	Kuliah, brainstorming dan diskusi [TM: 3x(2x50")] [BT: 3x(2x60")] [BM: 3x(2x60")]	<i>Organizational background desired for energy management motivation.</i>	5% (CP-MK4)

			<i>5. Presentation of the results of the discussion</i>			
13-15	Mahasiswa mampu mengevaluasi kelayakan teknoekonomi teknik konservasi energi yang diadopsi (CP-3, CP-6) <i>Students are able to evaluate the technological feasibility of the adopted energy conservation techniques.</i>	Ketepatan mahasiswa dalam menganalisa dan mengevaluasi manajemen energi dan proses detailnya. • <i>Accurate analysis and evaluation on energy management and its detailed processes. Accurate identification and calculation of energy balance using supply-demand approach</i>	TUGAS BESAR: 1. Mahasiswa mampu mengetahui latar belakang energi manajemen dan proses detailnya 2. Mampu menganalisa kelayakan teknoekonomi pada Thermostats, Boiler controls-proportional, differential and integral control, optimizers; compensators <i>FINAL PROJECT:</i> 1. <i>Students are able to know the background of energy management and the detailed process</i> 2. <i>Able to analyze the technological feasibility of Thermostats, Boiler controls-proportional, differential and integral control, optimizers; compensators</i>	Kuliah, brainstorming, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. <i>Detailed process of M&T</i> 2. <i>Thermostats.</i> 3. <i>Boiler controls-proportional.</i> 4. <i>Differential and integral control, optimizers; compensators.</i>	7.5% (CP-MK4) 12.5% (CP-MK5)
16	Evaluasi Akhir Semester <i>Final Examination</i>					10% (CP-MK4) 10% (CP-MK5)

Catatan :
Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Audit & Manajemen Energi Energy Audit & Management			RA&E	
				Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>	
Kode (<i>Code</i>): TF185310	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Energi <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 3 <i>Semester:3</i>		
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>Contact Person – Assessment & Evaluation Plan</i> Dr. Ridho Hantoro	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Dr.Ridho Hantoro		

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (7)	Bobot CP-MK5 (8)
1,2	Mahasiwa mampu mengidentifikasi kesenjangan pasokan permintaan energi (CP-2) <i>Students are able to identify the supply gap of energy demand</i>	Tugas 1: - Review literatur - Presentasi tentang scenario energi, management energi di industri dan monitoring energi - Presentasi mengenai Auditing & targeting, skema konservasi energi, Total Energy Systems <i>ASSIGNMENT 1:</i> <i>Literature review</i>	5%				

		• <i>Presentation on energy scenarios, energy management in industry and energy monitoring</i> • <i>Presentation on Auditing & targeting in energy conservation schemes and total energy systems</i>					
3-5	Mahasiswa mampu melakukan audit energi suatu industri / organisasi (CP-2, CP-3) <i>Students are able to conduct energy audits of an industry / organization</i>	Tugas 2: Non-Test: 1. Review tentang energi audit dan konservasi energi pada steam dan membuat diagram alir energi 2. Review tentang analisa rugi-rugi di boiler dan konservasi energi pada sistem steam; serta membuat diagram alir energi 3. Review mengenai konservasi energi pada centrifugal pump dan menggambarkan diagram alir energinya <i>ASSIGNMENT 2:</i> 1. <i>Review on audit energy and energy conservation in steam and making energy flow diagrams</i> 2. <i>Review on losses analysis in the boiler and energy conservation of the steam system; and making energy flow diagrams</i> 3. <i>Review on energy conservation in centrifugal pumps and describing energy flow diagrams</i>		10%			
6,7	Mahasiswa mampu menggambarkan diagram alir energi suatu industri dan mengidentifikasi energi yang terbuang (CP-3) <i>Students are able to draw the energy flow diagram of industry and to identify energy waste.</i>	Non-test: Diskusi energi konsumsi dan peluang penghematan energi angin <i>Non-Test: Discussion energy consumption and energy saving potencial</i>			10%		

8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>		5%	10%	10%		
9,10	Mahasiswa mampu memilih metode konservasi energi yang tepat untuk mengurangi pemborosan energi (CP-3, CP-6) <i>Students are able to choose the right energy conservation method to reduce energy waste</i>	TUGAS 3: 1. Analisa peluang penghematan energi di Refrigeration & Air conditioning 2. Analisa peluang penghematan energi pada sistem elektrik <i>ASSIGNMENT 3:</i> 1. <i>The analysis of energy saving potency in Refrigeration & Air conditioning</i> 2. <i>The analysis of energy saving potency in electrical systems</i>				5%	
11-13	Mahasiswa mampu menghitung, menganalisa dan memberikan rekomendasi hasil audit energi yang tepat untuk mengurangi pemborosan energi (CP-3, CP-6) <i>Students are able to calculate, analyze and provide appropriate recommendations for energy audit results to reduce energy waste</i>	TUGAS 4: Tugas Kelompok 1. Mahasiswa memilih studi kasus yang terjadi di Industri 2. Melakukan analisa energi dan lift-cycle assessment 3. Mahasiswa melakukan analisa ekonomi 4. Mahasiswa membuat laporan dan slide presentasi 5. Presentasi hasil diskusi <i>ASSIGNMENT 4: in a group</i> 1. <i>Case studies that occur in Industry</i> 2. <i>Conduct energy analysis and lift-cycle assessment</i> 3. <i>Conduct economic analysis</i> 4. <i>Make reports and presentation slides</i> 5. <i>Presentation of the results of the discussion</i>				5%	
13-15	Mahasiswa mampu mengevaluasi kelayakan teknoekonomi teknik konservasi energi yang diadopsi (CP-3, CP-6) <i>Students are able to evaluate the technological feasibility of the adopted energy conservation techniques.</i>	TUGAS BESAR: 1. Mahasiswa mampu mengetahui latar belakang energi managemen dan proses detailnya 2. Mampu menganalisa kelayakan teknoekonomi pada Thermostats, Boiler controls-proportional, differential and integral control, optimizers; compensators				5%	15%

		<i>FINAL PROJECT:</i> <i>1. Students are able to know the background of energy management and the detailed process</i> <i>2. Able to analyze the technological feasibility of Thermostats, Boiler controls-proportional, differential and integral control, optimizers; compensators</i>					
16	Evaluasi Akhir Semester <i>Final Examination</i>					10%	10%
Total Bobot Penilaian (%) <i>Total Point</i> (%)			10%	20%	20%	25%	25%

Elective Courses (Instrumentation Engineering)

TF185311 RPS RAE Kontrol Prediktif (*Predictive Control*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Kontrol Prediktif <i>Predictive Control</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185311	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization:</i> <i>Instrumentation Engineering</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Katherin Indriawati, ST, MT	Koordinator RMK <i>Field Coordinator</i> Dr. Katherin Indriawati, ST, MT	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	
	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	
	1. Mahasiswa mampu menganalisis dan melakukan perancangan sistem pengendalian otomatis menggunakan persamaan ruang keadaan (state space) sampai pada optimasi sistem. 2. Mahasiswa mampu berfikir kreatif dalam membuat model sistem pengendalian otomatis dengan menggunakan media TIK, serta mempresentasikan hasil karya rancangan 1. <i>Students are able to analyze and design automatic control systems using state space equation to system optimization</i> 2. <i>Students are able to think creatively in creating automatic control system models using ICT media and presenting design works</i>	
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini memberikan pemahaman dalam konsep perancangan sistem kendali secara prediktif. <i>This lecture provides an understanding of predictive control system design concepts.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Kendali secara Prediktif 2. Model Kendali Internal 3. Sistem Kendali Model Referensi 11. <i>Predictive Control.</i> 12. <i>Internal Model Control</i> 13. <i>Reference Model Control</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	
	4. Camacho and Bourdon, Model Predictive Control, Springer Verlag, 2000. 5. Anshari R.M, Tade M O, Nonlinear Model Based Process Control – Application in Petroleum Refining, Springer Verlag, 2000. 6. Bela L Liptak , Control Process, Chilton BC. 1995	
	Pendukung: <i>Supporting</i>	

Media Pembelajaran <i>Learning Media</i>		Perangkat lunak: <i>Software</i>		Perangkat keras: <i>Hardware</i>		
		-		Private Computer		
Tim Pengajar <i>Team Teaching</i>		Dr Katherin Indriawati, ST, MT and Dr Bambang L. Widjiantoro, ST, MT.				
Matakuliah syarat <i>Entry requirement</i>		Pemrosesan Sinyal <i>Signal Processing</i>		Bahasa pengantar: <i>Languages</i>		Bahasa Indonesia <i>Indonesian</i>
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessm ent point</i> (%) (7)
1-2	Mahasiswa mampu menganalisis dan melakukan perancangan sistem pengendalian otomatis menggunakan persamaan ruang keadaan (state space), sampai pada optimasi <i>Students are able to analyze and design automatic control systems using state space equation to system optimization</i>	Ketepatan menjelaskan dengan benar prinsip dasar kendali secara prediktif. <i>Accuracy explains correctly about basic principles of predictive control.</i>	TUGAS 1: Mahasiswa menyusun makalah dari literatur jurnal mengenai opini kendali secara prediktif dan presentasi. <i>ASSIGNMENT 1: Students compile papers from journal literature regarding predictive control opinions and present the result.</i>	SCL (Kuliah, e-learning dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Kendali secara Prediktif <i>Predictive Control</i>	10% (CP-MK1)
3-4		Ketepatan dalam menganalisis model kendali internal. <i>Accuracy analyzes correctly about internal model control.</i>	TUGAS 2: Mahasiswa menyusun makalah dari literatur jurnal mengenai kajian	Kuliah, e-learning dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Model Kendali Internal <i>Internal Model Control</i>	10% (CP-MK1)

			model kendali internal dan presentasi. <i>ASSIGNMENT 2: Students compile papers from journal literature regarding internal model control research and present the result.</i>			
5-7		Ketepatan dalam menganalisis system kendali model referensi. <i>Accuracy in analyzing correctly about reference model control systems.</i>	TUGAS 3: Mahasiswa menyusun makalah dari literatur jurnal mengenai deskripsi sistem kendali model referensi dan presentasi. <i>ASSIGNMENT 3: Students compile papers from journal literature regarding description of reference model control systems and present the result.</i>	Kuliah, e-learning dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Sistem Kendali Model Referensi <i>Reference Model Control Systems</i>	10% (CP-MK1)
5% (CP-MK2)						
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					20% (CP-MK1)
9,10	Mahasiswa mampu berfikir kreatif dalam membuat model sistem pengendalian otomatis	Ketepatan dalam menganalisis Internal model control	TUGAS 4: Mahasiswa menyusun makalah dari literatur	Kuliah, e-learning dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')]	Kendali secara Prediktif <i>Predictive Control</i>	10% (CP-MK2)

	dengan menggunakan media TIK, serta mempresentasikan hasil karya rancangan <i>Students are able to think creatively in creating automatic control system models using ICT media and presenting design works</i>	<i>Accuracy analyzes correctly about internal model control.</i>	jurnal mengenai predictive control <i>ASSIGNMENT 4:</i> <i>Students compile papers from journal literature regarding predictive control and present the result.</i>	[BM: 2x(2x60'')]		
11-12		Ketepatan dalam menganalisis Internal mode control. <i>Accuracy in analyzing correctly about internal model control.</i>	TUGAS 5: Mahasiswa menyusun makalah dari literatur jurnal mengenai model kendali internal dan presentasi. <i>ASSIGNMENT 5:</i> <i>Students compile papers from journal literature regarding internal model control and present the result.</i>	Kuliah, e-learning dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Model Kendali Internal <i>Internal Model Control</i>	10% (CP-MK2)
13-15		Ketepatan dalam menganalisis Reference mode control. <i>Accuracy in analyzing correctly about reference model control.</i>	TUGAS 6: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistem kendali model referensi dan presentasi. <i>ASSIGNMENT 6:</i> <i>Students compile papers from journal literature regarding reference model</i>	Kuliah, e-learning dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Kendali Model Referensi <i>Reference Model Control</i>	10% (CP-MK2)

			<i>control systems and present the result.</i>			
16	Evaluasi Akhir Semester <i>Final Examination</i>					10% (CP-MK3) 15% (CP-MK4)

Catatan :

Note

2. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) <i>ASSESSMENT & EVALUATION PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI IST <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RA&E
	Kontrol Prediktif <i>Predictive Control</i>		Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185311	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization:</i> <i>Instrumentation Engineering</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i> Dr. Katherin Indriawati, ST, MT	Koordinator RMK <i>Field Coordinator</i> Dr. Katherin Indriawati, ST, MT	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)
1,2	Mahasiswa mampu menganalisis dan melakukan perancangan sistem pengendalian otomatis menggunakan persamaan ruang keadaan (state space), sampai pada optimasi <i>Students are able to analyze and design automatic control systems using state space equation to system optimization</i>	TUGAS 1: Mahasiswa menyusun makalah dari literatur jurnal mengenai opini kendali secara prediktif dan presentasi. <i>ASSIGNMENT 1:</i> <i>Students compile papers from journal literature regarding predictive control opinions and present the result.</i>	10%	
3,4		TUGAS 2: Mahasiswa menyusun makalah dari literatur jurnal mengenai kajian model kendali internal dan presentasi. <i>ASSIGNMENT 2:</i> <i>Students compile papers from journal literature regarding internal model control research and present the result.</i>	10%	
5-7		TUGAS 3: Mahasiswa menyusun makalah dari literatur jurnal mengenai deskripsi sistem kendali model referensi dan presentasi. <i>ASSIGNMENT 3:</i> <i>Students compile papers from journal literature regarding description of reference model control systems and present the result.</i>	10%	
8	Evaluasi Tengah Semester (<i>Mid Term Examination</i>)		20%	
9,10	Mahasiswa mampu berfikir kreatif dalam membuat model sistem pengendalian otomatis dengan menggunakan media TIK, serta mempresentasikan hasil karya rancangan <i>Students are able to think creatively in creating automatic control system models using ICT media and presenting design works</i>	TUGAS 4: Mahasiswa menyusun makalah dari literatur jurnal mengenai predictive control <i>ASSIGNMENT 4:</i> <i>Students compile papers from journal literature regarding predictive control and present the result.</i>		10%

11,12		TUGAS 5: Mahasiswa menyusun makalah dari literatur jurnal mengenai model kendali internal dan presentasi. <i>ASSIGNMENT 5: Students compile papers from journal literature regarding internal model control and present the result.</i>		10%
13-15		TUGAS 6: Mahasiswa menyusun makalah dari literatur jurnal mengenai sistem kendali model referensi dan presentasi. <i>ASSIGNMENT 6: Students compile papers from journal literature regarding reference model control systems and present the result.</i>		10%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)			
Total Bobot Penilaian (%) <i>Total Point (%)</i>			50%	50%

TF185312 RPS RAE Pengendalian Proses secara Statistik (*Statistical Process Control*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Pengendalian Proses Secara Statistik <i>Statistical Process Control</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185312	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization:</i> Instrumentation Engineering	Smt: 3 <i>Semester:</i> 3

OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Ir. Syamsul Arifin	Koordinator RMK Field Coordinator Dr. rer. nat. Ir. Aulia M. T. N., MSc	Ka PRODI Head of Master Program Aulia M T Nasution
Capaian Pembelajaran (CP) Learning Outcome (LO)	CP-PRODI Program Learning Outcome (PLO)	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37.5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Are able to effectively communicate in both oral and written format.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i>	
	CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu memahami filosofi dan konsep dasar tentang perbaikan kualitas (quality improvement) (CP-2) (12.5%) <i>Students are able to understand the philosophy and basic concepts of quality improvement</i> 2. Mahasiswa mampu menggunakan metode SPC. (CP-6) (12.5%) <i>Students are able to use the SPC method</i> 3. Mahasiswa mampu merancang, menggunakan, dan menginterpretasikan grafik control. (CP-2, CP-5) (25%) <i>Students are able to design, use, and interpret control charts</i> 4. Mahasiswa mampu melakukan analisis kapabilitas proses dan kapabilitas sistem pengukuran, serta (CP-6, CP-5) (25%) <i>Students are able to analyze process capability and measurement system capability, as well as</i> 5. Mahasiswa mampu menunjukkan kemampuan merancang eksperimen untuk analisis kualitas. (CP-2, CP-6) (25%) <i>Students are able to demonstrate the ability to design experiments for quality analysis</i>	

Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini mempelajari tentang filosofi dan konsep dasar tentang perbaikan kualitas (quality improvement) dengan metode SPC sehingga mahasiswa mampu melakukan analisis kapabilitas proses dan kapabilitas sistem pengukuran. <i>This course learns about the philosophy and basic concepts of quality improvement using the SPC method so that students are able to analyze process capabilities and measurement system capabilities.</i>		
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Perbaikan kualitas proses / <i>Process quality improvement</i> 2. Metode dan filosofi SPC / <i>SPC method and philosophy</i> 3. Grafik kontrol untuk variable / <i>Control graph for variable</i> 4. Grafik kontrol untuk atribut / <i>Control graph for attributes</i> 5. Grafik kontrol CUSUM dan EWMA / <i>CUSUM and EWMA control charts</i> 6. Analisis kapabilitas / <i>Capability analysis</i> 7. Acceptance sampling / <i>Acceptance sampling</i> 8. Analisis korelasi / <i>Correlation analysis</i> 9. Rancangan eksperimen / <i>Experimental design</i> 10. Analisis varian (ANOVA) / <i>Analysis of variance (ANOVA)</i>		
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>		
	1. Introduction to Statistical Quality Control, 7th Edition, Douglas C. Montgomery, 2013, John Wiley & Sons Inc., New York. 2. Statistical Process Control, 2nd Edition, Leonard A. Doty, 1996, Industrial Press Inc., New York. 3. Six Sigma Pocket Guide, Rath & Strong, 2002, Lexington, MA		
	Pendukung: <i>Supporting</i>		
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras: <i>Hardware</i>	
	-	Private Computer	
Tim Pengajar <i>Team Teaching</i>	Dr. Ir. Syamsul Arifin, MT		
Matakuliah syarat <i>Entry requirement</i>	-	Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>

Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessment point (%)</i> (7)
1,2	Mampu memahami filosofi dan konsep dasar tentang perbaikan kualitas (quality improvement) <i>Students are able to understand the philosophy and basic concepts of quality improvement</i>	● Mahasiswa mampu memberikan contoh parameter kualitas dari sebuah proses ● Mahasiswa mampu memberikan contoh kasus perbaikan kualitas proses ● <i>Students are able to provide examples of quality parameters of a process</i> ● <i>Students are able to provide examples of process quality improvement cases</i>	Tugas 1: ● Makalah – tentang parameter kualitas dari sebuah proses dan contoh kasus perbaikan kualitas proses ● Presentasi <i>Assessment 1:</i> ● <i>Papers – about the quality parameters of a process and case examples of process quality improvement</i> <i>Presentation</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Perbaikan kualitas proses / <i>Process quality improvement</i>	10% (CP-MK1)
3,4	Mampu menggunakan dan memahami metode SPC <i>Students are able to use and understand the SPC method</i>	● Mahasiswa mampu menjelaskan konsep dasar SPC ● Mahasiswa mampu memberikan contoh kasus aplikasi SPC ● <i>Students are able to explain the basic concepts of SPC</i> ● <i>Students are able to provide examples of SPC application cases</i>	Tugas 2: ● Makalah – tentang konsep dasar SPC dan contoh aplikasinya ● Presentasi <i>Assessment 2:</i> ● <i>Papers – on the basic concepts of SPC and examples of their applications</i> ● <i>Presentation</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Metode dan filosofi SPC / <i>SPC method and philosophy</i>	10% (CP-MK2)

5-7	Mampu merancang, menggunakan, dan menginterpretasikan grafik kontrol <i>Students are able to design, use and interpret control charts</i>	● Mahasiswa mampu membuat grafik kontrol Shewhart ● Mahasiswa mampu membuat grafik kontrol yang direvisi ● Mahasiswa mampu membuat grafik EWMA dan CUSUM ● <i>Students are able to create a Shewhart control chart</i> ● <i>Students are able to make revised control charts</i> ● <i>Students are able to make EWMA and CUSUM graphs</i>	Tugas 3: ● Makalah – tentang grafik kontrol Shewhart, EWMA dan CUSUM ● Presentasi <i>Assessment 3:</i> ● <i>Papers – on Shewhart, EWMA and CUSUM control charts</i> ● <i>Presentation</i>	Kuliah dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Grafik kontrol untuk variable / <i>Control graph for variable</i> Grafik kontrol untuk atribut / <i>Control graph for attributes</i> Grafik kontrol CUSUM dan EWMA / <i>CUSUM and EWMA control charts</i>	20% (CP-MK3)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					2.5% (CP-MK1) 2.5% (CP-MK2) 5% (CP-MK3)
9-11	Mampu melakukan analisis kapabilitas proses dan kapabilitas sistem pengukuran <i>Students are able to analyze process capability and measurement system capability</i>	● Mahasiswa mampu menghitung rasio kapabilitas proses. ● Mahasiswa mampu memberikan contoh kasus kapabilitas sistem pengukuran. ● Mahasiswa mampu menggunakan kurva operating characteristic	Makalah – tentang rasio kapabilitas proses, contoh kasus kapabilitas sistem pengukuran serta kurva operating characteristic. <i>Papers – about process capability ratios, case examples of measurement system capabilities and operating characteristic curves.</i> Presentasi makalah <i>Presentation</i>	Kuliah, brainstorming dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Analisis kapabilitas / <i>Capability analysis</i> Acceptance sampling / <i>Acceptance sampling</i>	20% (CP-MK4)

		• <i>Students are able to calculate the ratio of process capability.</i> • <i>Students are able to provide examples of measurement system capability cases.</i> • <i>Students are able to use the operating characteristic curve.</i>				
12-15	Mampu merancang eksperimen untuk analisis kualitas proses <i>Students are able to analyze process capability and measurement system capability</i>	• Mahasiswa mampu melakukan analisis korelasi • Mahasiswa mampu mengidentifikasi faktor proses yang signifikan • Mahasiswa mampu membuat rancangan eksperimen • Mahasiswa mampu melakukan analisis varian • <i>Students are able to perform correlation analysis</i> • <i>Students are able to identify significant process factors</i> • <i>Students are able to make experimental designs</i> • <i>Students are able to perform analysis of variance</i>	Makalah– kejelasan dan ketajaman metode yang digunakan dalam menganalisis meta sains <i>Papers – clarity and sharpness of the methods used in analyzing meta-science</i> Presentasi makalah <i>Presentation</i>	Kuliah, brainstorming, presentasi dan diskusi [TM: 3x(2x50’)] [BT: 3x(2x60’)] [BM: 3x(2x60’)]	Analisis korelasi / <i>Correlation analysis</i> Rancangan eksperimen / <i>Experimental design</i> Analisis varian (ANOVA) / <i>Analysis of variance (ANOVA)</i>	20% (CP-MK5)
16	Evaluasi Akhir Semester Evaluasi Akhir Semester					5% (CP-MK4) 5% (CP-MK5)

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Pengendalian Proses Secara Statistik Statistical Process Control						RA&E
							Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185312	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: <i>Instrumentation Engineering</i>				Smt: 3 <i>Semester: 3</i>	
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Dr. Ir. Syamsul Arifin	Koordinator RMK Field Coordinator Dr. rer. nat. Ir. Aulia M. T. N., MSc				Ka PRODI Head of Master Program Aulia M T Nasution	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot (%) CP-MK4 (7)	Bobot (%) CP-MK5 (8)
1,2	Mampu memahami filosofi dan konsep dasar tentang perbaikan kualitas (quality improvement) <i>Students are able to understand the philosophy and basic concepts of quality improvement</i>	Tugas 1: • Makalah – tentang parameter kualitas dari sebuah proses dan contoh kasus perbaikan kualitas proses • Presentasi <i>Assessment 1:</i> • <i>Papers – about the quality parameters of a process and case examples of process quality improvement</i> • <i>Presentation</i>	10%				

3,4	Mampu menggunakan dan memahami metode SPC <i>Students are able to use and understand the SPC method</i>	Tugas 2: • Makalah – tentang konsep dasar SPC dan contoh aplikasinya • Presentasi Assessment 2: • <i>Papers – on the basic concepts of SPC and examples of their applications</i> • <i>Presentation</i>		10%			
5-7	Mampu merancang, menggunakan, dan menginterpretasikan grafik kontrol <i>Students are able to design, use and interpret control charts</i>	Tugas 3: • Makalah – tentang grafik kontrol Shewhart, EWMA dan CUSUM • Presentasi Assessment 3: • <i>Papers – on Shewhart, EWMA and CUSUM control charts</i> • <i>Presentation</i>			20%		
8	Evaluasi Tengah Semester (<i>Mid-Term Examination</i>)		2.5%	2.5%	5%		
9-11	Mampu melakukan analisis kapabilitas proses dan kapabilitas sistem pengukuran <i>Students are able to analyze process capability and measurement system capability</i>	Makalah – tentang rasio kapabilitas proses, contoh kasus kapabilitas sistem pengukuran serta kurva operating characteristic. <i>Papers – about process capability ratios, case examples of measurement system capabilities and operating characteristic curves.</i> Presentasi makalah <i>Presentation</i>				20%	
12-15	Mampu merancang eksperimen untuk analisis kualitas proses	Makalah– kejelasan dan ketajaman metode yang digunakan dalam menganalisis meta sains <i>Papers – clarity and sharpness of the methods used in analyzing meta-science</i>					20%

	<i>Students are able to analyze process capability and measurement system capability</i>	Presentasi makalah <i>Presentation</i>					
16	Evaluasi Akhir Semester <i>(Final Examination)</i>					5%	5%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			12.5%	12.5%	25%	25%	25%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Kecerdasan Buatan untuk Sistem Instrumentasi <i>Artificial Intelligence for Instrumentation Systems</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185313	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Ir. Syamsul Arifin	Koordinator RMK <i>Field Coordinator</i> Dr. rer. nat. Ir. Aulia M. T. N., MSc	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37.5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Are able to effectively communicate in both oral and written format.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i>	

	CP-MK Course Learning Outcome (CLO)	1. Mampu menjelaskan prinsip, klasifikasi dan fungsi sistem kecerdasan buatan secara mandiri dan bertanggung jawab. (CP-2, CP-6) (25%) <i>Able to explain the principles, classifications and functions of artificial intelligence systems independently and responsibly</i> 2. Mampu merancang simulasi sistem kecerdasan buatan fuzzy dalam bidang instrumentasi dg pendekatan inter dan multi disiplin. (CP-2, CP-6) (25%) <i>Able to design simulations of fuzzy artificial intelligence systems in the field of instrumentation with inter and multi-disciplinary approaches</i> 3. Mampu merancang simulasi sistem kecerdasan buatan JST dalam bidang instrumentasi dg pendekatan inter dan multi disiplin. (CP-2, CP-6) (25%) <i>Able to design ANN artificial intelligence system simulations in the field of instrumentation with inter and multi-disciplinary approaches</i> 4. Mampu mempresentasikan hasil rancangan sistem kecerdasan buatan secara ilmiah, mandiri, kreatif, inovatif, dan penuh tanggung jawab, serta bebas plagiasi. (CP-5) (25%) <i>Able to present the results of the artificial intelligence system design scientifically, independently, creatively, innovatively, and full of responsibility, and free of plagiarism</i>
Diskripsi Singkat MK Course Description	Kuliah ini membahas tentang teori serta penerapan sistem kecerdasan buatan pada instrumentasi untuk meningkatkan performansinya. Materi utama kuliah ini adalah sistem logika fuzzy, jaringan syaraf tiruan dan sistem pakar. <i>This lecture discusses the theory and application of artificial intelligence systems to instrumentation to improve its performance. The main materials of this course are fuzzy logic systems, artificial neural networks and expert systems.</i>	
Pokok Bahasan / Bahan Kajian Module content	1. Sistem kecerdasan buatan / <i>Artificial intelligence system</i> 2. Rule-Based Expert systems / <i>Rule-Based Expert systems</i> 3. Sistem Fuzzy: Klasifikasi logika fuzzy, himpunan fuzzy, relasi, mesin penalar fuzzy, simulasi sistem kecerdasan buatan / sistem pakar dengan logika fuzzy <i>Fuzzy System: Classification of fuzzy logic, fuzzy sets, relations, fuzzy reasoning engine, simulation of artificial intelligence systems / expert systems with fuzzy logic.</i> 4. Jaringan syaraf tiruan (JST): konsep dan arsitektur JST, model-model JST, aplikasi JST dalam bidang instrumentasi, simulasi sistem kecerdasan buatan / sistem pakar dengan JST <i>Artificial Neural Networks (ANN): ANN concepts and architecture, ANN models, ANN applications in the field of instrumentation, simulation of artificial intelligence systems / expert systems with ANN.</i>	
Pustaka Reading Materials	Utama: Main	1. Negnevitsky, M. (2002). Artificial Intelligence: A Guide to Intelligent Systems. England: Eddison Wesley. 2. Russell, S. J., & Norvig, P. (2010). Artificial Intelligence: A Modern Approach (3 ed.). New Jersey: Prentice Hall. 3. Schalkoff, R. J. (1990). Artificial Intelligence: An Engineering Approach. Singapore: McGraw-Hill International Editions. 4. Harris, J. (2006). Fuzzy Logic Applications in Engineering Science. Dordrecht, The Netherlands: Springer.

		Pendukung: <i>Supporting</i> 1. Budiharto, W., & Suhartono, D. (2014). Artificial Intelligence: Konsep dan Penerapannya. Yogyakarta: ANDI. 2. Sadeghian, A., & Mendel, J. M. (2013). Advances in Type-2 Fuzzy Sets and Systems: Theory and Applications. (H. Tahayori, Penyunt.) New York: Springer. 3. Ross, T. J. (2004). Fuzzy Logic With Engineering Applications (2 ed.). England: John Wiley & Sons. Suyanto. (2014). Artificial Intelligence: Searching-Reasoning-Planning-Learning (2 ed.). Bandung: Informatika.				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak: <i>Software</i> -		Perangkat keras: <i>Hardware</i> <i>Private Computer</i>		
Tim Pengajar <i>Team Teaching</i>		Dr. Imam Abadi, ST, MT. Dr. Suyanto, ST, MT.				
Matakuliah syarat <i>Entry requirement</i>		1. Matematika Teknik Lanjut / <i>Advanced Engineering Mathematics</i> 2. Dinamika Sistem Lanjut / <i>Advanced Dynamic Systems</i> 3. Instrumentasi Lanjut / <i>Advanced Instrumentation</i>		Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>	
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [<i>Work load</i>] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessm ent point</i> (%) (7)
1	Mampu menjelaskan pengertian, cabang-cabang, dan sejarah perkembangan ilmu kecerdasan buatan; <i>Students are able to explain the meaning, branches, and history of the development of artificial intelligence;</i>	Ketepatan menjelaskan pengertian, cabang-cabang, dan sejarah perkembangan ilmu kecerdasan buatan; <i>Accuracy in explaining the meaning, branches, and history of the development of artificial intelligence;</i>	Tugas 1: Mereview dan meringkas journal dan sumber rujukan dalam bentuk poster makalah. <i>Task 1: Reviewing and summarizing journals and reference sources in the form of paper posters.</i>	SCL (Kuliah dan diskusi) [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Sistem Kecerdasan Buatan: ● Pengertian kecerdasan Buatan atau mesin cerdas; ● Sejarah perkembangan Sistem Kecerdasan Buatan <i>Artificial Intelligence System:</i> ● <i>Definition of Artificial intelligence or intelligent machines;</i> ● <i>History of Artificial Intelligence System development</i>	5% (CP-MK1) 5% (CP-MK4)

2	Mampu merancang dan mengatur rule-based dari system pakar; <i>Students are able to design and manage rule-based expert systems;</i>	Ketepatan merancang dan mengatur rule-based dari system pakar; <i>Accuracy in designing and managing rule-based expert systems;</i>	Tugas 2: Merancang rule-based system pakar sederhana dari sebuah studi kasus yang dipilih <i>Task 2:</i> <i>Designing a simple rule-based expert system from a selected case study</i>	Kuliah dan diskusi [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Sistem Pakar: ● Rule-Based Expert systems; ● Uncertainty management in Rule-Based Expert systems <i>Expert system:</i> ● <i>Rule-Based Expert systems;</i> ● <i>Uncertainty management in Rule-Based Expert systems</i>	5% (CP-MK1) 5% (CP-MK2)
3-5	Mampu menggunakan berbagai tipe logika fuzzy pada system pakar; serta merancang mesin penalar fuzzy pada system pakar; <i>Students are able to use various types of fuzzy logic in expert systems; as well as designing a fuzzy reasoning engine on an expert system;</i>	Kesesuaian dan ketepatan menggunakan berbagai tipe logika fuzzy pada system pakar; serta merancang mesin penalar fuzzy pada system pakar; <i>Suitability and accuracy of using various types of fuzzy logic in expert systems; as well as designing a fuzzy reasoning engine on an expert system;</i>	Tugas 3: ● Merancang system pakar dengan menggunakan salah satu tipe logika fuzzy dengan mesin penalar pada studi kasus bidang Instrumentasi. ● Menyusun makalah presentasi; ● Menyusun poster makalah; <i>Task 3:</i> ● <i>Designing an expert system using one type of fuzzy logic with a reasoning engine in the case study of the Instrumentation field.</i> ● <i>Prepare presentation papers;</i> ● <i>Prepare paper posters;</i>	Kuliah dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	Fuzzy Expert System ● Himpunan Fuzzy ● Klasifikasi Logika Fuzzy: ● Himpunan dan Logika Fuzzy. ● Fuzzy Inference and Composition <i>Fuzzy Expert System</i> ● <i>Fuzzy Set</i> ● <i>Fuzzy Logic Classification:</i> ● <i>Sets and Fuzzy Logic.</i> ● <i>Fuzzy Inference and Composition</i>	5% (CP-MK1) 10% (CP-MK2)

6,7	Mampu merancang simulasi system pakar dengan logika fuzzy dengan menggunakan FIS-MATLAB; <i>Students are able to design expert system simulations with fuzzy logic using FIS-MATLAB;</i>	Ketepatan merancang simulasi system pakar dengan logika fuzzy dengan menggunakan FIS-MATLAB; <i>The accuracy of designing an expert system simulation with fuzzy logic using FIS-MATLAB;</i>	Tugas 4: - Memilih studi kasus system pakar bidang Instrumentasi; - Merancang simulasi system pakar logika fuzzy dengan menggunakan program FIS-MATLAB dan Simulink. <i>Task 4:</i> <i>Selecting case studies of expert systems in Instrumentation;</i> <i>Designing a fuzzy logic expert system simulation using FIS-MATLAB and Simulink programs.</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Modeling and Simulation Sistem Fuzzy with MATLAB: Studi kasus pada berbagai bidang Instrumentasi. <i>Modeling and Simulation of Fuzzy Systems with MATLAB: Case studies in various fields of Instrumentation.</i>	5% (CP-MK1) 10% (CP-MK2) 5% (CP-MK4)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK1)
9	Mampu menjelaskan prinsip, arsitektur, dan aplikasi JST dalam bidang Instrumentasi. <i>Students are able to explain the principles, architecture, and applications of ANN in the field of Instrumentation.</i>	Ketepatan menjelaskan prinsip, arsitektur, dan aplikasi JST dalam bidang Instrumentasi. <i>Accuracy describes the principles, architecture, and applications of ANN in the field of Instrumentation.</i>	Tugas 5: Mereview, mengkaji, dan menyusun poster makalah tentang arsitektur JST dan fungsi masing-masing elemennya. <i>Task 5:</i> <i>Reviewing, reviewing, and compiling paper posters on ANN architecture and</i>	Kuliah, brainstorming dan diskusi [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Artificial neural Network(JST) - Perkembangan JST, memori dan model, - Aplikasi JST - Arsitektur JST <i>Artificial Neural Network(ANN)</i> <i>Development of ANN, memory and models,</i> <i>ANN Application</i> <i>ANN Architecture</i>	5% (CP-MK3) 5% (CP-MK4)

			<i>the functions of each of its elements.</i>			
10-13	Mampu mengaplikasikan model-model JST pada system pakar di bidang Instrumentasi. <i>Students are able to apply ANN models to expert systems in the field of Instrumentation.</i>	Ketepatan mengaplikasikan model-model JST pada system pakar di bidang Instrumentasi. <i>The accuracy of applying ANN models to expert systems in the field of Instrumentation.</i>	Tugas 6: - Merancang system pakar dengan menggunakan model JST pada studi kasus bidang Instrumentasi; - Menyusun makalah presentasi; - Menyusun poster makalah; <i>Task 6:</i> <i>Designing an expert system using the ANN model in case studies in the Instrumentation field;</i> <i>Prepare presentation papers;</i> <i>Prepare paper posters;</i>	Kuliah, brainstorming, presentasi dan diskusi [TM: 4x(2x50'')] [BT: 4x(2x60'')] [BM: 4x(2x60'')]	Model & Algoritma JST - Model dan Algoritma Hebbian Net, Perceptron Net, Adalin Net, Madalin Net, - Backpropagation Neural Net. - Model Error Based Learning (supervised) - Algoritma pembelajaran Error Based Learning (supervised) <i>ANN Models & Algorithms</i> <i>Models and Algorithms of Hebbian Net, Perceptron Net, Adalin Net, Madalin Net,</i> <i>Backpropagation Neural Net.</i> <i>Error Based Learning Model (supervised)</i> <i>Error Based Learning (supervised) learning algorithm</i>	5% (CP-MK3) 5% (CP-MK4)
14,15	Mampu merancang simulasi system pakar JST dengan menggunakan FIS-MATLAB;	Ketepatan merancang simulasi system pakar JST dengan menggunakan FIS-MATLAB;	Tugas 7: - Memilih studi kasus system pakar bidang Instrumentasi; - Merancang simulasi system JST dengan	Kuliah, brainstorming, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Modeling and Simulation JST with MATLAB: Studi kasus pada berbagai bidang Instrumentasi.	10% (CP-MK3) 5% (CP-MK4)

	<i>Students are able to design simulation of ANN expert system using FIS-MATLAB;</i>	<i>Accuracy in designing ANN expert system simulation using FIS-MATLAB;</i>	menggunakan program ANFIS dan Simulink pd MATLAB; <i>Task 7:</i> • <i>Selecting case studies of expert systems in Instrumentation;</i> • <i>Designing ANN system simulation using ANFIS and Simulink program in MATLAB;</i>		<i>Modeling and Simulation ANN with MATLAB: Case studies in various fields of Instrumentation.</i>	
16	Evaluasi Akhir Semester <i>Final Examination</i>					5% (CP-MK3)

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			RA&E		
	Kecerdasan Buatan untuk Sistem Instrumentasi Artificial Intelligence for Instrumentation Systems			Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>		
Kode (<i>Code</i>): TF185313	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: Instrumentation Engineering		Smt: 3 <i>Semester: 3</i>		
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Dr. Ir. Syamsul Arifin	Koordinator RMK Field Coordinator Dr. rer. nat. Ir. Aulia M. T. N., MSc		Ka PRODI Head of Master Program Aulia M T Nasution		

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1	Mampu menjelaskan pengertian, cabang-cabang, dan sejarah perkembangan ilmu kecerdasan buatan; <i>Students are able to explain the meaning, branches, and history of the development of artificial intelligence;</i>	Tugas 1: Mereview dan meringkas journal dan sumber rujukan dalam bentuk poster makalah. <i>Task 1:</i> <i>Reviewing and summarizing journals and reference sources in the form of paper posters.</i>	5%			5%
2	Mampu merancang dan mengatur rule-based dari system pakar;	Tugas 2: Merancang rule-based system pakar sederhana dari sebuah studi kasus yang dipilih	5%	5%		

	<i>Students are able to design and manage rule-based expert systems;</i>	<i>Task 2: Designing a simple rule-based expert system from a selected case study</i>				
3-5	Mampu menggunakan berbagai tipe logika fuzzy pada system pakar; serta merancang mesin penalar fuzzy pada system pakar; <i>Students are able to use various types of fuzzy logic in expert systems; as well as designing a fuzzy reasoning engine on an expert system;</i>	Tugas 3: - Merancang system pakar dengan menggunakan salah satu tipe logika fuzzy dengan mesin penalar pada studi kasus bidang Instrumentasi. - Menyusun makalah presentasi; - Menyusun poster makalah; <i>Task 3:</i> <i>Designing an expert system using one type of fuzzy logic with a reasoning engine in the case study of the Instrumentation field.</i> <i>Prepare presentation papers;</i> <i>Prepare paper posters;</i>	5%	10%		
6,7	Mampu merancang simulasi system pakar dengan logika fuzzy dengan menggunakan FIS-MATLAB; <i>Students are able to design expert system simulations with fuzzy logic using FIS-MATLAB;</i>	Tugas 4: - Memilih studi kasus system pakar bidang Instrumentasi; - Merancang simulasi system pakar logika fuzzy dengan menggunakan program FIS-MATLAB dan Simulink. <i>Task 4:</i> <i>Selecting case studies of expert systems in Instrumentation;</i> <i>Designing a fuzzy logic expert system simulation using FIS-MATLAB and Simulink programs.</i>	5%	10%		5%
8	Evaluasi Tengah Semester (<i>Mid-Term Examination</i>)		5%			

9	Mampu menjelaskan prinsip, arsitektur, dan aplikasi JST dalam bidang Instrumentasi. <i>Students are able to explain the principles, architecture, and applications of ANN in the field of Instrumentation.</i>	Tugas 5: Mereview, mengkaji, dan menyusun poster makalah tentang arsitektur JST dan fungsi masing-masing elemennya. <i>Task 5:</i> <i>Reviewing, reviewing, and compiling paper posters on ANN architecture and the functions of each of its elements.</i>			5%	5%
10-13	Mampu mengaplikasikan model-model JST pada system pakar di bidang Instrumentasi. <i>Students are able to apply ANN models to expert systems in the field of Instrumentation.</i>	Tugas 6: - Merancang system pakar dengan menggunakan model JST pada studi kasus bidang Instrumentasi; - Menyusun makalah presentasi; - Menyusun poster makalah; <i>Task 6:</i> <i>Designing an expert system using the ANN model in case studies in the Instrumentation field;</i> <i>Prepare presentation papers;</i> <i>Prepare paper posters;</i>			5%	5%
14,15	Mampu merancang sismulasi system pakar JST dengan menggunakan FIS-MATLAB; <i>Students are able to design simulation of ANN expert system using FIS-MATLAB;</i>	Tugas 7: - Memilih studi kasus system pakar bidang Instrumentasi; - Merancang simulasi system JST dengan menggunakan program ANFIS dan Simulink pd MATLAB; <i>Task 7:</i> <i>Selecting case studies of expert systems in Instrumentation;</i>			10%	5%

		• <i>Designing ANN system simulation using ANFIS and Simulink program in MATLAB;</i>				
16	Evaluasi Akhir Semester (<i>Final Examination</i>)				5%	
Total Bobot Penilaian (%) <i>Total Point</i> (%)			25%	25%	25%	25%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Fisika Tubuh Manusia <i>Physics of Human Body</i>		RP Edisi: Agt 2018 Edition: Aug 2018
	Kode: TF185321 Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Medis Field of Specialization: Medical Engineering	Smt: 3 Semester: 3
OTORISASI <i>(Authorization)</i>	Pengembang RP Contact Person – Learning Plan Dr. Aulia Nasutiun	Koordinator RMK Field Coordinator Dr. Aulia Nasutiun	Ka PRODI Head of Master Program Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra-maupun multidisiplin ilmu. (37.5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Are able to effectively communicate in both oral and written format.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i>	

	CP-MK 1. Mampu menjelaskan dengan baik pembagian taksonomi tubuh manusia dari skala ukuran yang paling besar ke skala ukuran yang lebih kecil: tubuh, sistem organ, organ, tissue, sel, molekul, hingga atom penyusunnya, serta kaitan dengan letak, diferensiasi, dan fungsi masing-masingnya [FTM-1]. <i>Students are able to explain well the taxonomic division of the human body from the largest size scale to the smaller size scale: the body, organ systems, organs, tissues, cells, molecules, to their constituent atoms, as well as their relation to the location, differentiation, and function of each -each [FTM-1].</i> 2. Mahasiswa mampu menjelaskan dengan baik mekanisme sistem homeostatik tubuh, yang bekerja berdasar berbagai stimulus fisis spesifik, dan mampu menganalisis berbagai variabel fisis yang terlibat dalam mekanisme aksi-reaksi dari proses tersebut [FTM-2]. <i>Students are able to explain well the mechanism of the body's homeostatic system, which works based on various specific physical stimuli, and are able to analyze various physical variables involved in the action-reaction mechanism of the process [FTM-2].</i> 3. Mahasiswa mampu menjelaskan dengan baik berbagai fenomena pembangkitan berbagai sinyal fisis dalam level selular, mekanisme dalam proses perambatannya, serta menganalisis berbagai kondisi yang menyebabkan terjadinya perubahan karakteristik sinyal tersebut [FTM-3]. <i>Students are able to explain well various phenomena of the generation of various physical signals at the cellular level, the mechanisms in their propagation process, and analyze various conditions that cause changes in the characteristics of these signals [FTM-3].</i> 4. Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4]. <i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the processed signal results to understand well the condition of the organ/organ system being reviewed [FTM-4].</i> 5. Mahasiswa mampu menjelaskan karakteristik dari berbagai komponen penting dari suatu sistem instrumen medis yang digunakan untuk keperluan ekstraksi sinyal fisis tersebut, dan mampu menjelaskan proses kalibrasi dan pengukuran yang diperlukan untuk dapat menghasilkan kuantifikasi sinyal terolah yang akurat, presisi [FTM-5]. <i>Students are able to explain the characteristics of various important components of a medical instrument system used for the purpose of extracting these physical signals, and are able to explain the calibration and measurement processes needed to produce accurate, precise quantification of processed signals [FTM-5].</i>
Diskripsi Singkat MK <i>Course Description</i>	MK Fisika Tubuh Manusia (Physics of Human Body) ini merupakan mata kuliah pilihan, untuk memperkenalkan mahasiswa akan berbagai aspek fisika dari tubuh manusia. Pemahaman akan karakteristik fisis tubuh manusia ini sangat penting bagi seorang Teknik Fisikawan (Engineering Physicist) pada level magister, khususnya sebagai bekal keilmuan dalam melakukan upaya riset pengembangan suatu sistem instrumentasi baru untuk keperluan diagnostik maupun terapi. Tubuh manusia menyimpan berbagai kode enkripsi atas karakteristik fisis yang perlu dipecahkan, serta

	dipahami secara mendalam detail karakteristik dan rentang keberlakuan terkaitnya. Berbagai teknologi yang telah dikembangkan dalam banyak penggunaan dalam bidang medis berangkat dari riset panjang atas pemahaman karakteristik fisis tubuh manusia, yang sebelumnya tidak dipahami (encrypted) ini. Sebut saja misalkan penemuan ECG, EEG, dan EMG yang berbasis fenomena bioelektrik, MEG dan MRI yang berbasis fenomena biomagnetik, Radiografi X-ray, CT Scan, Gamma Camera, dan PET yang berbasis interaksi tubuh dengan berbagai jenis sumber radiasi mengion seperti sinar-x dan sinar gamma. Diharapkan pemahaman mahasiswa yang mendalam akan karakteristik fisis dari tubuh manusia dapat memicu penelitian lanjutan untuk pengembangan berbagai teknologi diagnostik dan terapi yang lebih akurat, presisi, sekaligus spesifik. <i>This course is an elective course, to introduce students to various aspects of the physics of the human body. An understanding of the physical characteristics of the human body is very important for an Engineering Physicist at the master's level, especially as a scientific provision in conducting research efforts to develop a new instrumentation system for diagnostic and therapeutic purposes. The human body stores various encryption codes for physical characteristics that need to be deciphered, and it is understood in detail the characteristics and their associated range of validity. Various technologies that have been developed in many uses in the medical field depart from long research on understanding the physical characteristics of the human body, which were previously not understood (encrypted). For example, the discovery of ECG, EEG, and EMG based on bioelectric phenomena, MEG and MRI based on biomagnetic phenomena, X-ray radiography, CT Scan, Gamma Camera, and PET based on the interaction of the body with various types of ionizing radiation sources such as x-rays. and gamma rays. It is hoped that students' in-depth understanding of the physical characteristics of the human body can trigger further research for the development of various diagnostic and therapeutic technologies that are more accurate, precise, as well as specific.</i>
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Pendahuluan: Kajian tentang tubuh manusia, pembagian keilmuan, serta taksonominya <i>Introduction: The study of the human body, the division of knowledge, and its taxonomy</i> 2. Sistem homeostatik dalam tubuh: berbagai mekanisme aksi-reaksi yang dikenal, sinyal stimulus dan aksi, serta berbagai variabel fisis yang terlibat didalamnya. <i>Homeostatic system in the body: various known action-reaction mechanisms, stimulus and action signals, as well as various physical variables involved in it.</i> 3. Sel: struktur, komponen, mekanisme transpor selular yang terjadi, dan proses differensiasinya. <i>Cell: structure, components, mechanism of cellular transport that occurs, and the process of differentiation.</i> 4. Sinyal Bioelektrik: penghasilan, perambatan, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Bioelectric signal: generation, propagation, factors that change signal parameters, quantification process, as well as various examples of instrument systems used to measure and perceive them.</i> 5. Sinyal Biomagnetik: penghasilan (internal/pasif dan eksternal), perambatan gelombang, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Biomagnetic Signals: generation (internal/passive and external), wave propagation, factors that change signal parameters, quantification processes, as well as various examples of instrument systems used to measure and perceive them.</i> 6. Sinyal Biooptik: sumber penghasilan (eksternal), perambatan, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya.

	<i>Biooptic signals: sources of (external) generation, propagation, factors that change signal parameters, quantification processes, as well as various examples of instrument systems used to measure and perceive them.</i> 7. Ultrasound wave: sumber penghasilan, mekanisme perambatan dan interaksinya di dalam tubuh, faktor yang mengubah perubahan parameter sinyal, proses kuantifikasi atas perubahan parameter sinyal ini, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Ultrasound waves: sources of production, mechanisms of propagation and their interactions in the body, factors that alter changes in signal parameters, the quantification process for changes in these signal parameters, as well as various examples of instrument systems used to measure and perceive them.</i> 8. Radiasi mengion (ionizing radiation): sumber penghasilan, mekanisme perambatan dan interaksinya di dalam tubuh, faktor yang mengubah perubahan parameter sinyal, proses kuantifikasi atas perubahan parameter sinyal ini, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Ionizing radiation: sources of production, mechanisms of propagation and interactions in the body, factors that alter changes in signal parameters, the process of quantifying these changes in signal parameters, as well as various examples of the instrument systems used to measure and perceive them.</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	1. Marieb, E.N. and Hoehn, K., Human Anatomy and Physiology, Pearson Education Limited, Harlow UK, 2015 2. Bronzino, J.D., Peterson, D.R., The Biomedical Engineering Handbook, Fourth Edition, CRC Press, Boca Raton FL, 2015.
	Pendukung: <i>Supporting</i>	1. Splinter, R., Handbook of physics in medicine and biology, CRC Press, Boca Raton, FL, 2010. 2. Herman, I.P., Physics of the Human Body, Second Ed., Springer-Verlag, Berlin Heidelberg, 2016.
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak : <i>Software</i>	Perangkat keras : <i>Hardware</i>
	OS:Windows; Office, Video demo, Matlab	PC & LCD Projector
Team Teaching <i>Team Teaching</i>	Sekartedjo, Aulia MT Nasution, Agus Muhamad Hatta	
Matakuliah syarat <i>Entry requirement</i>	-	

Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i>	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%)
------------------------------	------------------------------------	---	--------------------------------	---	--	---------------------------

			Criteria & Assessment Form (4)	[Work load] (5)		Assessment point (%) (7)
1,2	Mahasiswa Mampu menjelaskan dengan baik pembagian taksonomi tubuh manusia dari skala ukuran yang paling besar ke skala ukuran yang lebih kecil: tubuh, sistem organ, organ, tissue, sel, molekul, hingga atom penyusunnya, serta kaitan dengan letak, diferensiasi, dan fungsi masing-masingnya. <i>Students are able to explain well the taxonomic division of the human body from the largest size scale to the smaller size scale: the body, organ systems, organs, tissues, cells, molecules, to their constituent atoms, as well as the relationship with the location, differentiation, and function of each.</i>	Ketepatan menjelaskan Kajian tentang tubuh manusia, pembagian keilmuan, serta taksonominya <i>Accuracy in explaining the study of the human body, the division of knowledge, and its taxonomy</i> <i>Accuracy in explaining cell-related concepts which include structure, components, cellular transport mechanisms that occur, and the process of differentiation.</i>	-	Kuliah, Diskusi <i>Lecture, Discussion</i>	Pendahuluan: Kajian tentang tubuh manusia, pembagian keilmuan, serta taksonominya <i>Introduction: The study of the human body, the division of knowledge, and its taxonomy</i>	
3,4	Mahasiswa Mampu menjelaskan dengan baik pembagian taksonomi	Ketepatan dalam menjelaskan konsep terkait sel yang meliputi	Non-Test Tugas 1: Mahasiswa merangkum	Kuliah, Diskusi, Review paper journal	Sel: struktur, komponen, mekanisme transpor selular yang terjadi, dan proses	10%

	tubuh manusia dari skala ukuran yang paling besar ke skala ukuran yang lebih kecil: tubuh, sistem organ, organ, tissue, sel, molekul, hingga atom penyusunnya, serta kaitan dengan letak, diferensiasi, dan fungsi masing-masingnya <i>Students are able to explain well the taxonomic division of the human body from the largest size scale to the smaller size scale: the body, organ systems, organs, tissues, cells, molecules, to their constituent atoms, as well as the relationship with the location, differentiation, and function of each. each one</i>	struktur, komponen, mekanisme transpor selular yang terjadi, dan proses diferensiasinya. <i>Accuracy in explaining cell-related concepts which include structure, components, cellular transport mechanisms that occur, and the process of differentiation.</i>	dari literatur beberapa Sel: struktur, komponen, mekanisme transpor selular yang terjadi, dan proses diferensiasinya. <i>Non-Test Task 1: Students summarize from the literature several cells: their structure, components, cellular transport mechanisms that occur, and the process of differentiation.</i>	<i>Lectures, Discussions, Paper Review</i>	diferensiasinya. <i>Cell: structure, components, mechanism of cellular transport that occurs, and the process of differentiation.</i>	
5,6	Mahasiswa mampu menjelaskan dengan baik mekanisme sistem homeostatik tubuh, yang bekerja berdasar berbagai stimulus fisis spesifik, dan mampu menganalisis berbagai variabel fisis yang terlibat dalam	Ketepatan menjelaskan konsep sistem homeostatik pada tubuh manusia <i>Accuracy in explaining the concept of the homeostatic system in the human body</i>	Non-Test Tugas 2: Mahasiswa mereview jurnal terkait sistem homeostatis pada tubuh manusia <i>Non-Test Task 2: Students review journals</i>	Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Paper Review</i>	Sistem homeostatik dalam tubuh: berbagai mekanisme aksi-reaksi yang dikenal, sinyal stimulus dan aksi, serta berbagai variabel fisis yang terlibat didalamnya. eview optika dan fotonika dalam sistem komunikasi data optik <i>Homeostatic system in the</i>	20%

	mekanisme aksi-reaksi dari proses tersebut [FTM-2]. <i>Students are able to explain well the mechanism of the body's homeostatic system, which works based on various specific physical stimuli, and are able to analyze various physical variables involved in the action-reaction mechanism of the process [FTM-2].</i>		<i>related to the homeostatic system in the human body</i>		<i>body: various known action-reaction mechanisms, stimulus and action signals, as well as various physical variables involved in it. an overview of optics and photonics in optical data communication systems</i>	
7,8	Mahasiswa mampu menjelaskan dengan baik berbagai fenomena pembangkitan berbagai sinyal fisis dalam level selular, mekanisme dalam proses perambatannya, serta menganalisis berbagai kondisi yang menyebabkan terjadinya perubahan karakteristik sinyal tersebut [FTM-3]. <i>Students are able to explain well various phenomena of the generation of various physical signals at the</i>	Ketepatan dalam menjelaskan konsep terkait sel yang meliputi struktur, komponen, mekanisme transpor selular yang terjadi, dan proses differensiasinya. <i>Accuracy in explaining cell-related concepts which include structure, components, cellular transport mechanisms that occur, and the process of differentiation.</i>	Non-Test Tugas 3: Mahasiswa mereview jurnal terkait fenomena pembangkitan berbagai sinyal fisis <i>Non-Test Task 3: Students review journals related to the phenomenon of generating various physical signals</i>	Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Paper Review</i>	Sel: struktur, komponen, mekanisme transpor selular yang terjadi, dan proses differensiasinya. <i>Cell: structure, components, mechanism of cellular transport that occurs, and the process of differentiation.</i>	20%

	<i>cellular level, the mechanisms in their propagation process, and analyze various conditions that cause changes in the characteristics of these signals [FTM-3].</i>					
9,10	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4]. <i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the processed signal results to understand well the condition of the organ /</i>	Ketepatan menjelaskan konsep sinyal bioelektrik yang meliputi: penghasilan, perambatan, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Accuracy explains the concept of bioelectric signals which include: generation, propagation, factors that change signal parameters, quantification processes, as well as various examples of instrument systems used to measure and perceive them.</i>		Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Paper Review</i>	Sinyal Bioelektrik: penghasilan, perambatan, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Bioelectric Signals: generation, propagation, factors that change signal parameters, quantification processes, as well as various examples of the instrument systems used to measure and perceive them.</i>	

	<i>organ system being reviewed [FTM-4].</i>					
	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4]. <i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the processed signal results to understand well the condition of the organ / organ system being reviewed [FTM-4].</i>	Ketepatan menjelaskan konsep sinyal biomagnetik yang meliputi: penghasilan (internal/pasif dan eksternal), perambatan gelombang, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Accuracy explains the concept of biomagnetic signals which include: generation (internal/passive and external), wave propagation, factors that change signal parameters, quantification processes, as well as various examples of instrument systems used to measure and perceive them.</i>		Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Paper Review</i>	Sinyal Biomagnetik: penghasilan (internal/pasif dan eksternal), perambatan gelombang, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Biomagnetic Signals: generation (internal/passive and external), wave propagation, factors that change signal parameters, quantification processes, as well as various examples of instrument systems used to measure and perceive them.</i>	
11,12	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk	Ketepatan menjelaskan konsep Sinyal Biooptik yang meliputi sumber	Non-Test Tugas 4: Mahasiswa mengerjakan	Kuliah, Diskusi, Review paper journal	Sinyal Biooptik: sumber penghasilan (eksternal), perambatan, faktor yang	50%

	keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4]. <i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the processed signal results to understand well the condition of the organ / organ system being reviewed [FTM-4].</i>	penghasilan (eksternal), perambatan, faktor yang mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Accuracy explains the concept of Bioptic Signals which includes sources of income (external), propagation, factors that change signal parameters, quantification processes, as well as various examples of instrument systems used to measure and perceive them.</i>	tugas mereview jurnal dan disajikan dalam bentuk makalah terkait proses kuantifikasi untuk keperluan ekstraksi sinyal Mahasiswa mempresentasikan hasilnya di depan kelas pada minggu ke 16. <i>Non-Test Task 4: Students work on the task of reviewing journals and presented in the form of papers related to the quantification process for signal extraction purposes</i> <i>Students present their results in front of the class on week 16.</i>	<i>Lectures, Discussions, Paper Review</i>	mengubah parameter sinyal, proses kuantifikasi, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Bioptic Signals: sources of (external) generation, propagation, factors that change signal parameters, quantification processes, as well as various examples of the instrument system used to measure and perceive them.</i>	
13,14	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil	Ketepatan menjelaskan konsep Ultrasound wave: sumber penghasilan, mekanisme perambatan dan interaksinya di dalam tubuh, faktor yang mengubah perubahan parameter sinyal, proses kuantifikasi atas		Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Paper Review</i>	Ultrasound wave: sumber penghasilan, mekanisme perambatan dan interaksinya di dalam tubuh, faktor yang mengubah perubahan parameter sinyal, proses kuantifikasi atas perubahan parameter sinyal ini, serta berbagai contoh sistem	

	sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4]. <i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the processed signal results to understand well the condition of the organ / organ system being reviewed [FTM-4].</i>	perubahan parameter sinyal ini, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Accurately explains the concept of Ultrasound waves: sources of production, mechanisms of propagation and their interactions in the body, factors that alter changes in signal parameters, the quantification process for changes in these signal parameters, as well as various examples of instrument systems used to measure and perceive them.</i>			instrumen yang digunakan untuk mengukur dan mempersepsinya. <i>Ultrasound waves: sources of production, mechanisms of propagation and their interactions in the body, factors that alter changes in signal parameters, the process of quantifying these changes in signal parameters, as well as various examples of instrument systems used to measure and perceive them.</i>	
15,16	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4].	Ketepatan menjelaskan konsep Radiasi mengion (ionizing radiation): sumber penghasilan, mekanisme perambatan dan interaksinya di dalam tubuh, faktor yang mengubah perubahan parameter sinyal, proses kuantifikasi atas perubahan parameter sinyal ini, serta berbagai contoh sistem instrumen yang digunakan untuk		Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Paper Review</i>	Radiasi mengion (ionizing radiation): sumber penghasilan, mekanisme perambatan dan interaksinya di dalam tubuh, faktor yang mengubah perubahan parameter sinyal, proses kuantifikasi atas perubahan parameter sinyal ini, serta berbagai contoh sistem instrumen yang digunakan untuk mengukur dan mempersepsinya.	

	<i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the processed signal results to understand well the condition of the organ / organ system being reviewed [FTM-4].</i>	mengukur dan mempersepsinya. <i>Accurately explain the concept of ionizing radiation: sources of production, the mechanisms of their propagation and interactions in the body, factors that alter changes in signal parameters, the process of quantifying these changes in signal parameters, as well as various examples of the instrument systems used to measure and perceive them.</i>			<i>Ionizing radiation: sources of production, their propagation and interaction mechanisms in the body, factors that alter changes in signal parameters, the process of quantifying these changes in signal parameters, as well as various examples of the instrument systems used to measure and perceive them.</i>	
--	---	---	--	--	--	--

Catatan :

7. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS		RA&E
	Fisika Tubuh Manusia Physics of Human Body		Edisi: Agt 2018
Kode: TF185321	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Medis Field of Specialization: Medical Engineering	Smt: 3
OTORISASI (Authorization)	Penyusun RA & E Aulia MTN	Koordinator RMK Field Coordinator Dr. rer. nat. Ir. Aulia M. T. N., MSc	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
3,4	Mahasiswa Mampu menjelaskan dengan baik pembagian taksonomi tubuh manusia dari skala ukuran yang paling besar ke skala ukuran yang lebih kecil: tubuh, sistem organ, organ, tissue, sel, molekul, hingga atom penyusunnya, serta kaitan dengan letak, diferensiasi, dan fungsi masing-masingnya <i>Students are able to explain well the taxonomic division of the human body from the largest size scale to the smaller size scale: the body, organ</i>	Non-Test Tugas 1: Mahasiswa merangkum dari literatur beberapa Sel: struktur, komponen, mekanisme transpor selular yang terjadi, dan proses differensiasinya. <i>Non-Test Task 1:</i>	10%			

	<i>systems, organs, tissues, cells, molecules, to their constituent atoms, as well as the relationship with the location, differentiation, and function of each. each one</i>	<i>Students summarize from the literature several cells: their structure, components, cellular transport mechanisms that occur, and the process of differentiation.</i>				
5,6	Mahasiswa mampu menjelaskan dengan baik mekanisme sistem homeostatik tubuh, yang bekerja berdasar berbagai stimulus fisis spesifik, dan mampu menganalisis berbagai variabel fisis yang terlibat dalam mekanisme aksi-reaksi dari proses tersebut [FTM-2]. <i>Students are able to explain well the mechanism of the body's homeostatic system, which works based on various specific physical stimuli, and are able to analyze various physical variables involved in the action-reaction mechanism of the process [FTM-2].</i>	Non-Test Tugas 2: Mahasiswa mereview jurnal terkait sistem homeostatis pada tubuh manusia <i>Non-Test Task 2: Students review journals related to the homeostatic system in the human body</i>		20%		
7,8	Mahasiswa mampu menjelaskan dengan baik berbagai fenomena pembangkitan berbagai sinyal fisis dalam level selular, mekanisme dalam proses perambatannya, serta menganalisis berbagai kondisi yang menyebabkan terjadinya perubahan karakteristik sinyal tersebut [FTM-3]. 4. <i>Students are able to explain well various phenomena of the generation of various physical signals at the cellular level, the mechanisms in their propagation process, and analyze various conditions that cause changes in the characteristics of these signals [FTM-3]. 4.</i>	Non-Test Tugas 3: Mahasiswa mereview jurnal terkait fenomena pembangkitan berbagai sinyal fisis <i>Non-Test Task 3: Students review journals related to the phenomenon of generating various physical signals</i>			20%	

9-12	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4]. <i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the processed signal results to understand well the condition of the organ / organ system being reviewed [FTM-4].</i>	Non-Test Tugas 4: Mahasiswa mengerjakan tugas mereview jurnal dan disajikan dalam bentuk makalah terkait proses kuantifikasi untuk keperluan ekstraksi sinyal Mahasiswa mempresentasikan hasilnya di depan kelas pada minggu ke 16. <i>Non-Test Task 4: Students work on the task of reviewing journals and presented in the form of papers related to the quantification process for signal extraction purposes</i> <i>Students present their results in front of the class on week 16.</i>					50%
13,14	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4].						
15,16	Mahasiswa mampu menjelaskan dengan baik proses kuantifikasi untuk keperluan ekstraksi sinyal, mulai dari proses pendeteksian, akuisisi, pemrosesan sinyal dan pengenalan polanya, serta visualisasi hasil sinyal terolah untuk memahami dengan baik kondisi organ / sistem organ yang ditinjau [FTM-4]. <i>Students are able to explain well the quantification process for signal extraction purposes, starting from the process of detection, acquisition, signal processing and pattern recognition, as well as visualization of the</i>						

	<i>processed signal results to understand well the condition of the organ / organ system being reviewed [FTM-4].</i>					
--	--	--	--	--	--	--

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Asesmen Teknologi Kesehatan <i>Health Technology Assessment</i>		Edisi: Agt 2018
Kode: TF185322	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Smt: 3 <i>Semester: 3</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Aulia Nasution	Koordinator RMK <i>Field Coordinator</i> Dr. Aulia Nasution	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI		
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan kerekayasaan dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37.5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Are able to effectively communicate in both oral and written format.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i>		

	CP-MK	
	1. Mampu menjelaskan tujuan dan manfaat dilakukannya proses assesmen terhadap teknologi kesehatan yang akan digunakan dalam suatu unit / sistem pelayanan kesehatan serta industri terkait pelayanan kesehatan [ATK-1]. 2. Mampu menjelaskan tahapan2 dalam pelaksanaan proses assesmen teknologi kesehatan hingga dihasilkannya suatu rekomendasi keputusan terkait pemilihan opsi teknologi yang dibutuhkan bagi suatu jenis pelayanan kesehatan [ATK-2]. 3. Mampu menerapkan prosedur2 kajian assesmen teknologi kesehatan dan menghasilkan rekomendasi yang tepat terkait pemilihan teknologi kesehatan guna mendukung proses pelayanan kesehatan aman, efektif, terjangkau secara ekonomi, dan dapat diterima oleh masyarakat [ATK-3]. 4. Mampu menguji dan mengevaluasi kelayakan kajian assesmen teknologi kesehatan yang dihasilkan terhadap produk-produk teknologi kesehatan yang baru telah sesuai dengan prosedur serta standar assesmen yang berlaku [ATK-4]. 1. <i>Students are able to explain the purpose and benefits of conducting an assessment process on health technology that will be used in a health service unit/system as well as industries related to health services [ATK-1].</i> 2. <i>Students are able to explain the stages in the implementation of the health technology assessment process so that a decision recommendation is made regarding the selection of technology options needed for a type of health service [ATK-2].</i> 3. <i>Students are able to apply health technology assessment study procedures and produce appropriate recommendations regarding the selection of health technology to support the process of health care services that are safe, effective, economically affordable, and acceptable to the community [ATK-3].</i> 4. <i>Students are able to test and evaluate the feasibility of the resulting health technology assessment study on new health technology products that are in accordance with the applicable assessment procedures and standards [ATK-4].</i>	
Diskripsi Singkat MK <i>Course Description</i>	MK Assesmen Teknologi Kesehatan ini merupakan mata kuliah pilihan, untuk memberikan mahasiswa pengetahuan untuk melakukan evaluasi yang sistematis atas karakteristik, efek, atau dampak dari penggunaan teknologi kesehatan. Proses evaluasi ini merupakan menggunakan pendekatan multidisiplin untuk mengevaluasi berbagai issue terkait aspek sosial, ekonomi, organisasi, serta etika yang menyertai penemuan / penggunaan teknologi. Hasil evaluasi sistematis ini akan menjadi masukan bagi pengambil kebijakan terkait penggunaan teknologi kesehatan tersebut. Berbagai parameter / aspek yang terkait dengan penggunaan teknologi kesehatan: baik obat-obatan, alat kesehatan, maupun vaksin akan dievaluasi kesesuaiannya dengan kriteria yang diharapkan untuk mendapatkan rekomendasi pemilihan teknologi yang terbaik.	

	<i>This course is an elective course, to provide students with the knowledge to conduct a systematic evaluation of the characteristics, effects, or impacts of using health technology. This evaluation process uses a multidisciplinary approach to evaluate various issues related to social, economic, organizational, and ethical aspects that accompany the discovery / use of technology. The results of this systematic evaluation will be input for policy makers regarding the use of health technology. Various parameters/aspects related to the use of health technology: both drugs, medical devices, and vaccines will be evaluated for their suitability with the expected criteria to obtain recommendations for selecting the best technology.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Overview kebutuhan teknologi dalam pelayanan kesehatan 2. Pengenalan terhadap bidang HTA: konsep, tahapan, manfaatnya dan lingkup implementasinya 3. Parameter2 yang perlu dijadikan pertimbangan dalam analisa HTA 4. Metodologi, teknik, serta tools untuk melakukan kajian HTA 5. Analisa Ekonomi dalam HTA: variabel2 yang perlu di ukur 6. Aspek sosio-kultural dan etika dalam HTA 7. Analisis HTA terhadap kebutuhan beberapa jenis teknologi kesehatan (studi kasus) 1. <i>Overview of technology needs in health services</i> 2. <i>Introduction to the field of HTA: concept, stages, benefits and scope of implementation</i> 3. <i>Parameters that need to be considered in HTA analysis</i> 4. <i>Methodology, techniques, and tools for conducting HTA studies</i> 5. <i>Economic Analysis in HTA: variables that need to be measured</i> 6. <i>Socio-cultural and ethical aspects of HTA</i> 7. <i>HTA analysis of the need for several types of health technology (case study)</i>	
Pustaka <i>Reading Materials</i>	Utama:	
	1. Goodman, C.S., Introduction to Health Technology Assessment, The Lewin Group, 2004 2. Kristensen F.B. and Sigmund H (eds.), Health Technology Assessment Handbook, National Board of health, 2007. 3. Lehoux, P., The Problem of health technology: Policy Implications for Modern Health Care Systems, Routledge (Taylor & Francis Group), 2006	

	4. Edejer, T. Tan-Torres, Making choices in health: WHO guide to cost-effectiveness analysis, WHO - Geneva, Switzerland, 2003.	
	Pendukung :	
	-	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak :	Perangkat keras :
	OS:Windows; Office, Video demo	PC & LCD Projector
Team Teaching <i>Team Teaching</i>	Dr.rer.nat. Ir. Aulia Nasution=	
Matakuliah syarat <i>Entry requirement</i>	-	

Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method [Work load]</i> (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessment point (%)</i> (7)
1	Mampu menjelaskan tujuan dan manfaat dilakukannya proses assesmen terhadap teknologi kesehatan yang akan digunakan dalam suatu unit / sistem pelayanan kesehatan serta industri terkait pelayanan kesehatan [ATK-1].	Ketepatan dalam menjelaskan tujuan dan manfaat dilakukannya proses assesmen terhadap teknologi kesehatan yang akan digunakan dalam suatu unit	Non-Test Tugas 1: Mahasiswa mengerjakan tugas studi literatur terkait tentang proses assesmen teknologi kesehatan	Kuliah, Diskusi <i>Lecture, Discussion</i>	Overview kebutuhan teknologi dalam pelayanan Kesehatan <i>Overview of technology needs in health services</i>	(10%)
2				Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>		

		/ sistem pelayanan kesehatan serta industri terkait pelayanan Kesehatan <i>Accuracy in explaining the objectives and benefits of the assessment process for health technology to be used in a health care unit/system as well as industries related to health services</i>	<i>Non-Test Task 1: Students work on literature study assignments related to the health technology assessment process</i>			
3	Mampu menjelaskan tahapan2 dalam pelaksanaan proses assesmen teknologi kesehatan hingga dihasilkannya suatu rekomendasi keputusan terkait pemilihan opsi teknologi yang dibutuhkan bagi suatu jenis pelayanan kesehatan [ATK-2].	Ketepatan dalam menjelaskan tahapan2 dalam pelaksanaan proses assesmen teknologi kesehatan hingga dihasilkannya suatu rekomendasi keputusan terkait pemilihan opsi teknologi yang dibutuhkan bagi	Non-Test Tugas 2: Mahasiswa mengerjakan tugas studi literatur dan membuat karya ilmiah tentang proses assesmen teknologi kesehatan	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	Pengenalan terhadap bidang HTA: konsep, tahapan, manfaatnya dan lingkup implementasinya	(15%)
4	<i>Able to explain the stages in the implementation of the health technology assessment process to produce a decision recommendation related to the</i>			Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	<i>Introduction to the field of HTA: concept, stages, benefits and scope of implementation</i>	
5			<i>Non-Test Task 2:</i>	Kuliah, Diskusi, Review paper	Parameter2 yang perlu dijadikan pertimbangan dalam analisa HTA	

	<i>selection of technology options needed for a type of health service [ATK-2].</i>	suatu jenis pelayanan kesehatan [ATK-2]. <i>Accuracy in explaining the stages in the implementation of the health technology assessment process to produce a decision recommendation related to the selection of technology options needed for a type of health service [ATK-2].</i>	<i>Students work on literature study assignments and make scientific papers about the health technology assessment process</i>	<i>Lectures, Discussions, Review papers</i>	<i>Parameters that need to be considered in HTA analysis</i>	
6			Non-Test Tugas 3: Mahasiswa mengerjakan tugas studi literatur dan membuat karya ilmiah tentang proses assesmen teknologi Kesehatan hingga rekomendasi keputusan terkait pemilihan opsi teknologi yang dibutuhkan bagi suatu jenis pelayanan Kesehatan	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>		
7			<i>Non-Test Task 3: Students work on literature study assignments and</i>	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	Metodologi, teknik, serta tools untuk melakukan kajian HTA <i>Methodology, techniques, and tools for conducting HTA studies</i>	(15%)

			<i>make scientific papers about the Health technology assessment process to decision recommendations related to the selection of technology options needed for a type of health service</i>			
8	Midterm Evaluation	10 %				
9	Mampu menerapkan prosedur2 kajian assesmen teknologi kesehatan dan menghasilkan rekomendasi yang tepat terkait pemilihan teknologi kesehatan guna mendukung proses pelayanan kesehatan aman, efektif, terjangkau secara ekonomi, dan dapat diterima oleh masyarakat [ATK-3].	Ketepatan dalam menerapkan prosedur2 kajian assesmen teknologi kesehatan dan menghasilkan rekomendasi yang tepat terkait pemilihan teknologi kesehatan guna mendukung proses pelayanan kesehatan aman, efektif, terjangkau secara ekonomi, dan	Non-Test Tugas 4: Mahasiswa melakukan kajian literatur dan membuat studi kasus tentan penerapan prosedur kajian assesmen teknologi Kesehatan	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	Analisa Ekonomi dalam HTA: variabel2 yang perlu d ukur	(15%)
10				Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	<i>Economic Analysis in HTA: variables that need to be measured</i>	
11	<i>Able to apply health technology assessment study procedures and produce appropriate recommendations regarding the selection of health technology to support the process of health care services that are safe, effective,</i>		Non-Test Task 4: Students conduct a literature	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	Aspek sosio-kultural dan etika dalam HTA <i>Socio-cultural and ethical aspects in HTA</i>	

	<i>economically affordable, and acceptable to the community [ATK-3].</i>	dapat diterima oleh masyarakat [ATK-3]. <i>Accuracy in implementing health technology assessment study procedures and producing appropriate recommendations regarding the selection of health technology to support the process of health care services that are safe, effective, economically affordable, and acceptable to the community [ATK-3].</i>	review and make a case study on the application of the Health technology assessment study procedure			
12	Mampu menguji dan mengevaluasi kelayakan kajian assesmen teknologi kesehatan yang dihasilkan terhadap produk-produk teknologi kesehatan yang baru telah sesuai dengan prosedur	Ketepatan dalam menguji dan mengevaluasi kelayakan kajian assesmen teknologi kesehatan yang	Non-Test Tugas 5: Mahasiswa membuat karya ilmiah terkait dengan evaluasi mengevaluasi	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	Analisis HTA terhadap kebutuhan beberapa jenis teknologi kesehatan (studi kasus)	(15%)
13				Kuliah, Diskusi, Review paper		

	serta standar assesmen yang berlaku [ATK-4].	dihasilkan terhadap produk-produk teknologi kesehatan yang baru telah sesuai dengan prosedur serta standar assesmen yang berlaku	kelayakan kajian assesmen teknologi kesehatan yang dihasilkan terhadap produk-produk teknologi kesehatan yang baru	<i>Lectures, Discussions, Review papers</i>	<i>HTA analysis of the need for several types of health technology (case study)</i>	
14	<i>Able to test and evaluate the feasibility of the resulting health technology assessment studies on new health technology products that are in accordance with applicable assessment procedures and standards [ATK-4].</i>			Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>		
15		<i>Accuracy in testing and evaluating the feasibility of the resulting health technology assessment study on new health technology products in accordance with applicable assessment procedures and standards</i>	Non-Test Task 5: Students make scientific papers related to the evaluation of evaluating the feasibility of health technology assessment studies produced for new health technology products	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>		
16	Final Exam					20 %

Catatan :

1 sks = (50' TM + 60' BT + 60' BM)/Minggu
 TM = Tatap Muka (Kuliah)
 BT = Belajar Terstruktur.

BM = Belajar Mandiri
 PS = Praktikum Simulasi (3 jam/minggu)
 PL = Praktikum Laboratorium (3 jam/minggu)

T = Teori (aspek ilmu pengetahuan)
 P = Praktek (aspek ketrampilan kerja)

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran

	RENCANA ASSESSMENT & EVALUASI PRODI S2 TEKNIK FISIKA FTI ITS		RA&E
	Assesmen Teknologi Kesehatan		Edisi: Agt 2018
Kode: TF185322	Bobot sks (T/P): (2/0)	Rumpun MK: Pilihan	Smt: 3
OTORISASI	Penyusun RA & E Aulia MTN	Koordinator RMK	Ka PRODI Aulia MTN

Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (3)	Bobot Penilaian (%) <i>Assessment point (%)</i> (7)	Bobot CPMK2	Bobot CPMK3	Bobot CPMK4
1	Mampu menjelaskan tujuan dan manfaat dilakukannya proses assesmen terhadap teknologi kesehatan yang akan digunakan dalam suatu unit / sistem pelayanan kesehatan serta industri terkait pelayanan kesehatan [ATK-1].	Non-Test Tugas 1: Mahasiswa mengerjakan tugas studi literatur terkait tentang proses assesmen teknologi kesehatan	10%			
2						

		<i>Non-Test</i> <i>Task 1:</i> <i>Students work on literature study assignments related to the health technology assessment process</i>				
3	Mampu menjelaskan tahapan2 dalam pelaksanaan proses assesmen teknologi kesehatan hingga dihasilkannya suatu rekomendasi keputusan terkait pemilihan opsi teknologi yang dibutuhkan bagi suatu jenis pelayanan kesehatan [ATK-2]. <i>Able to explain the stages in the implementation of the health technology assessment process to produce a decision recommendation related to the selection of technology options needed for a type of health service [ATK-2].</i>	Non-Test Tugas 2: Mahasiswa mengerjakan tugas studi literatur dan membuat karya ilmiah tentang proses assesmen teknologi kesehatan	5%	10%		
4						
5		<i>Non-Test</i> <i>Task 2:</i> <i>Students work on literature study assignments and make scientific papers about the health technology assessment process</i>				
6		Non-Test	5%	10%		

		Tugas 3:				
		Mahasiswa				
		mengerjakan tugas				
		studi literatur dan				
		membuat karya ilmiah				
		tentang proses				
		assesmen teknologi				
		Kesehatan hingga				
		rekomendasi				
		keputusan terkait				
		pemilihan opsi				
		teknologi yang				
		dibutuhkan bagi suatu				
		jenis pelayanan				
		Kesehatan				
7		<i>Non-Test</i>				
		<i>Task 3:</i>				
		<i>Students work on</i>				
		<i>literature study</i>				
		<i>assignments and make</i>				
		<i>scientific papers about</i>				
		<i>the Health technology</i>				
		<i>assessment process to</i>				
		<i>decision</i>				
		<i>recommendations</i>				
		<i>related to the selection</i>				
		<i>of technology options</i>				
		<i>needed for a type of</i>				

		<i>health service</i>				
8	Mid Term Exam		10%	10%		
9-11	Mampu menerapkan prosedur2 kajian assesmen teknologi kesehatan dan menghasilkan rekomendasi yang tepat terkait pemilihan teknologi kesehatan guna mendukung proses pelayanan kesehatan aman, efektif, terjangkau secara ekonomi, dan dapat diterima oleh masyarakat [ATK-3]. <i>Able to apply health technology assessment study procedures and produce appropriate recommendations regarding the selection of health technology to support the process of health care services that are safe, effective, economically affordable, and acceptable to the community [ATK-3].</i>	Non-Test Tugas 4: Mahasiswa melakukan kajian literatur dan membuat studi kasus tentan penerapan prosedur kajian assesmen teknologi Kesehatan Non-Test Task 4: Students conduct a literature review and make a case study on the application of the Health technology assessment study procedure			15%	

12-15	Mampu menguji dan mengevaluasi kelayakan kajian assesmen teknologi kesehatan yang dihasilkan terhadap produk-produk teknologi kesehatan yang baru telah sesuai dengan prosedur serta standar assesmen yang berlaku [ATK-4]. <i>Able to test and evaluate the feasibility of the resulting health technology assessment studies on new health technology products that are in accordance with applicable assessment procedures and standards [ATK-4].</i>	Non-Test Tugas 5: Mahasiswa membuat karya ilmiah terkait dengan evaluasi mengevaluasi kelayakan kajian assesmen teknologi kesehatan yang dihasilkan terhadap produk-produk teknologi kesehatan yang baru Non-Test Task 5: Students make scientific papers related to the evaluation of evaluating the feasibility of health technology assessment studies produced for new health technology products				15%
16	Final Exam				10%	10%

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Instrumentasi Medis <i>Medical Instrumentation</i>		RP Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185323	Bobot sks (T/P)/ ECTS: (2/0) / 3.2 <i>Credits (T/P)/ ECTS :</i> (2/0)/ 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr.rer.nat. Ir. Aulia Nasution, MSc	Koordinator RMK <i>Field Coordinator</i> Dr.rer.nat. Ir. Aulia Nasution, MSc	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (35%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems</i> CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (30%) <i>Are able to effectively communicate in both oral and written format</i> CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (35%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i>	
	CP-MK		

	Course Learning Outcome (CLO) - Mahasiswa mampu menjelaskan dengan baik berbagai komponen umum utama dalam suatu instrumen medis, fungsi serta kriteria umum pemilihannya. (CP-2)(CP-3) (20%) <i>Students are able to explain well the various main general components in a medical instrument, their functions and general selection criteria</i> - Mahasiswa mampu menjelaskan dengan baik karakteristik khusus dari beberapa besaran fisis tubuh (i.e. bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (ionizing radiation)). (CP-2)(CP-3) (20%) <i>Students are able to explain well the special characteristics of several physical quantities of the body (i.e. bioelectric, biomagnetic, biooptical, bioacoustic, human bio-thermal, and ionizing radiation).</i> - Mahasiswa mampu menjelaskan dengan baik beberapa karakteristik statik dan dinamik sensor yang sesuai untuk keperluan pengukuran besaran fisis tubuh bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (ionizing radiation). (CP-2)(CP-3) (20%) <i>Students are able to explain well some of the static and dynamic characteristics of sensors that are suitable for measuring the physical quantities of bioelectric, biomagnetic, biooptic, bioacoustic, human bio-thermal bodies, and ionizing radiation.</i> - Mahasiswa mampu menjelaskan dengan baik pemilihan komponen yang tepat atas sistem akuisisi data, algoritma pemroses sinyal (waktu dan spasial), serta sistem visualisasinya untuk menghasilkan visualisasi sinyal yang well-visualized, interpretable dan perceptible. (CP-5)(20%) <i>Students are able to explain well the selection of the right components for data acquisition systems, signal processing algorithms (time and spatial), and their visualization systems to produce well-visualized, interpretable and perceptible signal visualizations.</i> - Mahasiswa mampu membahas dan menjelaskan dengan baik beberapa contoh sistem instrumentasi medis terkini yang digunakan dalam ranah klinis, terkait dengan pemilihan teknologi sensor, sistem akuisisi data, algoritma pemroses sinyal, serta sistem visualisasi yang digunakannya. (CP-5)(20%) <i>Students are able to discuss and explain well some examples of the latest medical instrumentation systems used in the clinical realm, related to the selection of sensor technology, data acquisition systems, signal processing algorithms, and the visualization systems they use.</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari tentang berbagai konsep dasar dalam membangun suatu sistem instrumentasi medis untuk berbagai keperluan pengukuran serta monitoring berbagai besaran fisis yang terdapat dalam tubuh manusia. Berbekal pada pemahaman mendalam akan karakteristik besaran fisis tubuh, mahasiswa diharapkan dapat menentukan spesifikasi serta pilihan yang tepat atas sensor, sistem akuisisi, algoritma pemroses sinyal, serta sistem visualisasi untuk menghasilkan tampilan yang well-visualized, interpretable, dan perceptible. Berbagai teknologi terkini instrumen medis terpakai dalam ranah klinis akan digunakan sebagai contoh penjelasan dalam bahan kajian yang diberikan. <i>This course learns about various basic concepts in building a medical instrumentation system for various purposes of measuring and monitoring various physical quantities contained in the human body. Armed with an in-depth understanding of the characteristics of the body's physical quantities, students are expected to be able to determine the specifications and the right choice of sensors, acquisition systems, signal processing algorithms, and visualization systems to produce a well-visualized, interpretable, and perceptible display. The latest technologies of medical instruments used in the clinical realm will be used as examples of explanations in the study materials provided.</i>
Pokok Bahasan / Bahan Kajian Module content	Overview sistem instrumentasi medis: konfigurasi, komponen umum penyusun serta masing-masing fungsinya. <i>Overview of medical instrumentation systems: configuration, general components and their respective functions.</i>

	2. Review tentang berbagai besaran fisis utama tubuh: bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (ionizing radiation) beserta karakteristik spesifiknya. <i>Review of the main physical quantities of the body: bioelectric, biomagnetic, biooptical, bioacoustic, human bio-thermal, and ionizing radiation and their specific characteristics.</i> 3. Karakteristik statik dan dinamik sensor dalam instrumen medis, dikaitkan dengan penggunaan untuk pengukuran besaran fisis utama tubuh: bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (ionizing radiation). <i>Static and dynamic characteristics of sensors in medical instruments, associated with their use for measuring the main physical quantities of the body: bioelectric, biomagnetic, biooptical, bioacoustic, human bio-thermal, and ionizing radiation.</i> 4. Prinsip berbagai moda pengukuran dalam instrumen medis: pengukuran titik, spasial, proyeksi 2D, serta tomografis <i>Principles of various measurement modes in medical instruments: point measurement, spatial, 2D projection and tomographic.</i> 5. Sistem akuisisi data: pola data sinyal fisis tubuh dan karakteristik sistem akuisisi yang sesuai <i>Data acquisition system: body physical signal data pattern and characteristics of the corresponding acquisition system</i> 6. Algoritma pengolahan sinyal dan sistem visualisasi dalam instrumen medis: jenis dan karakteristik pengolahan sinyalnya untuk mendapatkan visualisasi sinyal yang well-visualized, interpretable dan perceptible <i>Signal processing algorithms and visualization systems in medical instruments: types and characteristics of signal processing to obtain well-visualized, interpretable and perceptible signal visualization</i> 7. Kalibrasi sistem terbangun untuk mendapatkan hasil ekstraksi sinyal yang akurat dan presisi. <i>System calibration is built to get accurate and precise signal extraction results.</i> 8. Tinjauan atas beberapa sistem instrumentasi medis terkini yang digunakan dalam ranah klinis <i>An overview of some of the latest medical instrumentation systems used in the clinical field</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	1. Northrop, R. B., Noninvasive instrumentation and measurement in medical diagnosis, CRC Press, Boca Raton, 2001. 2. Ananthi, S., A Text Book of Medical Instrumentation, New Age International (P) Ltd., 2005. 3. Webster, J.G., Medical Instrumentation: Application and Design, 4th ed., Wiley, 2009.
	Pendukung : <i>Supporting</i>	1. Semmlow, J.L. and Griffel, B., , Biosignal and Biomedical Image Processing, Marcel Dekker, CRC Press, Boca Raton, 2014 2. Becchetti, C. and Neri, A., , Medical instrument design and development : from requirements to market placements, John Wiley & Sons Ltd., UK, 2013.
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras : <i>Hardware</i>
	-	PC
Team Teaching	Dr.rer.nat. Ir. Aulia Nasution, MSc	
Matakuliah syarat	TF185101 Fisika Teknik Lanjut <i>TF185101 Advanced Engineering Physics</i>	

Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-2	Mahasiswa mampu menjelaskan dengan baik berbagai komponen umum utama dalam suatu instrumen medis, fungsi serta kriteria umum pilihannya <i>Students are able to explain well the various main general components in a medical instrument, their functions and general selection criteria.</i>	Ketepatan menjelaskan komponen instrumentasi medis <i>Accuracy of explaining components of medical instrumentation.</i>	Non-Test Mahasiswa merangkum dari literatur komponen instrumentasi biomedis. <i>Students summarize from the literature on components of biomedical instrumentation.</i>	Kuliah Diskusi E-learning ● TM = 2 mg x 2 sks x 50' ● BT = 2 mg x 2 sks x 60' ● BM = 2 mg x 2 sks x 60'	Overview sistem instrumentasi medis: konfigurasi, komponen umum penyusun serta masing-masing fungsinya. Review tentang berbagai besaran fisis utama tubuh: bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (ionizing radiation) beserta karakteristik spesifiknya <i>Overview of medical instrumentation systems: configuration, general components and their respective functions. Review of the main physical quantities of the body: bioelectric, biomagnetic, biooptical, bioacoustic, human bio-thermal, and ionizing radiation and their specific characteristics..</i>	10% (CPMK-1)
3-4	Mahasiswa mampu menjelaskan dengan baik karakteristik khusus dari beberapa besaran fisis tubuh (i.e. bioelektrik, biomagnetik,	Ketepatan dalam menjelaskan karakteristik khusus dari besaran fisis tubuh: bioelektrik, biomagnetik <i>Accuracy in explaining the special characteristics of the physical quantities of</i>		Kuliah Diskusi E-learning ● TM = 2 mg x 2 sks x 50' ● BT = 2 mg x 2 sks x 60' ● BM = 2 mg x 2 sks x 60'	Bioelektrik Biomagnetik <i>Bioelectric Biomagnetic.</i>	10% (CPMK-2)

	biooptik, bioakustik,	<i>the body: bioelectric, biomagnetic.</i>				
5-6	human bio-thermal, serta radiasi mengion (ionizing radiation) <i>Students are able to explain well the special characteristics of several physical quantities of the body (i.e. bioelectric, biomagnetic, biooptical, bioacoustic, human bio-thermal, and ionizing radiation).</i>	Ketepatan dalam menjelaskan karakteristik khusus dari besaran fisis tubuh: biooptik, bioakustik <i>Accuracy in explaining the special characteristics of the body's physical quantities: biooptics, bioacoustics</i>	Non-Test Mahasiswa mereview jurnal terkait karakteristik khusus sinyal medis <i>Students review journals related to the special characteristics of medical signals.</i>	Kuliah Diskusi E-learning • TM = 2 mg x 2 sks x 50' • BT = 2 mg x 2 sks x 60' • BM = 2 mg x 2 sks x 60'	Biooptik Bioakustik <i>Biooptics</i> <i>Bioacoustics.</i>	
7	<i>bioelectric, biomagnetic, biooptical, bioacoustic, human bio-thermal, and ionizing radiation).</i>	Ketepatan dalam menjelaskan karakteristik khusus dari besaran fisis tubuh: , human bio-thermal, serta radiasi mengion <i>Accuracy in explaining the special characteristics of the body's physical quantities: , human bio-thermal, and ionizing radiation.</i>		Kuliah Diskusi E-learning • TM = 1 mg x 2 sks x 50' • BT = 1 mg x 2 sks x 60' • BM = 1 mg x 2 sks x 60'		
8	Evaluasi Tengah Semester – Review aktifitas minggu ke 1 sd minggu ke 7 dan evaluasi hasil luaran <i>Mid Term Exam - Review the activities of the 1st week to the 7th week and evaluate the results</i>					20% (CPMK-1) (CPMK-2)
9-10	Mahasiswa mampu menjelaskan dengan baik	Ketepatan dalam menjelaskan karakteristik dinamik	Non-Test Mahasiswa meninjau suatu instrumentasi biomedis dan menyebutkan dan	Kuliah Diskusi E-learning • TM = 2 mg x 2 sks x 50'	Karakteristik statik dan dinamik sensor dalam instrumen medis, dikaitkan dengan penggunaan	15% (CPMK-3)

beberapa karakteristik statik dan dinamik sensor yang sesuai untuk keperluan pengukuran besaran fisis tubuh bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (<i>ionizing radiation</i>) <i>Students are able to explain well some of the static and dynamic characteristics of sensors that are suitable for measuring the physical quantities of bioelectric, biomagnetic, biooptic, bioacoustic, human bio-thermal bodies, and ionizing radiation.</i>	dari sensor untuk keperluan instrumentasi biomedis <i>Accuracy in describing the dynamic characteristics of sensors for biomedical instrumentation purposes.</i>	membahas karakteristik dinamik dari sensor yang digunakan <i>Students review a biomedical instrumentation and mention and discuss the dynamic characteristics of the sensors used.</i>	● BT = 2 mg x 2 sks x 60' ● BM = 2 mg x 2 sks x 60'	untuk pengukuran besaran fisis utama tubuh <i>The static and dynamic characteristics of sensors in medical instruments, associated with their use for the measurement of the main physical quantities of the body.</i>	
---	--	--	--	--	--

11-12	Mahasiswa mampu menjelaskan dengan baik pemilihan komponen yang tepat atas sistem akuisisi data, algoritma pemroses sinyal (waktu dan spasial), serta sistem visualisasinya untuk menghasilkan visualisasi sinyal yang <i>well-visualized</i>, <i>interpretable</i> dan <i>perceptible</i> <i>Students are able to explain well the selection of the right components for data acquisition systems, signal processing algorithms (time and spatial), and their visualization systems to produce well-visualized,</i>	Ketepatan menjelaskan pemilihan komponen pada instrumentasi biomedis <i>Accuracy explains component selection in biomedical instrumentation.</i>	Non-Test Mahasiswa mengerjakan tugas mereview jurnal terkait komponen dalam instrumentasi medis <i>Students work on the task of reviewing journals related to components in medical instrumentation.</i>	Kuliah Diskusi E-learning • TM = 2 mg x 2 sks x 50' • BT = 2 mg x 2 sks x 60' • BM = 2 mg x 2 sks x 60'	Pemilihan komponen pada instrumentasi biomedis <i>Selection of components in biomedical instrumentation.</i>	15% (CPMK-4)
-------	--	--	---	---	--	--------------------------------

	<i>interpretable and perceptible signal visualizations.</i>					
13-14	Mahasiswa mampu membahas dan menjelaskan dengan baik beberapa contoh sistem instrumentasi medis terkini yang digunakan dalam ranah klinis, terkait dengan pemilihan teknologi sensor, sistem akuisisi data, algoritma pemroses sinyal, serta sistem	Ketepatan menjelaskan sistem visualisasi serta mampu menganalisa kategori visualisasi yang meliputi: well-visualized, interpretable dan perceptible <i>Accuracy in explaining the visualization system and being able to analyze visualization categories which include: well-visualized, interpretable and perceptible.</i>	Non-Test Mahasiswa mengerjakan tugas mereview jurnal terkait konsep dalam menganalisa kategori visualisasi yang meliputi: well-visualized, interpretable dan perceptible <i>Students work on the task of reviewing journals related to concepts in analyzing visualization categories which include: well-visualized, interpretable and perceptible.</i>	Kuliah Diskusi E-learning ● TM = 2 mg x 2 sks x 50' ● BT = 2 mg x 2 sks x 60' ● BM = 2 mg x 2 sks x 60'	Pemilihan komponen pada instrumentasi biomedis <i>Selection of components in biomedical instrumentation.</i>	10% (CPMK-5)
15	visualisasi yang digunakannya <i>Students are able to discuss and explain well some examples of the latest medical instrumentation systems used in the clinical realm, related to the selection of sensor technology, data</i>	Ketepatan membahas dan menjelaskan dengan baik beberapa contoh sistem instrumentasi medis terkini. <i>Accurately discuss and explain well some examples of the latest medical instrumentation systems.</i>	Non-Test Mahasiswa mengerjakan tugas mereview jurnal terkait contoh sistem instrumentasi medis terkini <i>Students work on the task of reviewing journals related to examples of the latest medical instrumentation systems.</i>	Kuliah Diskusi E-learning ● TM = 1 mg x 2 sks x 50' ● BT = 1 mg x 2 sks x 60' ● BM = 1 mg x 2 sks x 60'	Kalibrasi sistem terbangun untuk mendapatkan hasil ekstraksi sinyal yang akurat dan presisi. Tinjauan atas beberapa sistem instrumentasi medis terkini yang digunakan dalam ranah klinis <i>The system calibration is built to get accurate and precise signal extraction results. An overview of some of the latest medical instrumentation systems used in the clinical field.</i>	

	<i>acquisition systems, signal processing algorithms, and the visualization systems they use.</i>					
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam - Review the activities of the 9th week to the 15th week and evaluate the results</i>					20% (CPMK-3) (CPMK-4) (CPMK-5)

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	Manajemen Keselamatan Proses Process Safety Management		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185323	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: <i>Instrumentation and Control Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr.rer.nat. Ir. Aulia Nasution, MSc	Koordinator RMK Field Coordinator Dr.rer.nat. Ir. Aulia Nasution, MSc	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (7)	Bobot CP-MK5 (8)
1-2	Mahasiswa mampu menjelaskan dengan baik berbagai komponen umum utama dalam suatu instrumen medis, fungsi serta kriteria umum pemilihannya <i>Students are able to explain well the various main general components in a medical instrument, their functions and general selection criteria.</i>	Non-Test Mahasiswa merangkum dari literatur komponen instrumentasi biomedis. <i>Students summarize from the literature on components of biomedical instrumentation.</i>	10%				
3-7	Mahasiswa mampu menjelaskan dengan baik karakteristik khusus dari beberapa besaran	Non-Test		10%			

	fisis tubuh (i.e. bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (ionizing radiation)) <i>Students are able to explain well the special characteristics of several physical quantities of the body (i.e. bioelectric, biomagnetic, biooptical, bioacoustic, human bio-thermal, and ionizing radiation).</i>	Mahasiswa mereview jurnal terkait karakteristik khusus sinyal medis <i>Students review journals related to the special characteristics of medical signals.</i>					
8	Evaluasi Tengah Semester <i>Mid Term Exam</i>	Review Aktifitas Minggu ke 1 sd Minggu ke 7 dan evaluasi hasil luaran <i>Review the activities of the 1st week to the 7th week and evaluate the results</i>	10%	10%			
9-10	Mahasiswa mampu menjelaskan dengan baik beberapa karakteristik statik dan dinamik sensor yang sesuai untuk keperluan pengukuran besaran fisis tubuh bioelektrik, biomagnetik, biooptik, bioakustik, human bio-thermal, serta radiasi mengion (ionizing radiation) <i>Students are able to explain well some of the static and dynamic characteristics of sensors that are suitable for measuring the physical quantities of bioelectric, biomagnetic, biooptic, bioacoustic, human bio-thermal bodies, and ionizing radiation.</i>	Non-Test Mahasiswa meninjau suatu instrumentasi biomedis dan menyebutkan dan membahas karakteristik dinamik dari sensor yang digunakan <i>Students review a biomedical instrumentation and mention and discuss the dynamic characteristics of the sensors used.</i>			15%		
11-12	Mahasiswa mampu menjelaskan dengan baik pemilihan komponen yang tepat atas sistem akuisisi data, algoritma pemroses sinyal (waktu dan spasial), serta sistem visualisasinya untuk menghasilkan visualisasi sinyal yang <i>well-visualized, interpretable</i> dan <i>perceptible</i> <i>Students are able to explain well the selection of the right components for data acquisition</i>	Non-Test Mahasiswa mengerjakan tugas mereview jurnal terkait komponen dalam instrumentasi medis <i>Students work on the task of reviewing journals related to components in medical instrumentation.</i>				15%	

	<i>systems, signal processing algorithms (time and spatial), and their visualization systems to produce well-visualized, interpretable and perceptible signal visualizations.</i>						
13-15	Mahasiswa mampu membahas dan menjelaskan dengan baik beberapa contoh sistem instrumentasi medis terkini yang digunakan dalam ranah klinis, terkait dengan pemilihan teknologi sensor, sistem akuisisi data, algoritma pemroses sinyal, serta sistem visualisasi yang digunakannya <i>Students are able to discuss and explain well some examples of the latest medical instrumentation systems used in the clinical realm, related to the selection of sensor technology, data acquisition systems, signal processing algorithms, and the visualization systems they use.</i>	Non-Test Mahasiswa mengerjakan tugas mereview jurnal terkait konsep dalam menganalisa kategori visualisasi yang meliputi: well-visualized, interpretable dan perceptible Mahasiswa mengerjakan tugas mereview jurnal terkait contoh sistem instrumentasi medis terkini <i>Students work on the task of reviewing journals related to concepts in analyzing visualization categories which include: well-visualized, interpretable and perceptible.</i> <i>Students work on the task of reviewing journals related to examples of the latest medical instrumentation systems.</i>					10%
16	Evaluasi Akhir <i>Final Exam</i>	Review Aktifitas Minggu ke 9 sd Minggu ke 15 dan evaluasi hasil luaran <i>Review the activities of the 9th week to the 15th week and evaluate the results</i>			5%	5%	10%
Total bobot penilaian			20%	20%	20%	20%	20%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Psikoakustik <i>Psychoacoustic</i>			RP
				Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185324	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 3 <i>Semester: 3</i>	
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Dhany Arifianto, M.Eng	Koordinator RMK <i>Field Coordinator</i> Dr. Dhany Arifianto, M.Eng	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro	

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	

	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%) <i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i>
	CP-MK Course Learning Outcome (CLO) 4. Mampu memahami fisiologi telinga dan pendengaran <i>Students are able to understand the physiology of the ear and hearing.</i> 5. Mampu memahami konsep arsitektur tonotopikal pendengaran. <i>Students are able to understand the concept of auditory tonotopical architecture.</i> 6. Mampu mendesain algoritma alat bantu pendengaran (auditory prostheses) dan evaluasinya. <i>Students are able to design hearing aid algorithms (auditory prostheses) and their evaluation</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini memiliki tujuan mempelajari dan memberikan gambaran menyeluruh di bidang telinga dan pendengaran. Diharapkan melalui mata kuliah ini mahasiswa mampu mendesain algoritma alat bantu pendengaran dan melakukan evaluasi terhadap alat tersebut. <i>This course aims to study and provide a comprehensive overview in the field of ear and hearing. It is hoped that through this course students will be able to design hearing aid algorithms and evaluate these devices.</i>
Pokok Bahasan / Bahan Kajian Module content	4. Anatomi dan Fisiologi Telinga 5. Auditory Cortex & Auditory Brainstem 6. Mekanisme Pendengaran dan Persepsi : Binaural & Spatial 7. Auditory Stimuli & Masking 8. Computational Auditory Neuroscience 9. Auditory Prostheses (Hearing Aid and Cochlear Implant). 1. <i>Ear Anatomy and Physiology</i> 2. <i>Auditory Cortex & Auditory Brainstem</i> 3. <i>Mechanism of Hearing and Perception: Binaural & Spatial</i> 4. <i>Auditory Stimuli & Masking</i> 5. <i>Computational Auditory Neuroscience</i> 6. <i>Auditory Prostheses (Hearing Aid and Cochlear Implant).</i>
Pustaka Reading Materials	Utama: Main 1. David Howard & Jamie Angus, Acoustics and Psychoacoustics 4Ed, Elsevier, 2009.

		2. Stanley Gelfand, Hearing : An Introduction to Psychological and Physiological Acoustics, Informa, 2010				
		Pendukung: <i>Supporting</i>				
		1. Hugo Fastl & Eberhard Zwicker, Psychoacoustics, Springer, 2007.				
		3. Graeme Clark, <i>Cochlear Implants : Fundamentals and Applications</i> , Springer, 2003.				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>	
		Matlab, Labview			Accelerometer Array, DAQ Board	
Tim Pengajar <i>Team Teaching</i>		Dr. Dhany Arifianto				
Matakuliah syarat <i>Entry requirement</i>		-			Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>
Mg Ke-Week (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessment point</i> (%) (7)
1-2	Mahasiswa mampu memahami anatomi dan fisiologi organ telinga <i>Students are able to understand the anatomy and physiology of the ear organs</i>	- Ketepatan mahasiswa dalam memahami urutan penjaran bunyi pada telinga - Ketepatan mahasiswa dalam memahami fungsi organ dan bagian pada telinga. <i>The accuracy of students in understanding the sequence of sound propagation in the ear</i> <i>Accuracy of students in understanding the function of organs and parts of the ear</i>	TUGAS 1 Makalah kajian tentang anatomi dan fisiologi organ telinga. <i>ASSIGNMENT 1:</i> <i>Study paper on the anatomy and physiology of the ear organ</i>	SCL (Kuliah, diskusi dan E-learning) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Anatomi Telinga - Telinga Tengah - Telinga Dalam [1, hal. 2 – 89][3, hal. 1 – 55] [2 pendukung, hal. 10 – 135] <i>- Ear Anatomy</i> <i>- Middle Ear</i> <i>- Inner Ear</i> [1, p. 2 – 89][3, p. 1 – 55] [2 supporters, p. 10 – 135]	5% (CP-MK1)

3-5	Mahasiswa mampu memahami mekanisme transduksi gelombang bunyi pada organ telinga. <i>Students are able to understand the mechanism of sound wave transduction in the ear organs.</i>	• Ketepatan mahasiswa dalam memahami transduksi sinyal bunyi hingga pembentukan persepsi • Ketepatan mahasiswa dalam memahami peta proses pada otak • <i>Accuracy of students in understanding the transduction of sound signals to the formation of perception</i> • <i>The accuracy of students in understanding process maps on the brain</i>	TUGAS 2 • Makalah tentang mekanisme transduksi gelombang bunyi pada organ telinga • Presentasi <i>ASSIGNMENT 2:</i> • <i>Paper on the mechanism of sound wave transduction in the ear organ</i> • <i>Presentation</i>	- Kuliah /diskusi - Program Matlab [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Transduksi sinyal dari telinga melalui syaraf pendengaran (<i>auditory cortex</i>) - Peta Tonotopic Pada Otak untuk pembentukan Persepsi - Model Matematika Transduksi [1, hal. 2 – 89][3, hal. 1 – 55] [2 pendukung, hal. 10 – 135] - <i>Transduction of signals from the ear via the auditory nerve (auditory cortex)</i> - <i>Tonotopic map of the brain for perception formation</i> - <i>Mathematical Model of Transduction</i> [1, p. 2 – 89][3, p. 1 – 55] [2 supporters, p. 10 – 135]	7,5% (CP-MK1) 2,5% (CP-MK2)
6-7	Mahasiswa mampu memahami Persepsi Bunyi Binaural dan Spatial serta Auditory Illusion. <i>Students are able to understand Binaural and Spatial Sound Perception and Auditory Illusion</i>	Ketepatan mahasiswa dalam memahami Pembentukan efek bunyi akibat posisi spatial dengan monoaural dan bilateral hearing. <i>Accuracy of students in understanding the formation of sound effects due to spatial position with monoaural and bilateral hearing.</i>	TUGAS 3 • Makalah tentang pembentukan efek bunyi akibat posisi spatial dengan monoaural dan bilateral hearing • Presentasi <i>ASSIGNMENT 3:</i> • <i>Papers on the formation of sound effects due to spatial position with monoaural and bilateral hearing</i> • <i>Presentation</i>	- Kuliah/ diskusi - E learning [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Auditory Scene Analysis - Spatial Hearing [2, hal. 25 – 177] [2pendukung, hal. 141 – 170] - <i>Auditory Scene Analysis</i> - <i>Spatial Hearing</i> [2, p. 25 – 177] [2 supporters, p. 141 – 170]	10% (CP-MK2)
8	Evaluasi Tengah Semester (ETS)					15%

	Mid Term Examination					
9-11	Mahasiswa mampu memahami Persepsi Bunyi Binaural dan Spasial dan Ilusi Auditori <i>Students are able to understand Binaural and Spatial Sound Perception and Auditory Illusion</i>	Ketepatan mahasiswa dalam mendesain audio stimuli untuk mengukur fungsi spesifik telinga dan bagian telinga <i>Accuracy of students in designing audio stimuli to measure the specific function of the ear and the part of the ear</i>	TUGAS 4: Membuat desain stimuli audio untuk mengukur fungsi telinga sensor <i>ASSIGNMENT 4: Design audio stimuli to measure sensor ear function.</i>	- Kuliah/ diskusi - E-learning - Matlab [TM: 3x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Persepsi Loudness, Phase, Frequency Bunyi - Supresi dan Kompresi Bunyi [1, hal. 161 – 364] [2, hal. 107 – 140] <i>- Perception of Loudness, Phase, Sound Frequency</i> <i>-Sound Suppression and Compression</i> <i>[1, p. 161 – 364]</i> <i>[2, p. 107 – 140]</i>	10% (CP-MK3)
12-13	Mahasiswa mampu memahami dan mendesain algoritma meniru (mimicking) fungsi telinga <i>Students are able to understand and design algorithms to mimic ear function</i>	Ketepatan dalam desain algoritma dan stimuli audio untuk mengeksitasi dan mengukur fungsi telinga dalam <i>Accuracy in the design of algorithms and audio stimuli to excite and measure inner ear function</i>	TUGAS 5 Membuat desain algoritma meniru (mimicking) fungsi telinga <i>ASSIGNMENT 5: Designing an algorithm to mimic the function of the ear</i>	- Kuliah/diskusi - E learning - Program Matlab [TM: 3x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Auditory Signal Processing - Information Theory and Data Fusion [1, hal. 161 – 364] [2, hal. 141 – 243] <i>- Auditory Signal Processing</i> <i>- Information Theory and Data Fusion</i> <i>[1, p. 161 – 364]</i> <i>[2, p. 141 – 243]</i>	10% (CP-MK3)
14-15	Mahasiswa mampu memahami dan mendesain algoritma hearing aids dan cochlear implant <i>Students are able to understand and design algorithms for hearing aids and cochlear implants</i>	Ketepatan dalam merancang algoritma komputasi untuk meningkatkan kualitas dan kinerja alat bantu dengar dan implan koklea <i>Accuracy in designing computational algorithms for improving the quality and performance of hearing aids and cochlear implants</i>	TUGAS 6 Membuat design algoritma hearing aids dan cochlear implant <i>ASSIGNMENT 6: Designing hearing aids algorithms and cochlear implants</i>	- Kuliah/diskusi - E learning - Program Matlab [TM: 3x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Signal Processing for Enhancement 2. Signal Processing for Cochlear Implant. <i>1. Signal Processing for Enhancement</i> <i>2. Signal Processing for Cochlear Implant.</i>	10% (CP-MK3)

16	Evaluasi Akhir Semester <i>Final Examination</i>	20%
----	---	-----

Catatan :

Note

3. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Psikoakustik Psychoacoustic			RA&E
	Kode (Code): TF185324	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>	Edisi (<i>Edition</i>): Agt 2018 Aug 2018 Smt: 3 <i>Semester: 3</i>
OTORISASI (Authorization)	Penyusun RA & E PIC – Assessment & Evaluation Plan Dr. Dhany Arifianto, M.Eng	Koordinator RMK Field Coordinator Dr. Dhany Arifianto, M.Eng	Ka PRODI Head of Master Program Dr. Ridho Hantoro	

Mg ke	Sub CP-MK	Bentuk Asesmen (Penilaian)	Bobot	Bobot	Bobot (%)
-------	-----------	----------------------------	-------	-------	-----------

(1)	(2)	(3)	CP-MK1 (4)	CP-MK2 (5)	CP-MK3 (6)
1-2	Mahasiswa mampu memahami anatomi dan fisiologi organ telinga <i>Students are able to understand the anatomy and physiology of the ear organs</i>	TUGAS 1 Makalah kajian tentang anatomi dan fisiologi organ telinga. <i>ASSIGNMENT 1:</i> <i>Study paper on the anatomy and physiology of the ear organ</i>	10%		
3-5	Mahasiswa mampu memahami mekanisme transduksi gelombang bunyi pada organ telinga. <i>Students are able to understand the mechanism of sound wave transduction in the ear organs.</i>	TUGAS 2 - Makalah tentang mekanisme transduksi gelombang bunyi pada organ telinga - Presentasi <i>ASSIGNMENT 2:</i> <i>Paper on the mechanism of sound wave transduction in the ear organ</i> <i>Presentation</i>	7,5%	2,5%	
6-7	Mahasiswa mampu memahami Persepsi Bunyi Binaural dan Spatial serta Auditory Illusion. <i>Students are able to understand Binaural and Spatial Sound Perception and Auditory Illusion</i>	TUGAS 3 - Makalah tentang pembentukan efek bunyi akibat posisi spatial dengan monaural dan bilateral hearing - Presentasi <i>ASSIGNMENT 3:</i> <i>Papers on the formation of sound effects due to spatial position with monaural and bilateral hearing</i> <i>Presentation</i>		15%	
8			7,5%	7,5%	
9-11	Students are able to understand Binaural and Spatial Sound Perception and Auditory Illusion <i>Students are able to understand Binaural and Spatial Sound Perception and Auditory Illusion</i>	TUGAS 4: Membuat desain stimuli audio untuk mengukur fungsi telinga sensor <i>ASSIGNMENT 4:</i> <i>Design audio stimuli to measure sensor ear function.</i>			10%

12-13	Mahasiswa mampu memahami dan mendesain algoritma meniru (mimicking) fungsi telinga <i>Students are able to understand and design algorithms to mimic ear function</i>	TUGAS 5 Membuat desain algoritma meniru (mimicking) fungsi telinga <i>ASSIGNMENT 5: Designing an algorithm to mimic the function of the ear</i>			10%
14-15	Mahasiswa mampu memahami dan mendesain algoritma hearing aids dan cochlear implant <i>Students are able to understand and design algorithms for hearing aids and cochlear implants</i>	TUGAS 6 Membuat design algoritma hearing aids dan cochlear implant <i>ASSIGNMENT 6: Designing hearing aids algorithms and cochlear implants</i>			10%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)				20%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			25%	25%	50%

TF185331 RPS RAE Sensor Fotonik (*Photonic Sensor*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Sensor Fotonik <i>Photonic Sensor</i>		RP
			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode: TF185331	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 3 <i>Semester: 3</i>

OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Agus M. Hatta	Koordinator RMK <i>Field Coordinator</i> Dr. Aulia Nasution	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i> CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37.5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Are able to effectively communicate in both oral and written format.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i> CP-MK - Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika - Mahasiswa mampu merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri atau lainnya. - Mahasiswa mampu mengevaluasi kinerja sensor fotonik. - Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan dan evaluasi sensor fotonik. <i>• Students are able to explain and apply the concepts of optics and photonics</i> <i>• Students are able to design photonic sensors for physical quantity monitoring applications in industry or others.</i> <i>• Students are able to evaluate the performance of photonic sensors.</i> <i>• Students are able to make written reports and scientific presentations of the results of the design and evaluation of photonic sensors.</i>		
Diskripsi Singkat MK <i>Course Description</i>			
Pokok Bahasan / Bahan Kajian <i>Module content</i>	Dalam Matakuliah ini mahasiswa akan mempelajari pokok bahasan-pokok bahasan sebagai berikut: - Review optik dan fotonik - Ragam sensor fotonik - Keterkinian sensor fotonik		

	• Perancangan sensor fotonik • Evaluasi kinerja sensor fotonik. • Laporan dan presentasi perancangan sensor fotonik In this course, students will study the following topics: • Optical and photonic reviews • Variety of photonic sensors • Up-to-date photonic sensors • Photonic sensor design • Evaluation of photonic sensor performance. • Photonic sensor design reports and presentations	
Pustaka <i>Reading Materials</i>	Utama:	1. F. T. Yu and S. Yin, Fiber Optic Sensors, Marcel Dekker, 2002 2. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 4 th edition, Springer, 2010
	Pendukung :	1. Huston, Structural sensing, health monitoring, and performance evaluation. Taylor & Francis, 2011. 2. B. A. Saleh, M. C. Teich, Fundamental of Photonics, Wiley-Interscience, 2013. 3. Jurnal terkait sensor fotonik: a. Photonics Sensors: http://www.springer.com/physics/optics+%26+lasers/journal/13320 b. Sensors and Actuators A: Physical http://www.sciencedirect.com/science/journal/09244247 c. Applied Optics : http://www.opticsinfobase.org/ao/
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak :	Perangkat keras :
	OS:Windows; Office, Video demo, Matlab	PC & LCD Projector
Team Teaching <i>Team Teaching</i>	Sekartedjo, Aulia MT Nasution, Agus Muhamad Hatta	
Matakuliah syarat <i>Entry requirement</i>	-	

Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessment point (%) (7)
-----------------------	-----------------------------	--	--	--	---	--

1-3	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika <i>Students are able to explain and apply the concepts of optics and photonics</i>	Ketepatan menjelaskan dan menerapkan konsep-konsep optik dan fotonik <i>Accuracy in explaining and applying optical and photonic concepts</i>	-	Kuliah, Diskusi <i>Lecture, Discussion</i>	Review konsep dasar optika dan fotonika <i>Review the basic concepts of optics and photonics</i>	
4-5	Mahasiswa mampu merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri atau lainnya. <i>Students are able to design photonic sensors for physical quantity monitoring applications in industry or others.</i>	Ketepatan menjelaskan dan menerapkan ragam sensor fotonik <i>Accuracy in explaining and applying various photonic sensors</i>	Non-Test Tugas 1: Mahasiswa mengerjakan tugas mereview jurnal terkait ragam sensor fotonik <i>Non-Test Task 1: Students work on the task of reviewing journals related to various photonic sensors</i>	Kuliah, Diskusi, Review paper <i>Lectures, Discussions, Review papers</i>	Ragam Sensor Fotonik <i>Variety of Photonic Sensors</i>	20%
6-7	Mahasiswa mampu merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri atau lainnya. <i>Students are able to design photonic sensors for physical quantity</i>	Ketepatan menjelaskan dan menelusur keterkinian suatu sensor fotonik <i>Accuracy in describing and tracing the latest in a photonic sensor</i>	-	Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Review papers</i>	Perancangan dan Pengembangan Sensor Fotonik <i>Photonic Sensor Design and Development</i>	

	<i>monitoring applications in industry or others.</i>					
8	Mahasiswa mampu merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri atau lainnya. <i>Students are able to design photonic sensors for physical quantity monitoring applications in industry or others.</i>	Kedalaman dalam melakukan perancangan sensor fotonik berdasarkan telusur keterkinian <i>Ability to design photonic sensors based on up-to-date tracking</i>	Non-Test Tugas 2: Mahasiswa mengerjakan tugas mereview jurnal terkait merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri <i>Non-Test Task 2: Students work on an assignment to review journals related to designing photonic sensors for physical quantity monitoring applications in industry</i>	Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Review papers</i>	Perancangan dan Pengembangan Sensor Fotonik <i>Photonic Sensor Design and Development</i>	20%
9-14	Mahasiswa mampu mengevaluasi kinerja sensor fotonik. <i>Students are able to evaluate the performance of photonic sensors.</i>	Ketepatan dalam melakukan pembuatan dan evaluasi kinerja sensor fotonik <i>Accuracy in making and evaluating the performance of photonic sensors</i>	-	Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Review papers</i>	Evaluasi Perancangan Sensor Fotonik <i>Evaluation of Photonic Sensor Design</i>	
15,16	Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari perancangan dan evaluasi sensor fotonik.	Ketepatan dalam menyusun laporan dan presentasi perancangan sensor fotonik	Non-Test Tugas 3: Mahasiswa merancang eksperimen terkait sensor fotonik dan membuat laporan tertulis dan presentasi	Kuliah, Diskusi, Review paper journal <i>Lectures, Discussions, Review papers</i>	Evaluasi Perancangan Sensor Fotonik <i>Evaluation of Photonic Sensor Design</i>	60%

	<i>Students are able to make written reports and scientific presentations of the results of the design and evaluation of photonic sensors.</i>	<i>Accuracy in compiling reports and presentations on photonic sensor designs</i>	<i>Non-Test Task 3: Students design experiments related to photonic sensors and make written reports and presentations</i>			
--	--	---	--	--	--	--

Catatan :

1 sks = (50' TM + 60' BT + 60' BM)/Minggu

TM = Tatap Muka (Kuliah)

BT = Belajar Terstruktur.

BM = Belajar Mandiri

PS = Praktikum Simulasi (3 jam/minggu)

PL = Praktikum Laboratorium (3 jam/minggu)

T = Teori (aspek ilmu pengetahuan)

P = Praktek (aspek ketrampilan kerja)

Catatan :

Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS Sensor Fotonik Photonic Sensor			RA&E Edisi: Agt 2018
	Kode: TF185331	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: <i>Instrumentation and Control Engineering</i>	Smt: 3 Semester: 3
OTORISASI	Pengembang RP Contact Person – Learning Plan Dr. Agus M. Hatta	Koordinator RMK Field Coordinator Dr. Aulia Nasution	Ka PRODI Head of Master Program Dr. Ridho Hantoro	

Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (7)
4-5	Mahasiswa mampu merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri atau lainnya. <i>Students are able to design photonic sensors for physical quantity monitoring applications in industry or others.</i>	Non-Test Tugas 1: Mahasiswa mengerjakan tugas mereview jurnal terkait ragam sensor fotonik <i>Non-Test</i> Task 1: <i>Students work on the task of reviewing journals related to various photonic sensors</i>	10%	10%		

8	Mahasiswa mampu merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri atau lainnya. <i>Students are able to design photonic sensors for physical quantity monitoring applications in industry or others.</i>	Non-Test Tugas 2: Mahasiswa mengerjakan tugas mereview jurnal terkait merancang sensor fotonik untuk aplikasi pemantauan besaran fisis di industri <i>Non-Test Task 2: Students work on an assignment to review journals related to designing photonic sensors for physical quantity monitoring applications in industry</i>		20%		
15,16	Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari ^[1]perancangan dan evaluasi sensor fotonik. <i>Students are able to make written reports and scientific presentations of the results of the design and evaluation of photonic sensors.</i>	Non-Test Tugas 3: Mahasiswa merancang eksperimen terkait sensor fotonik dan membuat laporan tertulis dan presentasi <i>Non-Test Task 3: Students design experiments related to photonic sensors and make written reports and presentations</i>			30%	30%

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Metrologi Optik Lanjut <i>Advanced Optical Metrology</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185332	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Agus M. Hatta	Koordinator RMK <i>Field Coordinator</i> Prof. Sekartedjo	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	
	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i>	
	CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika untuk metrology <i>Students are able to explain and apply the concepts of optics and photonics for metrology</i> 2. Mahasiswa mampu merancang komponen/sistem metrologi optik <i>Students are able to design components/systems of optical metrology</i> 3. Mahasiswa mampu mengevaluasi kinerja komponen/sistem metrologi optik. <i>Students are able to evaluate the performance of optical metrology components/systems</i> 4. Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan dan evaluasi komponen/sistem metrologi optik. <i>Students are able to make written reports and scientific presentations of the results of the design and evaluation of optical metrology components/systems.</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini membahas aspek-aspek fisis, disain dan evaluasi komponen/sistem dalam metrologi optik. Tinjauan tentang optika dan fotonika dibahas dibagian awal, dan dilanjutkan dengan pembahasan komponen/sistem metrologi optik. Mahasiswa diharapkan dapat merancang suatu komponen/sistem metrologi optik dan membuat suatu laporan dan presentasi singkat dari hasil perancangan tersebut. <i>This course discusses the physical aspects, design and evaluation of components/systems in optical metrology. An overview of optics and photonics is discussed at the beginning, and is continued with a discussion of optical metrology components/systems. Students are expected to be able to design an optical metrology component/system and make a report and a brief presentation of the results of the design</i>	
Pokok Bahasan / Bahan Kajian Module content	• Tinjauan tentang optika geometri, optika fisis, dan fotonika dalam kaitan aplikasinya pada bidang metrologi optis; pengukuran berbasis karakteristik amplituda, frekuensi dan fasa. • Komponen-komponen dalam sistem metrologi optis • Interferensi gelombang, interferometri, dan interferometer • Keterkinian komponen/sistem metrologi optik • Perancangan komponen/sistem metrologi optik • Evaluasi kinerja komponen/sistem metrologi optik • Laporan dan presentasi perancangan komponen/sistem metrologi optik • <i>Overview of geometric optics, physical optics, and photonics in relation to their application in the field of optical metrology; measurement based on the characteristics of amplitude, frequency and phase.</i> • <i>Components of an optical metrology system</i>	

	- Wave interference, interferometry and interferometer - Up-to-date optical metrology components/systems - Optical metrology component/system design - Performance evaluation of optical metrology components/systems - Optical metrology component/system design reports and presentations					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	7. Gåsvik, KJ., Optical Metrology, 3rd ed., John Wiley & Sons, 2002					
	Pendukung: <i>Supporting</i>					
	1. Hariharan, P., Optical Interferometry, , 2nd Ed., Academic Press, 2003 2. Amidror, I., The Theory of the Moiré Phenomenon, Springer Verlag, 2007 3. Jurnal terkait metrologi optik: - Journal Optical Engineering, SPIE - Applied Optics, OSA					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>		
	OS:Windows; Office, Video demo, Matlab			PC & LCD Projector		
Tim Pengajar <i>Team Teaching</i>	Sekartedjo, Aulia MT Nasution, Agus Muhamad Hatta					
Matakuliah syarat <i>Entry requirement</i>	-			Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>	
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment</i> <i>Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessm ent point</i> (%) (7)
1-2	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep	Ketepatan dalam menjelaskan dan menerapkan konsep-konsep tentang optika		SCL (Kuliah, diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')]	Review optika dan fotonika dalam metrologi optik	

	tentang optika geometri, optika fisis, dan fotonika dalam kaitan aplikasinya pada bidang metrologi optis; pengukuran berbasis karakteristik amplituda, frekuensi dan fasa. <i>Students are able to explain and apply concepts about geometrical optics, physical optics, and photonics in relation to their application in the field of optical metrology; measurement based on the characteristics of amplitude, frequency and phase</i>	geometri, optika fisis, dan fotonika dalam kaitan aplikasinya pada bidang metrologi optis; pengukuran berbasis karakteristik amplituda, frekuensi dan fasa. <i>Accuracy in explaining and applying the concepts of geometrical optics, physical optics, and photonics in relation to their application in the field of optical metrology; measurement based on the characteristics of amplitude, frequency and phase.</i>		[BM: 2x(2x60'')]	<i>Review of optics and photonics in optical metrology</i>	
3	Mahasiswa mampu menyebutkan dan menjelaskan komponen yang digunakan pada metrologi optik. <i>Students are able to name and explain the components used in optical metrology.</i>	Ketepatan dalam menyebutkan dan menjelaskan komponen yang digunakan pada metrologi optik. <i>Accuracy in mentioning and explaining the components used in optical metrology</i>	Non-Test Tugas 1: Mahasiswa mengerjakan tugas mereview jurnal terkait konsep komponen yang digunakan pada metrologi optik. <i>Non-Test Task 1: Students work on the task of reviewing journals related to the concept of components used in optical metrology</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Komponen Metrologi Optik <i>Optical Metrology Components</i>	20%

4-5	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep interferensi gelombang, interferometri, dan interferometer <i>Students are able to explain and apply the concepts of wave interference, interferometry, and interferometer</i>	Ketepatan dalam menjelaskan dan menerapkan konsep-konsep interferensi gelombang, interferometri, dan interferometer <i>Accuracy in explaining and applying the concepts of wave interference, interferometry, and interferometer</i>	Non-Test Tugas 2: Mahasiswa mengerjakan tugas mereview jurnal konsep interferensi gelombang, interferometri, dan interferometer <i>Non-Test Task 2: Students work on the task of reviewing the concept of wave interference, interferometry, and interferometer journals</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Interferensi gelombang, interferometri, dan interferometer <i>interference, interferometry and interferometer</i>	
6-7	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep keterkinian komponen/sistem metrologi optik <i>Students are able to explain and apply up-to-date concepts of optical metrology components/systems</i>	Ketepatan dalam menjelaskan dan menerapkan konsep-konsep keterkinian komponen/sistem metrologi optik <i>Accuracy in explaining and applying up-to-date concepts of optical metrology components/systems</i>	Non-Test Tugas 3: Mahasiswa mengerjakan tugas mereview jurnal terkait keterkinian komponen/sistem metrologi optik <i>Non-Test Task 3: Students work on the task of reviewing journals related to the up-to-date components/systems of optical metrology</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Keterkinian komponen/sistem metrologi optik <i>Up-to-date optical metrology components/systems</i>	20%
8	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep	Ketepatan dalam menjelaskan dan menerapkan konsep-konsep optika dan fotonika	Non-Test Tugas 5:	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')]	Deteksi Sinyal Optik <i>Optical Signal Detection</i>	

	optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	dalam komunikasi data optik <i>Accuracy in explaining and applying the concepts of optics and photonics in optical data communication</i>	Mahasiswa mengerjakan tugas mereview jurnal terkait konsep deteksi sinyal optik <i>Non-Test</i> <i>Task 5:</i> <i>Students work on an assignment to review journals related to the concept of optical signal detection</i>	[BT: 2x(2x60'')] [BM: 2x(2x60'')]		
9-12	Mahasiswa mampu merancang komponen/sistem metrologi optik <i>Students are able to design components/systems of optical metrology</i>	Ketepatan dalam merancang komponen/sistem metrologi optik <i>Accuracy in designing optical metrology components/systems</i>	Non-Test Tugas 6: Mahasiswa merancang proyek terkait sistem metrologi optik <i>Non-Test</i> <i>Task 6:</i> <i>Students design projects related to optical metrology systems</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Perancangan Sistem Metrologi Optik <i>Optical Metrology System Design</i>	30%
13-14	Mahasiswa mampu mengevaluasi kinerja komponen/sistem komunikasi data optik <i>Students are able to evaluate the performance of optical data communication components/systems</i>	Ketepatan dalam mengevaluasi kinerja komponen/sistem komunikasi data optik <i>Accuracy in evaluating the performance of optical data communication components/systems</i>	Ketepatan evaluasi kinerja komponen dan sistem metrologi optik <i>Accuracy of performance evaluation of optical metrology components and systems</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Evaluasi Kinerja Komponen dan sistem metrologi optik <i>Performance Evaluation of Optical Metrology Components and Systems</i>	

15-16	Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan/analisa dari komponen/sistem komunikasi data optic <i>Students are able to make written reports and scientific presentations of the results of the design/analysis of optical data communication components/systems</i>	Ketepatan dalam membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan/analisa dari komponen/sistem komunikasi data optic <i>Accuracy in making written reports and scientific presentations of the results of the design/analysis of optical data communication components/systems</i>	Non-Test Tugas 6: Mahasiswa membuat presentasi dan laporan terkait sistem sistem metrologi optic <i>Non-Test Task 6: Students make presentations and reports related to optical metrology systems</i>	Kuliah, diskusi, review jurnal, Presentasi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Laporan dan presentasi hasil rancangan/analisa komponen/ sistem metrologi optic <i>Reports and presentations on design/component analysis/optical metrology systems</i>	30%
-------	--	---	--	--	---	-----

Catatan :

Note

4. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Metrologi Optik Lanjut Advanced Optical Metrology	RA&E
		Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>

Kode (Code): TF185332	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: Energy Engineering and Environmental Conditioning	Smt: 3 <i>Semester: 3</i>
OTORISASI (Authorization)	Penyusun RA & E PIC – Assessment & Evaluation Plan August M. Hatta	Koordinator RMK Field Coordinator Prof. Sekartedjo	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
3	Mahasiswa mampu menyebutkan dan menjelaskan komponen yang digunakan pada metrologi optik. <i>Students are able to name and explain the components used in optical metrology.</i>	Non-Test Tugas 1: Mahasiswa mengerjakan tugas mereview jurnal terkait konsep komponen yang digunakan pada metrologi optik. <i>Non-Test</i> <i>Task 1:</i> <i>Students work on the task of reviewing journals related to the concept of components used in optical metrology</i>	10%	10%		
6-7	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep keterkinian komponen/sistem metrologi optik <i>Students are able to explain and apply up-to-date concepts of optical metrology components/systems</i>	Non-Test Tugas 3: Mahasiswa mengerjakan tugas mereview jurnal terkait keterkinian komponen/sistem metrologi optik <i>Non-Test</i> <i>Task 3:</i> <i>Students work on the task of reviewing journals related to the up-to-date components/systems of optical metrology</i>	10%	10%		
9-12	Mahasiswa mampu merancang	Non-Test			15%	15%

	komponen/sistem metrologi optik <i>Students are able to design components/systems of optical metrology</i>	Tugas 6: Mahasiswa merancang proyek terkait sistem metrologi optik <i>Non-Test</i> <i>Task 6:</i> <i>Students design projects related to optical metrology systems</i>				
15-16	Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan/analisa dari komponen/sistem komunikasi data optic <i>Students are able to make written reports and scientific presentations of the results of the design/analysis of optical data communication components/systems</i>	Non-Test Tugas 6: Mahasiswa membuat presentasi dan laporan terkait sistem sistem metrologi optic <i>Non-Test</i> <i>Task 6:</i> <i>- Students make presentations and reports related to optical metrology systems</i>			15%	15%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			20%	20%	30%	30%

TF185333 RPS RAE Optika Kuantum (*Quantum Optics*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Optika Kuantum <i>Quantum Optics</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185333	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization:</i> <i>Instrumentation and Control Engineering</i>	Smt: 3 <i>Semester: 3</i>

OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Agus M. Hatta, Ph.D	Koordinator RMK <i>Field Coordinator</i> Dr.rer.nat Aulia MTN	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (37,5%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis</i> CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format</i> CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (37,5%) <i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	h. Mampu menerapkan hukum-hukum mekanika kuantum pada sistem kuantum i. Mampu menganalisa sistem kuantum. j. Mampu menerapkan prinsip-prinsip kuantisasi cahaya dan kuantum elektrodinamika. k. Mampu menganalisis sistem laser berdasarkan optika kuantum. <i>a. Able to apply the laws of quantum mechanics to quantum systems</i> <i>b. Able to analyze quantum systems.</i> <i>c. Able to apply the principles of light quantization and quantum electrodynamics.</i> <i>d. Able to analyze laser systems based on quantum optics.</i>	
	Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini berkaitan dengan IPTEK cahaya berdasarkan pendekatan kuantum. Pada bagian pertama, dibahas hukum-hukum mekanika kuantum dan contoh penerapannya pada sistem kuantum. Pada bagian kedua dibahas kuantisasi gelombang elektromagnetik, kuantum elektrodinamika, dan laser.	

	<i>This course is related to light science and technology based on a quantum approach. In the first part, the laws of quantum mechanics are discussed and examples of their application to quantum systems. The second part discusses the quantization of electromagnetic waves, quantum electrodynamics, and lasers.</i>					
Pokok Bahasan / Bahan Kajian <i>Module content</i>	5. Hukum-hukum mekanika kuantum : persamaan Schrodinger, prinsip pengukuran, dan keteramatan 6. Paket gelombang dan atom: atom hidrogen, basis komutator, dan prinsip ketidakpastian 7. Aplikasi mekanika kuantum: pemantulan dan transmisi partikel, dan aplikasi lainnya 8. Kuantisasi: kuantisasi gelombang elektromagnetika 9. Elektrodinamika Kuantum: Model Jaynes Cmmings, Kerapatan Matrik untuk sistem 2 tingkatan, Cavity Quantum Electrodynamics 10. Laser: laser 3 tingkatan, kontrol koheren 1. <i>The laws of quantum mechanics: the Schrodinger equation, the principle of measurement, and observability</i> 2. <i>Wave packets and atoms: hydrogen atom, commutator base and uncertainty principle</i> 3. <i>Quantum mechanics applications: particle reflection and transmission, and other applications</i> 4. <i>Quantization: quantization of electromagnetic waves</i> 5. <i>Quantum Electrodynamics: Jaynes Cmmings Model, Matrix Density for 2-tier systems, Cavity Quantum Electrodynamics</i> 6. <i>6. Laser: 3-level laser, coherent control</i>					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i> 1. Bram Gaasbeek, Introduction to Quantum Mechanics, arxiv, 2010 2. David J. Griffiths, Introduction to Quantum Mecahnics, 2nd ed, Prentice Hall. 3. Jonathan Keeling, Light-Matter Interactons and Quantum Optics 4. Mark Fox, Quantum Optics – an introduction, Oxford University Press, 2006 Pendukung : <i>Supporting</i>					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras : <i>Hardware</i>		
	OS:Windows; Office, Video demo, Matlab			PC & LCD Projector		
Team Teaching	Agus M. Hatta, Ph.D, Prof. Sekartedjo					
Matakuliah syarat	Fisika Teknik Lanjut					
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu]	Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)

				(5)	(6)	(7)
1-4	Mahasiswa mampu menjelaskan medan elektromagnetik dengan pendekatan semiklasik dan kuantum <i>Students are able to explain electromagnetic fields with semiclassical and quantum approaches</i>	Ketepatan dalam menjelaskan medan elektromagnetik dengan pendekatan semi klasik dan kuantum <i>Accuracy in explaining electromagnetic fields with semiclassical and quantum approaches</i>	Quiz 1 Mahasiswa mengerjakan 4 soal terkait dengan persamaan Maxwell, Hamiltonian medan-atom, kuantisasi dan operator, matrik densitas <i>Quiz 1</i> <i>Students work on 4 problems related to Maxwell's equations, atomic-field Hamiltonian, quantization and operators, density matrices</i>	Kuliah, Review paper journal dan diskusi •TM = 4 mg x 2 sks x 50' •BT = 5 mg x 2 sks x 60' •BM = 5 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 4 mg x 2 sks x 50' •BT = 4 mg x 2 sks x 60' •BM = 4 mg x 2 sks x 60'	Deskripsi medan elektromagnetik dengan pendekatan semiklasik dan kuantum: Persamaan Maxwell, Hamiltonian medan-atom, kuantisasi dan operator, matrik densitas <i>Description of electromagnetic fields with semiclassical and quantum approaches: Maxwell's equations, atomic-field Hamiltonian, quantization and operators, density matrices</i>	20% (CPMK-1)
5-7	Mahasiswa mampu mendiskusikan teori kuantum koheren optik, interferometri, dan deteksi foton <i>Students are able to discuss optical coherent quantum theory, interferometry, and photon detection</i>	Ketepatan dalam mendiskusikan teori kuantum koheren optik, interferometri, dan deteksi foton <i>Accuracy in discussing optical coherent quantum theory, interferometry, and photon detection</i>	Quiz 2 Mahasiswa mengerjakan 4 soal terkait dengan teori kuantum koheren optik, interferometri, dan deteksi foton <i>Quiz 2</i> <i>Students work on 4 problems related to optical coherent quantum theory, interferometry, and photon detection</i>	Kuliah, Review paper journal dan diskusi •TM = 3 mg x 2 sks x 50' •BT = 3 mg x 2 sks x 60' •BM = 3 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 3 mg x 2 sks x 50' •BT = 3 mg x 2 sks x 60' •BM = 3 mg x 2 sks x 60'	Teori kuantum koheren optik, interferometri, dan deteksi foton <i>Optical coherent quantum theory, interferometry and photon detection</i>	20% (CPMK-2)

	<i>and photon detection</i>					
8	Evaluasi Tengah Semester (ETS) Mid-Term Exam					5% (CPMK-1) 5% (CPMK-2)
9-10	Mahasiswa mampu merumuskan keadaan cahaya dan deteksinya <i>Students are able to formulate the state of light and its detection</i>	Ketepatan dalam merumuskan keadaan cahaya dan deteksinya <i>Accuracy in formulating the state of light and its detection</i>	Quiz 3 Mahasiswa mengerjakan 4 soal terkait dengan coherent states, squeezed states, photon counting versus homodyne detection, measuring conjugate properties Quiz 3 <i>Students work on 4 questions related to coherent states, squeezed states, photon counting versus homodyne detection, measuring conjugate properties</i>	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'	Keadaan cahaya dan deteksinya: coherent states, squeezed states, photon counting versus homodyne detection, measuring conjugate properties <i>Light states and their detection: coherent states, squeezed states, photon counting versus homodyne detection, measuring conjugate properties</i>	15 % (CPMK-3)
11-13	Mahasiswa mampu menganalisa interaksi medan-atom dan sistem kuantum terbuka <i>Students are able to analyze atomic-field interactions and open quantum systems</i>	Ketepatan dalam menganalisa interaksi medan-atom dan sistem kuantum terbuka <i>Accuracy in analyzing atomic-field interactions and open quantum systems</i>	Quiz 4 Mahasiswa mengerjakan soal terkait Interaksi medan-atom: kopling antara sebuah atom dan medan EM dalam sebuah kaviti, pendekatan dua-tingkat (two-level), model Jaynes- Cummings Quiz 4 <i>Students work on problems related to atomic-field interactions: coupling</i>	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'	Interaksi medan-atom: kopling antara sebuah atom dan medan EM dalam sebuah kaviti, pendekatan dua-tingkat (two-level), model Jaynes- Cummings. <i>Atom-field interactions: coupling between an atom and an EM field in a cavity, two-level approximation, Jaynes-Cummings model.</i>	15 % (CPMK-4)

			<i>between an atom and an EM field in a cavity, two-level approximation, Jaynes-Cummings model</i>			
14-15	Mahasiswa mampu mendiskripsikan peran kuantum optik dalam bidang quantum entanglement dan quantum information. <i>Students are able to describe the role of quantum optics in the field of quantum entanglement and quantum information.</i>	Ketepatan dalam mendiskripsikan peran kuantum optik dalam bidang quantum entanglement dan quantum information. <i>Accuracy in describing the role of quantum optics in the field of quantum entanglement and quantum information.</i>	Mahasiswa membuat makalah terkait peran kuantum optik dalam bidang quantum entanglement dan quantum information. Mahasiswa mempresentasikan hasil makalah yang telah dibuat <i>Students make a paper related to the role of quantum optics in the field of quantum entanglement and quantum information.</i> <i>Students present the results of the papers that have been made</i>	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	Topik pilihan: peran kuantum optik dalam bidang quantum entanglement dan quantum information. <i>Selected topic: the role of quantum optics in the field of quantum entanglement and quantum information.</i>	10 % (CPMK-4)
16	Evaluasi Akhir Semester <i>Final Exam</i>					5% (CPMK-3) 10% (CMPK-4)

Catatan :

8. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	Optika Kuantum Quantum Optics		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185333	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: Instrumentation and Control Engineering	Smt: 3 <i>Semester: 3</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Agus M. Hatta, Ph.D	Koordinator RMK Field Coordinator Dr.rer.nat Aulia MTN	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK3 (7)
1-4	Mahasiswa mampu menjelaskan medan elektromagnetik dengan pendekatan semiklasik dan kuantum <i>Students are able to explain electromagnetic fields with semiclassical and quantum approaches</i>	Quiz 1 Mahasiswa mengerjakan 4 soal terkait dengan persamaan Maxwell, Hamiltonian medan-atom, kuantisasi dan operator, matrik densitas Quiz 1 <i>Students work on 4 problems related to Maxwell's equations, atomic-field Hamiltonian, quantization and operators, density matrices</i>	20%			

5-7	Mahasiswa mampu mendiskusikan teori kuantum koheren optik, interferometri, dan deteksi foton <i>Students are able to discuss optical coherent quantum theory, interferometry, and photon detection</i>	Quiz 2 Mahasiswa mengerjakan 4 soal terkait dengan teori kuantum koheren optik, interferometri, dan deteksi foton <i>Quiz 2</i> <i>Students work on 4 problems related to optical coherent quantum theory, interferometry, and photon detection</i>		20%		
8	Evaluasi Tengah Semester <i>Mid Term Exam</i>		5%	5%		
9-10	Mahasiswa mampu merumuskan keadaan cahaya dan deteksinya <i>Students are able to formulate the state of light and its detection</i>	Quiz 3 Mahasiswa mengerjakan 4 soal terkait dengan coherent states, squeezed states, photon counting versus homodyne detection, measuring conjugate properties <i>Quiz 3</i> <i>Students work on 4 questions related to coherent states, squeezed states, photon counting versus homodyne detection, measuring conjugate properties</i>			15%	
11-13	Mahasiswa mampu menganalisa interaksi medan-atom dan sistem kuantum terbuka <i>Students are able to analyze atomic-field interactions and open quantum systems</i>	Quiz 4 Mahasiswa mengerjakan soal terkait Interaksi medan-atom: kopling antara sebuah atom dan medan EM dalam sebuah kaviti, pendekatan dua-tingkat (two-level), model Jaynes- Cummings <i>Quiz 4</i> <i>Students work on problems related to atomic-field interactions: coupling between an atom and an EM field in a cavity, two-level approximation, Jaynes-Cummings model</i>				15%
14-15	Mahasiswa mampu mendiskripsikan peran kuantum optik dalam bidang quantum entanglement dan quantum information. <i>Students are able to describe the role of quantum optics in the field of quantum entanglement and quantum information.</i>	Mahasiswa membuat makalah terkait peran kuantum optik dalam bidang quantum entanglement dan quantum information. Mahasiswa mempresentasikan hasil makalah yang telah dibuat				10%

		<i>Students make a paper related to the role of quantum optics in the field of quantum entanglement and quantum information.</i> <i>Students present the results of the papers that have been made</i>				
16	Evaluasi Akhir Semester (EAS) <i>Final Exam</i>				5%	5%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Monitoring Getaran <i>Vibration Monitoring</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185411	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Dhany Arifianto, ST, MEng	Koordinator RMK <i>Field Coordinator</i> Dr. Dhany Arifianto, ST, MEng	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	
	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i>	
	CP-MK Course Learning Outcome (CLO)	
	Mahasiswa mampu memahami konsep getaran mekanik dan getaran struktur, mampu mengakuisisi data getaran mesin, mengolah dan mendiagnosa kerusakan dasar, serta mampu mendesain algoritma pengolahan data vibrasi secara komputasional. <i>Students are able to understand the concepts of mechanical vibration and structural vibration, are able to acquire machine vibration data, process and diagnose basic damage, and are able to design computational vibration data processing algorithms.</i>	
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari tentang konsep sinyal getaran serta akustik dari struktur bangunan dan mesin guna diolah secara komputasional dalam rangka rekayasa untuk fungsi yang berkelanjutan. <i>This course studies the concepts of vibration and acoustic signals from building structures and machines to be processed computationally in the context of engineering for sustainable functions.</i>	
Pokok Bahasan / Bahan Kajian Module content	Teori Vibrasi Mekanik dan Kerusakan; Akuisisi data, Pengkondisian Sinyal dan Pemrosesan Data; Vibration Monitoring; Ultrasonic Signal Processing; Wireless Vibration Monitoring; serta Maintenance Management. <i>Mechanical Vibration and Damage Theory; Data acquisition, Signal Conditioning and Data Processing; Vibration Monitoring; Ultrasonic Signal Processing; Wireless Vibration Monitoring; and Maintenance Management..</i>	
Pustaka Reading Materials	Utama: Main	
	1. Keith Mobley, <i>An Introduction to Predictive Maintenance 2Ed</i>, Butterworth, 2002. 2. P. Girdhar, <i>Practical Machinery Vibration Analysis and Predictive Maintenance</i>, Elsevier Science, 2004	
	Pendukung: Supporting	
	4. K. Shin & J. Hammond, <i>Fundamental of Signal Processing for Sound and Vibration Engineers</i>, John Wiley, 2008. 5. Robert B. Randall, <i>Vibration-Based Condition Monitoring</i>, John Wiley, 2011. 6. R. Isermann, <i>Fault-Diagnosis Applications</i>, Springer, 2011	
Media Pembelajaran	Perangkat lunak:	Perangkat keras:

Learning Media		Software		Hardware		
		Matlab, LabView		Accelerometer Array, DAQ Board		
Tim Pengajar Team Teaching		Dr. Dhany Arifianto, ST, MEng				
Matakuliah syarat Entry requirement		-		Bahasa pengantar: Languages	Bahasa Indonesia Indonesian	
Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessm ent point (%) (7)
1,2	Mampu memahami gejala getaran mekanik pada mesin dan struktur <i>Students are able to understand the symptoms of mechanical vibration in machines and structures</i>	- Ketepatan dalam penurunan model matematis studi kasus getaran mekanik satu derajat kebebasan - Ketepatan dalam penurunan model matematis studi kasus getaran mekanik n-derajat kebebasan <i>Accuracy in deriving mathematical models of case studies of mechanical vibrations of one degree of freedom</i> <i>Accuracy in deriving mathematical models from case studies of mechanical vibrations of n-degrees of freedom</i>	TUGAS 1: Tugas (Review gejala getaran mekanik pada mesin dan struktur.) <i>ASSIGNMENT 1: Tasks (Review of mechanical vibration symptoms in machines and structures.)</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Getaran satu derajat kebebasan 2. Getaran n-derajat kebebasan 3. Kerusakan 4. <i>Vibration of one degree of freedom</i> 5. <i>Vibration n-degrees of freedom</i> 6. <i>Damage</i>	10% (CP-MK1)

3-5	Mampu mengukur / akuisisi data vibrasi sesuai standar industri (ISO) <i>Students are able to measure / acquire vibration data according to industry standards (ISO)</i>	• Ketepatan dalam mengukur, akuisisi data dan interpretasi data • Ketepatan dalam mendapatkan respon normal/kerusakan beserta diagnosa tingkat kerusakan • <i>Accuracy in measuring, data acquisition and interpretation of data</i> • <i>Accuracy in obtaining a normal/damage response along with a diagnosis of the level of damage</i>	TUGAS 2: Tugas Praktikum Matlab <i>ASSIGNMENT 2: Task Matlab Practicum</i>	Kuliah dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	• Mengukur model getaran bebas • Mengukur model getaran paksa (forced vibration) • Analisa data getaran normal vs rusak • <i>Measuring vibration free model</i> • <i>Measuring the forced vibration model</i> • <i>Analysis of normal vs. faulty vibration data</i>	10% (CP-MK1)
6,7	Mampu mendapatkan (mendiagnosa) respon mesin normal dan rusak dengan parameter vibration monitoring <i>Students are able to get (diagnose) normal and faulty engine response with vibration monitoring parameters</i>	• Ketepatan menentukan lubrikasi • Ketepatan desain dan rentang operasional untuk memonitor lajur wear (aus). • <i>The accuracy of determining the lubrication</i> • <i>Design accuracy and operational range to monitor wear lanes (wear).</i>	TUGAS 3: Tugas (review mendiagnosa) respon mesin normal dan rusak dengan parameter vibration monitoring) <i>ASSIGNMENT 5: Task (review diagnosing normal and faulty engine response with vibration monitoring parameters)</i>	Kuliah dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Percepatan, Kecepatan dan Displacement • Kerusakan (wear) • <i>Acceleration, Velocity and Displacement</i> • <i>Damage (wear)</i>	15% (CP-MK1)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					15% (CP-MK1)
9-10	Mampu mendapatkan respon mesin normal dan rusak dengan parameter ultrasonic	• Ketepatan menentukan kerusakan berdasarkan parameter elektrik • Ketepatan desain dan rentang operasional	TUGAS 4: • Mahasiswa menyusun Tugas Praktikum III • Demo program Matlab • Evaluasi Program	Kuliah, brainstorming dan diskusi [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	• Kuliah / Diskusi • E-learning • <i>Lectures / Discussions</i> • <i>E-learning</i>	10% (CP-MK1)

	<i>Students are able to get normal and faulty engine response with ultrasonic parameters</i>	• Accuracy of determining damage based on electrical parameters • Design accuracy and operational range	ASSIGNMENT 4: • Students prepare practicum assignments III • Matlab program demo • Program Evaluation			
12,13	Mampu memahami teknologi akuisisi data dan respon secara nirkabel <i>Students are able to understand wireless data acquisition and response technology</i>	• Ketepatan menentukan kerusakan berdasarkan parameter elektrik • Ketepatan desain dan rentang operasional • Accuracy of determining damage based on electrical parameters • Design accuracy and operational range	TUGAS 5: • Tugas Praktikum III • Demo program Matlab • Evaluasi Program ASSIGNMENT 5: • Practicum Task III • Matlab program demo • Program Evaluation	Kuliah, brainstorming dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Kuliah / Diskusi • E-learning • Lectures / Discussions • E-learning	10% (CP-MK1)
14,15	Mampu mendesain maintenance management berdasarkan data prediksi <i>Students are able to design maintenance management based on predictive data</i>	• Ketepatan menganalisa dan Ketepatan dalam menentukan strategi kendali umpan balik serta penalaan pada perubahan masukan • Kemampuan desain kendali PID terdistribusi • Accuracy in analyzing and Accuracy in determining feedback control strategies and tuning in input changes • Distributed PID control design capabilities	TUGAS 6: Final Project ASSIGNMENT 6: Final Project	Kuliah, brainstorming, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Kuliah / Diskusi 2. E-learning 3. Program Matlab • Lectures / Discussions • E-learning • Matlab Program	10% (CP-MK1)
16	Evaluasi Akhir Semester					25%

	<i>Final Examination</i>	(CP-MK1)
--	--------------------------	----------

Catatan :

Note

5. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) <i>ASSESSMENT & EVALUATION PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI IST <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RA&E
	Monitoring Getaran <i>Vibration Monitoring</i>		Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185411	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization:</i> <i>Instrumentation Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i> Dr. Dhany Arifianto, ST, MEng	Koordinator RMK <i>Field Coordinator</i> Dr. Dhany Arifianto, ST, MEng	Ka PRODI <i>Head of Master Program</i>

			Dr. Ridho Hantoro
--	--	--	-------------------

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot (%) CP-MK
1,2	Mampu memahami gejala getaran mekanik pada mesin dan struktur <i>Students are able to understand the symptoms of mechanical vibration in machines and structures</i>	TUGAS 1: Tugas (Review gejala getaran mekanik pada mesin dan struktur.) <i>ASSIGNMENT 1: Tasks (Review of mechanical vibration symptoms in machines and structures.)</i>	10
3-5	Mampu mengukur / akuisisi data vibrasi sesuai standar industri (ISO) <i>Students are able to measure / acquire vibration data according to industry standards (ISO)</i>	TUGAS 2: Tugas Praktikum Matlab <i>ASSIGNMENT 2: Task Matlab Practicum</i>	10
6,7	Mampu mendapatkan (mendiagnosa) respon mesin normal dan rusak dengan parameter vibration monitoring <i>Students are able to get (diagnose) normal and faulty engine response with vibration monitoring parameters</i>	TUGAS 3: Tugas (review mendiagnosa) respon mesin normal dan rusak dengan parameter vibration monitoring) <i>ASSIGNMENT 3: Task (review diagnosing) normal and faulty engine response with vibration monitoring parameters)</i>	15
8	Mid Term Examination		15
9,10	Mahasiswa mampu menjelaskan tentang sensor konvensional dan soft-sensor <i>Students are able to explain about conventional sensors and soft sensors</i>	TUGAS 4: Mahasiswa menyusun makalah dari literatur jurnal mengenai teknologi sensor konvensional dan soft sensor.	10

		<i>ASSIGNMENT 4: Students compile papers from journal literature regarding conventional sensor technology and soft sensors.</i>	
11-13	Mahasiswa mampu menjelaskan tentang transmitter konvensional , transmitter smart and intelegent transmitter <i>Students are able to explain about conventional transmitters, smart transmitters and intelligent transmitters</i>	TUGAS 5: Mahasiswa menyusun makalah dari literatur jurnal mengenai teknologi transmitter konvensional, transmitter smart dan intelligent <i>ASSIGNMENT 5: Students compile papers from journal literature regarding conventional transmitter technology, smart and intelligent transmitters</i>	10
14-15	Mahasiswa mampu merancang soft sensor, smart and intelligent transmitter <i>Students are able to design soft sensors, smart and intelligent transmitters</i>	TUGAS 6: Mahasiswa menyusun makalah dari literatur jurnal mengenai arsitektur dan metode pembelajaran dalam Neural Network metodologi perancangan smart and intelligent transmitter <i>ASSIGNMENT 6: Students compile papers from journal literature regarding architecture and learning methods in the Neural Network smart and intelligent transmitter design methodology</i>	15
16	Evaluasi Akhir Semester (<i>Final Examination</i>)		15
Total Bobot Penilaian (%) <i>Total Point (%)</i>			100

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Manajemen Keselamatan Proses <i>Process Safety Management</i>		RP Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185412	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Ir. Ali Musyafa', M.Sc	Koordinator RMK <i>Field Coordinator</i> Totok Ruki Biyanto, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems</i> CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (50%) <i>Are able to effectively communicate in both oral and written format</i> CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (25%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	a. Mahasiswa mampu mengidentifikasi tentang konsep manajemen bahaya (CP-2) (CP-5) (50%)	

	<i>Students are able to identify the concept of hazard management.</i> b. Mahasiswa mampu mengidentifikasi teknik-teknik perlindungan pekerja, fasilitas aset dan lingkungan. (CP-6.I) (50%) <i>Students are able to identify worker, asset and environmental protection techniques.</i>	
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini mempelajari tentang konsep manajemen bahaya, teknik-teknik perlindungan pekerja, fasilitas aset dan lingkungan. <i>This course studies the contribution of hazard management concepts, worker protection techniques, asset facilities and the environment.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Aplikasi Manajemen Keselamatan Proses (<i>Process Safety Management Application</i>) 2. Partisipasi Pekerja (<i>Employee Participation</i>) 3. Informasi Keselamatan Proses (<i>Process Safety Information</i>) 4. Analisis Bahaya Proses (<i>Process Hazard Analysis</i>) 5. Prosedur Operasi (<i>Operating Procedure</i>) 6. Kontraktor (<i>Contractors</i>) 7. Tinjauan Keselamatan Sebelum Memulai (<i>Pre-Start up Safety Review</i>) 8. Memulai Tinjauan Keamanan (<i>Start up Safety Review</i>) 9. Integritas Mekanik (<i>Mechanical Integrity</i>) 10. Hot Work (Otorisasi Kerja Non Rutin) (<i>Hot Work (Non Routine Work Authorizations)</i>) 11. Manajemen Perubahan (<i>Management of change</i>) 12. Investigasi Insiden (<i>Incident Investigation</i>) 13. Perencanaan dan Tanggap Darurat (<i>Emergency Planning and Response</i>) 14. Audit Kepatuhan (<i>Compliance Audits</i>)	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	1. Guidelines for Preventing Human Error in Process Safety, American Institute of Chemical Engineers, 1994 2. Layer of Protection Analysis SIMPLIFIED PROCESS RISK ASSESSMENT, Center for Chemical Process Safety, 2001 3. Hardware Safety Integrity Process Industri, IEC-61511; 2007 4. Process Automation and Safety in Refining – A Multi-Dimensional Approach, Honeywell, 2013
	Pendukung : <i>Supporting</i>	1. Journal of Homeland Security and Emergency Management 2. International Journal of Metrology and Quality Engineering
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras : <i>Hardware</i>
	-	PC
Team Teaching	Dr. Ir. Ali Musyafa', M.Sc. Totok Ruki Biyanto, ST, MT, Ph.D.	
Matakuliah syarat	TF185103 Instrumentasi Lanjut <i>TF185103 Advanced Instrumentation</i>	

Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-2	Mahasiswa mampu mengidentifikasi tentang konsep manajemen bahaya. <i>Students are able to identify the concept of hazard management.</i>	- Ketepatan dalam menjelaskan prinsip dasar aplikasi process safety management. <i>Students are able to explain the basic principles of process safety management application</i> - Ketepatan dalam menyebutkan employee participation <i>Students are able to mention employee participation</i>	Tes 1: Penyusunan makalah tentang aplikasi process safety management serta employee participation. <i>Preparation of papers on the application of process safety management and employee participation</i> Presentasi <i>Assignment Presentation</i>	Kuliah Diskusi E-learning - TM = 2 mg x 2 sks x 50' - BT = 2 mg x 2 sks x 60' - BM = 2 mg x 2 sks x 60'	- Aplikasi Manajemen Keselamatan Proses <i>Process Safety Management Application</i> - Partisipasi Pekerja <i>Employee Participation</i>	10% (CPMK-1)
3-4		Ketepatan dalam menganalisis informasi keselamatan proses dan process hazard analysis. <i>Students are able to analyzing Process safety information and process hazard analysis</i>	Tes 2: Penyusunan makalah tentang kajian Process Safety Information serta Process Hazard Analysis. <i>Preparation of papers on the study of Process Safety Information and Process Hazard Analysis</i> Presentasi <i>Assignment Presentation</i>	Kuliah Diskusi E-learning - TM = 2 mg x 2 sks x 50' - BT = 2 mg x 2 sks x 60' - BM = 2 mg x 2 sks x 60'	- Informasi Keselamatan Proses <i>Process Safety Information</i> - Analisis Bahaya Proses <i>Process Hazard Analysis</i>	10% (CPMK-1)
5-7		Ketepatan dalam menjelaskan operating procedure, contractors serta	Tes 3: Penyusunan makalah tentang Operating Procedure, Contractors	Kuliah Diskusi E-learning TM = 3 mg x 2 sks x 50'	- Prosedur Operasi <i>Operating Procedure</i> - Kontraktor <i>Contractors</i>	10% (CPMK-1)

		Pre-Start up Safety Review. <i>Students are able to explain operating procedures, contractors and Pre-Start up Safety Review</i>	serta Pre-Startup Safety Review. <i>Preparation of papers on Operating Procedures, Contractors and Pre-Startup Safety Review</i> Presentasi <i>Assignment Presentation</i>	● BT = 3 mg x 2 sks x 60' ● BM = 3 mg x 2 sks x 60'	● Tinjauan Keselamatan Sebelum Memulai <i>Pre-Start up Safety Review</i>	
8	Evaluasi Tengah Semester – Review aktifitas minggu ke 1 sd minggu ke 7 dan evaluasi hasil luaran <i>Mid Term Exam - Review the activities of the 1st week to the 7th week and evaluate the results</i>					20% (CPMK-1)
9-10	Mahasiswa mampu mengidentifikasi teknik-teknik perlindungan pekerja, fasilitas aset dan lingkungan. <i>Students are able to identify worker, asset and environmental protection techniques.</i>	● Ketepatan dalam menjelaskan prinsip dasar Mechanical Integrity <i>Students are able to explain the basic principles of mechanical integrity</i> ● Ketepatan dalam menjelaskan prinsip Hot Work (Non routine Work Authorizations) <i>Students are able to explain the principle of Hot Work (Non routine Work Authorizations)</i>	Tes 4: Penyusunan makalah tentang Mechanical Integrity serta Hot Work (Non routine Work Authorizations). <i>Preparation of papers on Mechanical Integrity and Hot Work (Non routine Work Authorizations)</i> Presentasi <i>Assignment Presentation</i>	Kuliah Diskusi E-learning ● TM = 2 mg x 2 sks x 50' ● BT = 2 mg x 2 sks x 60' ● BM = 2 mg x 2 sks x 60'	● Integritas Mekanik <i>Mechanical Integrity</i> ● Hot Work (Otorisasi Kerja Non Rutin) <i>Hot Work (Non Routine Work Authorizations)</i>	10% (CPMK-2)
11-12		● Ketepatan dalam menganalisis Management of change serta Incident Investigation.	Tes 5: Penyusunan makalah tentang Management of change beserta Incident Investigation.	Kuliah Diskusi E-learning ● TM = 2 mg x 2 sks x 50' ● BT = 2 mg x 2 sks x 60' ● BM = 2 mg x 2 sks x 60'	● Manajemen Perubahan <i>Management of change</i> ● Investigasi Insiden <i>Incident Investigation</i>	10% (CPMK-2)

		<i>Students are able to analyze management of change and Incident Investigation</i>	<i>Preparation of papers on Management of change and Incident Investigation</i> Presentasi <i>Assignment Presentation</i>			
13-15		- Kemampuan dalam merancang Emergency Planning and response. <i>Students are able to designing Emergency Planning and response</i> - Kemampuan dalam mengaplikasikan Compliance audit. <i>Students are able to apply compliance audits.</i>	Tes 6: Penyusunan makalah tentang Emergency Planning and Response beserta Compliance Audits. <i>Preparation of papers on Emergency Planning and Response along with Compliance Audits</i> Presentasi <i>Assignment Presentation</i>	Kuliah Diskusi E-learning - TM = 3 mg x 2 sks x 50' - BT = 3mg x 2 sks x 60' - BM = 3 mg x 2 sks x 60'	- Perencanaan dan Tanggap Darurat <i>Emergency Planning and Response</i> - Audit Kepatuhan <i>Compliance Audits</i>	10% (CPMK-2)
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam - Review the activities of the 9th week to the 15th week and evaluate the results</i>					20% (CPMK-2)

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Manajemen Keselamatan Proses Process Safety Management		RA&E
			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185412	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: <i>Instrumentation and Control Engineering</i>	Smt: 2 <i>Semester: 2</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Ir. Ali Musyafa', M.Sc	Koordinator RMK Field Coordinator Totok Ruki Biyanto, PhD	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)
1-2	Mahasiswa mampu mengidentifikasi tentang konsep manajemen bahaya. <i>Students are able to identify the concept of hazard management.</i>	Non-Tes: Penyusunan makalah tentang aplikasi process safety management serta employee participation. <i>Preparation of papers on the application of process safety management and employee participation</i> Presentasi <i>Assignment Presentation</i>	10%	
3-4		Non-Tes: Penyusunan makalah tentang kajian Process Safety Information serta Process Hazard Analysis.	10%	

		<i>Preparation of papers on the study of Process Safety Information and Process Hazard Analysis</i> Presentasi <i>Assignment Presentation</i>		
5-7		Non-Tes: Penyusunan makalah tentang Operating Procedure, Contractors serta Pre-Startup Safety Review. <i>Preparation of papers on Operating Procedures, Contractors and Pre-Startup Safety Review</i> Presentasi <i>Assignment Presentation</i>	10%	
8	Evaluasi Tengah Semester <i>Mid Term Exam</i>	Review Aktifitas Minggu ke 1 sd Minggu ke 7 dan evaluasi hasil luaran <i>Review the activities of the 1st week to the 7th week and evaluate the results</i>	20%	
9-10	Mahasiswa mampu mengidentifikasi teknik-teknik perlindungan pekerja, fasilitas aset dan lingkungan. <i>Students are able to identify worker, asset and environmental protection techniques.</i>	Non-Tes: Penyusunan makalah tentang Mechanical Integrity serta Hot Work (Non routine Work Authorizations). <i>Preparation of papers on Mechanical Integrity and Hot Work (Non routine Work Authorizations)</i> Presentasi <i>Assignment Presentation</i>		10%
11-12		Non-Tes: Penyusunan makalah tentang Management of change beserta Incident Investigation. <i>Preparation of papers on Management of change and Incident Investigation</i> Presentasi <i>Assignment Presentation</i>		10%
13-15		Non-Tes: Penyusunan makalah tentang Emergency Planning and Response beserta Compliance Audits. <i>Preparation of papers on Emergency Planning and Response along with Compliance Audits</i> Presentasi <i>Assignment Presentation</i>		10%
16	Evaluasi Akhir <i>Final Exam</i>	Review Aktifitas Minggu ke 9 sd Minggu ke 15 dan evaluasi hasil luaran <i>Review the activities of the 9th week to the 15th week and evaluate the results</i>		20%
Total bobot penilaian			50%	50%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Teknologi Sensor dan Transmitter <i>Sensor and Transmitter Technology</i>		RP Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185413	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 2 <i>Semester: 2</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Ir. Purwadi Agus Darwito, M.Sc	Koordinator RMK <i>Field Coordinator</i> Dr. Imam Abadi, S.T., M.T	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (25%) <i>Are able to critically apply the knowledge of advanced mathematics, physics, and engineering in order to solve complex problems</i> CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (50%) <i>Are able to effectively communicate in both oral and written format</i> CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (25%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	a. Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya [CP-2] [30 %]	

	<i>Students are able to design sensors for physical quantity monitoring applications in industry or others</i> b. Mahasiswa mampu mengevaluasi kinerja sensor [CP-5] [30 %] <i>Students are able to evaluate sensor performance</i> c. Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan dan evaluasi sensor [CP-6.I] [40 %] <i>Students are able to make written reports and scientific presentations of the results of sensor designs and evaluations</i>	
Diskripsi Singkat MK <i>Course Description</i>	Membahas teknologi perkembangannya pada sensor dan transmitter yang digunakan di industri dan peralatan elektronik masa <i>Discussing technology developments in sensors and transmitters used in industry and modern electronic equipment</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Ragam sensor <i>Various of sensors</i> 2. Review sensor <i>Sensor review</i> 3. Keterkinian sensor <i>Sensor update</i> 4. Perancangan sensor <i>Sensor design</i> 5. Evaluasi kinerja sensor <i>Evaluation of sensor performance</i> 6. Sistem transmisi <i>Transmission system</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	
	-	Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 4th edition, Springer, 2010
	Pendukung : <i>Supporting</i>	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras : <i>Hardware</i>
	OS:Windows; Office, Video demo, Matlab	PC & LCD Projector
Team Teaching	Dr. Ir. Purwadi Agus Darwito, M.Sc. Dr. Imam Abadi, ST, MT	
Matakuliah syarat		

Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-5	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya. <i>Students are able to design sensors for physical quantity monitoring applications in industry or others.</i>	Ketepatan menjelaskan dan menerapkan ragam sensor <i>Accuracy of explaining and applying various sensors.</i>	Non-Test Tugas 1: Mahasiswa mengerjakan tugas mereview jurnal terkait ragam sensor <i>Non-Test Task 1: Students work on the task of reviewing journals related to various sensors</i>	Kuliah, Review paper journal dan diskusi •TM = 5 mg x 2 sks x 50' •BT = 5 mg x 2 sks x 60' •BM = 5 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 5 mg x 2 sks x 50' •BT = 5 mg x 2 sks x 60' •BM = 5 mg x 2 sks x 60'	1. Ragam sensor <i>Various of sensors</i>	8% (CPMK-1)
6-7	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya <i>Students are able to design sensors for physical quantity</i>	Ketepatan menjelaskan dan menelusur keterkinian suatu sensor <i>The Accuracy of describing and tracking a sensor's up-to-date</i>	Non-Test Tugas 2: Mahasiswa mengerjakan tugas mereview jurnal terkait aplikasi sensor di dunia industri <i>Non-Test Task 1: Students work on the task of reviewing journals related to sensor applications in the industrial world</i>	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'	1. Review sensor <i>Sensor review</i>	7% (CPMK-1)

	<i>monitoring applications in industry or others</i>					
8	Evaluasi Tengah Semester (ETS) Mid-Term Exam					15% (CPMK-1)
9-10	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya <i>Students are able to design sensors for physical quantity monitoring applications in industry or others</i>	Kedalaman dalam melakukan perancangan sensor berdasarkan telusur keterkinian <i>Depth in designing sensors based on traceability</i>	Non-Test Tugas 3: Mahasiswa mengerjakan tugas mereview jurnal terkait merancang sensor untuk aplikasi pemantauan besaran fisis di industri Non-Test Task 2: <i>Students work on an assignment to review journals related to designing photonic sensors for physical quantity monitoring applications in industry</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Keterkinian sensor <i>Sensor update</i> 2. Perancangan sensor <i>Sensor design</i>	10 % (CPMK-2)
11-14	Mahasiswa mampu mengevaluasi kinerja sensor <i>Students are able to evaluate sensor performance</i>	Ketepatan dalam melakukan pembuatan dan evaluasi kinerja sensor <i>Accuracy in making and evaluating sensor performance</i>	Non-Test Tugas 4: Mahasiswa mengerjakan tugas mereview jurnal terkait mengavaluasi kinerja sensor yang digunakan pada plan di industri Non-Test Task 4:	Kuliah, Review paper journal dan diskusi •TM = 4 mg x 2 sks x 50' •BT = 4 mg x 2 sks x 60' •BM = 4 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 4 mg x 2 sks x 50' •BT = 4 mg x 2 sks x 60'	1. Evaluasi kinerja sensor <i>Evaluation of sensor performance</i> 2. Sistem transmisi <i>Transmission system</i>	10 % (CPMK-2) 10% (CPMK-3)

			<i>Students work on the task of reviewing journals related to evaluating the performance of sensors used in industrial plans</i>	<i>•BM = 4 mg x 2 sks x 60'</i>		
15	Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan dan evaluasi sensor <i>Students are able to make written reports and scientific presentations of the results of sensor designs and evaluations</i>	Ketepatan dalam menyusun laporan dan presentasi perancangan sensor <i>Accuracy in compiling reports and presentations on sensor design</i>	Non-Test Tugas 5: Mahasiswa merancang eksperimen terkait sensor dan membuat laporan tertulis dan presentasi <i>Non-Test Task 5: Students design experiments related to sensors and make written reports and presentations</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Perancangan sensor <i>Sensor design</i> 2. Evaluasi kinerja sensor <i>Evaluation of sensor performance</i>	20 % (CPMK-3)
16	Evaluasi Akhir Semester <i>Final Exam</i>					20% (CPMK-2: 10%; CMPK-3: 10%)

Catatan :

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

		RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS				RA&E
		Teknologi Sensor dan Transmitter Sensor and Transmitter Technology				Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185413		Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>			Smt: 2 <i>Semester: 2</i>
OTORISASI (Authorization)		Pengembang RP Contact Person – Learning Plan Dr. Ir. Purwadi Agus Darwito, M.Sc	Koordinator RMK Field Coordinator Dr. Imam Abadi, S.T., M.T			Ka PRODI Head of Master Program Dr. Ridho Hantoro
Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)		Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)
1-5	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya. <i>Students are able to design sensors for physical quantity monitoring applications in industry or others.</i> .	TUGAS 1 ASSIGNMENT 1 Mahasiswa mengerjakan tugas mereview jurnal terkait ragam sensor <i>Students work on the task of reviewing journals related to various sensors</i>		8%		
6-7	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya <i>Students are able to design sensors for physical quantity monitoring applications in industry or others</i>	TUGAS 2 ASSIGNMENT 2 Mahasiswa mengerjakan tugas mereview jurnal terkait aplikasi sensor di dunia industri		7%		

		<i>Students work on the task of reviewing journals related to sensor applications in the industrial world</i>			
8	Evaluasi Tengah Semester Mid Term Exam		15%		
9-10	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya <i>Students are able to design sensors for physical quantity monitoring applications in industry or others</i>	TUGAS 3 ASSIGNMENT 3 Mahasiswa mengerjakan tugas mereview jurnal terkait merancang sensor untuk aplikasi pemantauan besaran fisis di industri <i>Students work on an assignment to review journals related to designing sensors for physical quantity monitoring applications in industry</i>		10%	
11-14	Mahasiswa mampu mengevaluasi kinerja sensor <i>Students are able to evaluate sensor performance</i>	TUGAS 4 ASSIGNMENT 4 Mahasiswa mengerjakan tugas mereview jurnal terkait mengevaluasi kinerja sensor yang digunakan pada plan di industri <i>Students work on the task of reviewing journals related to evaluating the performance of sensors used in industrial plans</i>		10%	10%
15	Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan dan evaluasi sensor <i>Students are able to make written reports and scientific presentations of the results of sensor designs and evaluations</i>	TUGAS 5 ASSIGNMENT 5 Mahasiswa merancang eksperimen terkait sensor dan membuat laporan tertulis dan presentasi <i>Students design experiments related to sensors and make written reports and presentations</i>			20%
16	Evaluasi Akhir Semester (EAS) Final Exam			10%	10%

TF185421 RPS RAE Teknologi Pencitra Medis (*Medical Imaging Technologies*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>			RP
	Teknologi Pencitraan Medis <i>Medical Imaging Technologies</i>			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185421	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 2/4 <i>Semester: 2/4</i>	
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Aulia MT Nasution	Koordinator RMK <i>Field Coordinator</i> Dr. Rony Dwi N.	Ka PRODI <i>Head of Master Program</i> Dr. Aulia MT Nasution	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI / <i>Program Learning Outcome (PLO)</i>			
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan kerekayasaan dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (25%) <i>PLO-2 Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>PLO-5 Are able to effectively communicate in both oral and written format.</i> CP-6. Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (50%) <i>PLO-6. Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i>			
	CP-MK / <i>Program Learning Outcome (PLO)</i>			
	CPMK 1 Mahasiswa mampu menjelaskan dan menyarikan tentang ragam jenis teknologi pencitra medis. (CP-2) (25%) <i>Students are able to explain and summarize about the various types of medical imaging technology.</i> CPMK 2 Mahasiswa mampu memberikan alternatif dan penyelesaian aspek teknis dalam pengembangan teknologi pencitra medis. (CP-6) 25% <i>Students are able to provide alternatives and completion of technical aspects in the development of medical imaging technology.</i> CPMK 3 Mahasiswa mampu membuat tulisan kritis tentang pengembangan suatu teknologi pencitra di bidang medis. (CP-5, CP-6) 50% <i>Students are able to write critically about the development of a medical imaging technology</i>			

Diskripsi Singkat MK <i>Course Description</i>	MK Teknologi Pencitra Medis (Medical Imaging Technologies) ini merupakan mata kuliah pilihan, untuk memperkenalkan mahasiswa akan berbagai teknologi pencitraan medis. Pemahaman akan proses dan karakteristik teknologi pencitraan medis sangat penting pada level magister, khususnya sebagai bekal keilmuan dalam melakukan upaya riset pengembangan suatu sistem pencitraan yang baru untuk keperluan diagnostik. Tubuh manusia menyimpan berbagai kode enkripsi atas karakteristik fisis yang perlu dipecahkan, serta dipahami secara mendalam detail karakteristik dan rentang keberlakuan terkaitnya. Berbagai teknologi pencitra medis yang telah dikembangkan dalam banyak penggunaan dalam bidang medis berangkat dari riset panjang atas pemahaman karakteristik fisis tubuh manusia, yang sebelumnya tidak dipahami (<i>encrypted</i>) ini. Diharapkan pemahaman mahasiswa yang mendalam terkait teknologi pencitraan medis dapat memicu penelitian lanjutan untuk pengembangan berbagai teknologi pencitraan medis yang lebih akurat, presisi, spesifik, dan murah. <i>This course is an elective course, to introduce students to various medical imaging technologies. An understanding of the process and characteristics of medical imaging technology is very important at the master's level, especially as a scientific provision in conducting research efforts to develop a new imaging system for diagnostic purposes. The human body stores various encryption codes for physical characteristics that need to be deciphered, and it is understood in detail the characteristics and their associated range of validity. Various medical imaging technologies that have been developed in many uses in the medical field depart from long research on understanding the physical characteristics of the human body, which were previously not understood (encrypted). It is hoped that students' in-depth understanding of medical imaging technology can trigger further research for the development of various medical imaging technologies that are more accurate, precise, specific, and inexpensive.</i>
Pokok Bahasan / Bahan Kajian <i>Module content</i>	Dalam Matakuliah ini mahasiswa akan mempelajari pokok bahasan-pokok bahasan sebagai berikut: • Overview sistem pencitra medis: karakteristik, manfaat, dan trend perkembangan terkini. • Penghasilan dan karakteristik perambatan berbagai gelombang utama dalam penggunaan pencitraan medis (listrik, magnetik, radiasi, suara, dan optis). • Komponen utama dari suatu sistem pencitra medis; dari sensor hingga monitor. • Karakteristik spesifik komponen utama terkait dengan besaran gelombang utama dalam penggunaan pencitraan medis. • Proses pengembangan sistem pencitra medis: pemilihan komponen utama dan pengujiannya, serta kalibrasi sistem terbangun untuk mendapatkan hasil ekstraksi sinyal citra yang akurat dan presisi. • Algoritma-algoritma utama dalam pemrosesan citra dan pengenalan pola dalam suatu citra medis untuk mendapatkan visualisasi citra yang <i>interpretable</i> dan <i>perceptible</i>. • Tinjauan kritis atas berbagai sistem pencitra medis yang digunakan dalam aplikasi klinis: sistem pencitra medis berbasis listrik, magnetik, radiasi, suara, dan optis. <i>In this course, students will study the following topics:</i> • <i>Overview of medical imaging technologies: characteristics, benefits, and current development trends.</i> • <i>Generating and propagation characteristics of various signals/stimulus in medical imaging uses (electric, magnetic, radiation, sound, and optical signals/stimulus).</i> • <i>The main components of a medical imaging system; from sensors to monitors.</i> • <i>The specific characteristics of the principal components are related to the main signal parameters in medical imaging uses.</i> • <i>The medical imaging system development process: the selection of the main components and their testing, as well as the calibration of the developed system to obtain the accurate and precise image signal extraction results.</i>

	<i>The main algorithms in image processing and pattern recognition to process medical images, to produce interpretable and perceptible image visualization.</i> <i>A critical review of various medical imaging systems used in clinical applications: electrical, magnetic, radiation, sound and optical based medical imaging systems.</i>	
Pustaka <i>Reading Materials</i>	Utama:	
	1. Prince, J.L., and Links, J.M., Medical Imaging Signals and Systems, Pearson Education, Inc., Upper Saddle River, NJ 07458.	
	2. Bryan, R. N., Introduction to the Science of Medical Imaging, Cambridge University Press, New York, 2010	
	Pendukung :	
	1. Lai, K. W., and Dewi D.E.O (Eds), Medical Imaging Technology: Reviews and Computational Applications, Springer Singapore	
	2. Bankmann, I.N. (Ed.), Handbook of Medical Imaging: Processing and Analysis, Academic Press, San Diego, CA, 2000	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak :	Perangkat keras :
	OS:Windows; Office, Video demo	PC & LCD Projector
Tim Pengajar <i>Team Teaching</i>	Aulia MT Nasution	
Matakuliah syarat <i>Prerequisite courses</i>	Fisika Teknik Lanjut; <i>Advanced Engineering Physics</i> Fisika Tubuh Manusia; <i>The Physics of Human Body</i>	

Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode / Strategi Pembelajaran (5)	Materi Pembelajaran (6)	Bobot Penilaian (%) (7)
1	Mahasiswa mampu menjelaskan konsep dasar dan terminologi dalam pencitraan medis yang relevan terhadap berbagai jenis teknologi pencitraan medis. <i>Students are able to explain the basic concepts and terminologies in medical imaging that are relevant to various types of</i>	Ketepatan menjelaskan konsep dasar dan terminologi dalam pencitraan medis yang relevan terhadap berbagai jenis teknologi pencitraan medis. <i>Appropriate explanation on the basic concepts and terminologies in medical imaging that are relevant to various types of medical imaging technologies.</i>	Non-test: Penulisan makalah singkat <i>Non-test:</i> <i>Writing a short paper</i> TUGAS 1: Mahasiswa melakukan review tentang suatu sistem pencitraan medis (Prinsip Kerja dan Komponennya) <i>ASSIGNMENT 1:</i> <i>Students conduct a review of a medical imaging system.</i>	SCL (Kuliah dan diskusi) [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	1. Dasar karakteristik citra 2. Fisika dari radiografi 3. Fisika dari medis nuklir 4. Fisika <i>ultrasound</i> 5. Fisika optis 6. Fisika kuantum <i>1. Basic image characteristics</i> <i>2. Physics of radiography</i> <i>3. Physics of nuclear medicine</i> <i>4. Ultrasound physics</i> <i>2. Optical physics</i>	15% (CP-MK1)

	<i>medical imaging technologies.</i>				<i>3. Quantum physics</i>	
2-4	Mahasiswa mampu menjelaskan prinsip kerja dari suatu teknologi pencitra medis <i>Students are able to explain the working principle of a medical imaging technology</i>	- Ketepatan dalam menjelaskan prinsip kerja dari suatu teknologi pencitra medis <i>Appropriate explanation on the working principle of a medical imaging technology</i> - Ketepatan dalam menjelaskan proses pencitraan dari sensor sampai monitor <i>Appropriate explanation of the imaging process; from sensor to monitor</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a short paper</i> TUGAS 1: Mahasiswa melakukan review tentang suatu sistem pencitraan medis (Prinsip Kerja dan Komponennya) <i>ASSIGNMENT 1: Students conduct a review of a medical imaging system (the working principle and its component)</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	<i>Computed tomography</i> <i>Pencitra X-ray</i> <i>Nuclear magnetic resonance</i> <i>Magnetic resonance imaging</i> <i>Sistem-sistem pencitraan optis</i> <i>Sistem-sistem pencitraan ultrasound</i> <i>Computed tomography</i> <i>X-ray imaging</i> <i>Nuclear magnetic resonance</i> <i>Magnetic resonance imaging</i> <i>Optical imaging systems</i> <i>Ultrasound imaging systems</i>	
5-7	Mahasiswa mampu menjelaskan metode analisis citra dan sinyal untuk menganalisis fenomena fisiologis dalam aplikasi berbagai teknologi pencitraan medis <i>Students are able to explain image and signal analysis methods to analyze physiological phenomena in the application of various</i>	Ketepatan dalam menjelaskan metode analisis citra dan sinyal untuk menganalisis fenomena fisiologis dalam aplikasi berbagai teknologi pencitraan medis <i>Appropriate explanation on the image and signal analysis methods for analyzing physiological phenomena in the application of various medical imaging technologies</i>	Non-test: Penulisan makalah dan presentasi. <i>Non-test: Writing a paper and Making presentation</i> TUGAS 2: Mahasiswa melakukan studi komprehensif terkait metode analisis citra dan sinyal untuk menganalisis fenomena fisiologis pada salah satu teknologi pencitraan medis	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	<i>Sinyal dan sistem</i> <i>Analisis Fourier: deret dan transformasi Fourier</i> <i>Transformasi Fourier: teori sampling, transformasi Fourier diskrit.</i> <i>Signals and systems</i> <i>Fourier analysis: series and Fourier transform</i> <i>Fourier transform: sampling theory, discrete Fourier transform.</i>	15% (CP-MK2)

	<i>medical imaging technologies</i>		<i>ASSIGNMENT 2: Students conduct the comprehensive studies related to image and signal analysis methods to analyze physiological phenomena in a medical imaging technology.</i>			
8	Ujian Tengah Semester (UTS)/ <i>Mid Term Examination</i>					10% (CP-MK1) 10% (CP-MK2)
9-11	Mahasiswa mampu membuat pemodelan persamaan matematis dari rekonstruksi citra <i>Students are able to build the mathematical equations from image reconstruction</i>	- Ketepatan dalam membuat formula matematis citra dan <i>Accuracy in building the mathematical equations</i> - Penguasaan dalam menyusun algoritma pemrograman <i>Mastery in compiling programming algorithms</i>	Non-test: Penulisan makalah dan presentasi. <i>Non-test: Writing a paper and Making presentation</i> TUGAS 3: Mahasiswa melakukan studi komprehensif terkait pemodelan persamaan matematis dari rekonstruksi citra serta menyusun algoritma terkait model tersebut. <i>ASSIGNMENT 3: Students conduct a comprehensive study related to the mathematical model from image reconstruction and develop an algorithm related to the model.</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Kalkulus multivariabel - Aljabar linear - Pengenalan C, Matlab, Python <i>1. Multivariable calculus 2. Linear algebra 3. Introduction to C, Matlab, Python</i>	10% (CP-MK3)
12-14	Mahasiswa mampu menilai kualitas citra dalam pencitraan medis.	Ketepatan dalam memberikan analisis dari citra hasil.	Non-test: Penulisan makalah dan presentasi. <i>Non-test: Writing a paper and Making presentation</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Kualitas citra I: kontras, resolusi - Kualitas citra II: <i>noise, signal-ratio</i>, akurasi	10% (CP-MK3)

	<i>Students are able to assess image quality in medical imaging.</i>	<i>Accuracy in providing analysis of the resulting image.</i>	TUGAS 4: Mahasiswa melakukan studi komprehensif terkait penilaian kualitas citra berdasarkan suatu teknologi pencitraan medis. <i>ASSIGNMENT 4: Students carry out a comprehensive study related to image quality assessment based on a medical imaging technology.</i>		1. <i>Image quality I: contrast, resolution</i> 2. <i>Image quality II: noise, signal-ratio, accuracy</i>	
15	Mahasiswa menunjukkan kemampuan presentasi dan diskusi hasil dan kesimpulan dari suatu analisis teknologi pencitraan medis dengan mahasiswa lainnya. <i>Students demonstrate the ability to present and discuss the results and conclusions of an analysis of medical imaging technology with other students.</i>	Pemahaman dalam menyampaikan ide dan konsep, serta kejelasan cara berkomunikasi saat presentasi tentang teknologi pencitraan medis <i>Understanding in describing ideas and concepts, as well as clarity on how to communicate during presentation about medical imaging technologies</i>	Non-test: Penulisan makalah dan presentasi. <i>Non-test: Writing a paper and Making presentation</i> TUGAS 5: Mahasiswa melakukan presentasi yang komprehensif terkait dengan teknologi pencitraan medis. <i>ASSIGNMENT 5: Students carry out a comprehensive presentation related to medical imaging technologies</i>	SCL (Kuliah dan diskusi) [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Presentasi	10% (CP-MK3)
16	UJIAN AKHIR SEMESTER (UAS) <i>Final Term Examination</i>					20% (CP-MK3)

Catatan : Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran

Notes: Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTIRS ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS Teknologi Pencitraan Medis Medical Imaging Technologies			RA&E
	Edisi: Agt 2018			
Kode (Code): TF185421	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: Instrumentation Engineering	Smt: 2/4 Semester: 2/4	
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Aulia MT Nasution	Koordinator RMK Field Coordinator Dr. Rony Dwi N.	Ka PRODI Head of Master Program Dr. Aulia MT Nasution	

Mg ke (1)	Sub Capaian Pembelajaran (2)	Bentuk Asesmen /Penilaian (3)	Bobot CPMK1 (4)	Bobot CPMK2 (5)	Bobot CPMK3 (6)
1-4	Mahasiswa mampu menjelaskan konsep dasar dan terminologi dalam pencitraan medis yang relevan terhadap berbagai jenis teknologi pencitraan medis. <i>Students are able to explain the basic concepts and terminologies in medical imaging that are relevant to various types of medical imaging technologies.</i>	TUGAS 1: Mahasiswa melakukan review tentang suatu sistem pencitraan medis (Prinsip Kerja dan Komponennya) Penyusunan makalah, berisi materi: Sejarah dan perkembangan salah satu teknologi pencitra medis Komponen-komponen yang menyusun suatu teknologi pencitra medis Metode dalam pengolahan sinyal dan rekonstruksi citra Catatan: Tugas dikumpul melalui surat elektronik (e-mail) COGNITIVE ASSIGNMENT 1:	15%		

		<i>Students conduct a review of a medical imaging system. Writing a paper, containing the following materials: History and development of medical imaging technology The components that make up a medical imaging technology Methods in signal processing and image reconstruction</i>			
5-7	Mahasiswa mampu menjelaskan metode analisis citra dan sinyal untuk menganalisis fenomena fisiologis dalam aplikasi berbagai teknologi pencitraan medis <i>Students are able to explain image and signal analysis methods to analyze physiological phenomena in the application of various medical imaging technologies</i>	TUGAS 2: Mahasiswa melakukan studi komprehensif terkait metode analisis citra dan sinyal untuk menganalisis fenomena fisiologis pada salah satu teknologi pencitraan medis Penyusunan makalah, berisi materi: Metode analisis citra dan sinyal Penjelasan dan penggunaan teori sampling Metode pengolahan sinyal <i>COGNITIVE ASSIGNMENT 2: Students conduct the comprehensive studies related to image and signal analysis methods to analyze physiological phenomena in a medical imaging technology.</i> <i>Writing a paper, containing the following materials: Image and signal analysis method Explanation and use of sampling theory Signal processing method</i>		15%	
8	Evaluasi Tengah Semester Presentasi <i>Mid Term Examination</i> <i>COGNITIVE ASSIGNMENT</i>		10%	10%	

9-11	Mahasiswa mampu membuat pemodelan persamaan matematis dari rekonstruksi citra <i>Students are able to build the mathematical equations from image reconstruction</i>	TUGAS 3: Mahasiswa melakukan studi komprehensif terkait pemodelan persamaan matematis dari rekonstruksi citra serta menyusun algoritma terkait model tersebut. Penyusunan makalah, berisi materi: Menjelaskan penggunaan kalkulus multivariabel dan aljabar linier dalam citra Membuat model matematis dalam formulasi citra Membuat algoritma rekonstruksi citra <i>CASE-BASED ASSIGNMENT 3:</i> <i>Students conduct a comprehensive study related to the mathematical model from image reconstruction and develop an algorithm related to the model.</i> <i>Writing a paper, containing the following materials:</i> <i>Explain the use of multivariable calculus and linear algebra in images.</i> <i>Creating mathematical models in image formulation.</i> <i>Creating an image reconstruction algorithm.</i>			10%
12-14	Mahasiswa mampu menilai kualitas citra dalam pencitraan medis. <i>Students are able to assess image quality in medical imaging.</i>	TUGAS 4: Mahasiswa melakukan studi komprehensif terkait penilaian kualitas citra berdasarkan suatu teknologi pencitraan medis. Penyusunan makalah, berisi materi terkait dengan parameter kualitas citra seperti: kontras, resolusi, noise, sinyal to noise ratio, akurasi, dll. <i>CASE-BASED ASSIGNMENT 4:</i> <i>Students carry out a comprehensive study related to image quality assessment based on a medical imaging technology.</i> <i>Writing a paper, containing the image quality parameter, such as contrast, resolution, noise, signal-ratio, accuracy, etc.</i>			10%

15	Mahasiswa menunjukkan kemampuan presentasi dan diskusi hasil dan kesimpulan dari suatu analisis teknologi pencitraan medis dengan mahasiswa lainnya. <i>Students demonstrate the ability to present and discuss the results and conclusions of an analysis of medical imaging technology with other students.</i>	TUGAS 5: Mahasiswa melakukan presentasi yang komprehensif terkait dengan teknologi pencitraan medis. <i>PRESENTATION - ASSIGNMENT 5: Students carry out a comprehensive presentation related to medical imaging technologies.</i>			10%
16	Evaluasi Akhir Semester <i>Final Term Examination</i> <i>PROJECT BASED ASSIGNMENT</i>				20%
Total			25%	25%	50%

Catatan : Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran

Notes: Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Dasar Clinical Engineering <i>Basic Clinical Engineering</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185422	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Aulia MTN	Koordinator RMK <i>Field Coordinator</i> Aulia MTN	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	
	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i> CP-MK Course Learning Outcome (CLO) - Profesi Clinical Engineering (CE) dalam suatu unit pelayanan kesehatan (healthcare units): domain kerja, peran strategis, karier, serta tanggung jawab profesional yang diemban <i>Clinical Engineering (CE) profession in a health care unit: work domain, strategic role, career, and professional responsibilities.</i> - Model keberadaan Departemen Clinical Engineering dalam suatu unit pelayanan kesehatan: studi kasus kajian keberadaan departemen CE di berbagai negara. <i>Model of the existence of the Clinical Engineering Department in a health care unit: a case study study of the existence of the CE department in various countries.</i> - Penggunaan Teknologi dalam Pelayanan Kesehatan: Peran Sentral dan Implikasinya dalam issue Patient-Safety dalam pelayanan kesehatan, standardisasi aspek keamanan, pemastian kualitas dalam pelayanan kesehatan, pemegang kendali dan tanggung jawab terkait pengelolaan penggunaan teknologi. <i>Use of Technology in Health Services: Central Role and Its Implications in Patient-Safety issues in health services, standardization of security aspects, quality assurance in health services, control holders and responsibilities related to the management of technology use</i> - Pemangku kepentingan dalam pelayanan kesehatan: peran sentral CE dalam kaitan penggunaan teknologi didalamnya. <i>Stakeholders in healthcare: the central role of CE in terms of technology use in it</i> - identifikasi dan skoring terkait keberadaan domain kerja Clinical Engineering dalam suatu unit pelayanan kesehatan, khususnya jika dikaitkan dengan aspek-aspek penilaian dalam proses Akreditasi Rumah Sakit. <i>identification and scoring related to the existence of the Clinical Engineering work domain in a health service unit, especially if it is associated with assessment aspects in the Hospital Accreditation process.</i>
Diskripsi Singkat MK Course Description	MK Dasar Clinical Engineering ini merupakan mata kuliah pilihan yang akan memberikan bahasan tentang konsep dasar terkait profesi Clinical Engineer (CE) : yaitu domain kerja, peran strategis, karier, serta tanggung jawab profesional yang diemban oleh profesi CE dalam suatu unit pelayanan kesehatan (healthcare units). Mahasiswa juga akan diperkenalkan kepada beberapa model keberadaan suatu Departemen CE didalam suatu unit pelayanan kesehatan di berbagai negara. Nilai strategis dari keberadaan profesi CE dalam pelayanan kesehatan, khususnya dalam penanganan penggunaan teknologi kesehatan dalam suatu unit pelayanan kesehatan meliputi penanganan issue patient-safety, manajemen pengelolaan penggunaan teknologi dalam pelayanan kesehatan, jembatan komunikasi antara berbagai pemangku kepentingan dalam pelayanan kesehatan (terkait dengan adanya penggunaan teknologi dalam pelayanan kesehatan), pemastian terlaksananya berbagai regulasi dan standardisasi di bidang pelayanan kesehatan. Koridor etika professional, serta trend perkembangan kedepan profesi ini juga ikut dibicarakan. <i>This Clinical Engineering Basic Course is an elective course that will provide a discussion of the basic concepts related to the Clinical Engineer (CE) profession: namely the work domain, strategic roles, careers, and professional responsibilities carried out by the CE profession in a health service unit (healthcare units). Students will also be introduced to several models of the existence of a CE Department within a health care unit in various countries. The strategic</i>

	<i>value of the existence of the CE profession in health services, especially in handling the use of health technology in a health service unit includes handling patient-safety issues, management of technology use in health services, communication bridges between various stakeholders in health services (related to the use of technology in health services), ensuring the implementation of various regulations and standardization in the field of health services. The corridors of professional ethics, as well as future development trends of this profession are also discussed.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	10. Clinical Engineering: sejarah perkembangan, domain kerja, dan peran strategis 11. Unit pelayanan kesehatan (Healthcare Units): pemangku kepentingan yang terlibat, skala dan kompleksitas lingkup pelayanannya 12. Profesi CE dalam suatu unit pelayanan kesehatan: model organisasi di berbagai linkup unit pelayanan kesehatan 13. Trend Penggunaan Teknologi dalam pelayanan kesehatan modern 14. Implementasi penggunaan teknologi dan permasalahan ikutan terkait: Strategic Planning, Procurement, Installation & Comissioning, Maintenance and Repair, Quality Assurance, dan Technology Evaluation 15. Akreditasi Rumah Sakit: Aspek CE dalam penilaian 16. Etika Profesi dalam CE dan Tren Pengembangan Keilmuan Kedepannya 7. <i>Clinical Engineering: development history, work domain and strategic role</i> 8. <i>Healthcare Units: the stakeholders involved, the scale and complexity of the scope of service</i> 9. <i>CE profession in a health care unit: organizational model in various health care unit scopes</i> 10. <i>Trends in the use of technology in modern health services</i> 11. <i>Implementation of the use of technology and associated problems: Strategic Planning, Procurement, Installation & Commissioning, Maintenance and Repair, Quality Assurance, and Technology Evaluation</i> 12. <i>Hospital Accreditation: CE Aspects in Assessment</i> 13. <i>Professional Ethics in CE and Future Trends in Scientific Development</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	
	8. Dyro, J., Clinical Engineering Handbook, Elsevier Academic Press, Burlington MA, 2004 9. Yadin, D. et al., Clinical Engineering, CRC Press, Boca Raton FL, 2003 10. American College of Clinical Engineering (ACCE), url: http://accenet.org/publications/Pages/ReferenceMaterials.aspx Pendukung: <i>Supporting</i> 7. -	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras: <i>Hardware</i>
	OS:Windows; Office, Video demo	PC & LCD Projector
Tim Pengajar	Dr.rer.nat. Ir. Aulia Nasution, M.Sc	

Team Teaching						
Matakuliah syarat Entry requirement			-		Bahasa pengantar: Languages	Bahasa Indonesia Indonesian
Mg Ke-Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessment point (%) (7)
1-2	Mahasiswa mampu memahami Clinical Engineering: sejarah, perkembangan, domain kerja, dan peran strategis <i>Students are able to understand Clinical Engineering: history, development, work domain, and strategic role</i>		Quiz. <i>Quiz</i>	SCL (Kuliah, diskusi dan E-learning) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Clinical Engineering: Suatu perkembangan disiplin keilmuan - Sejarah proses rekayasa dan Teknologi dalam bidang Kesehatan <i>- Clinical Engineering: A scientific discipline development</i> <i>- History of engineering processes and technology in the field of Health</i>	10% (CP-MK1)
3-5	- Mahasiswa mampu memahami Unit pelayanan kesehatan (<i>Healthcare Units</i>): pemangku kepentingan yang terlibat, skala dan kompleksitas lingkup pelayanannya. - Mahasiswa mampu memahami Skala lingkup kompleksitas		TUGAS 1 - Makalah 1 - Presentasi <i>ASSIGNMENT 1:</i> <i>Paper 1</i> <i>Presentation</i>	- Kuliah /diskusi - Presentasi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Profesi CE dalam suatu unit pelayanan kesehatan: model Organisasi di berbagai lingkup unit pelayanan kesehatan <i>- CE profession in a health care unit: an organizational model in various health care units</i>	10%

	unit pelayanan kesehatan dan model kedudukan Departemen CE dalam Unit Pelayanan Kesehatan dan model CE di berbagai negara • <i>Students are able to understand Healthcare Units: the stakeholders involved, the scale and complexity of the scope of service.</i> • <i>Students are able to understand the scale of the complexity of the health care unit and the model of the position of the CE Department in the Health Service Unit and the CE model in various countries.</i>					
6-7	Mahasiswa mampu memahami Trend Penggunaan Teknologi dalam pelayanan kesehatan modern. <i>Students are able to understand the trend of using technology in modern health services</i>		TUGAS 2 • Makalah 2 • Presentasi <i>ASSIGNMENT 3:</i> • <i>Papers 2</i> • <i>Presentation</i>	- Kuliah/ diskusi - Presentasi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Peran sentral penggunaan teknologi dalam pelayanan kesehatan modern: Suatu perspektif • Perkembangan penggunaan Teknologi dalam diagnostik dan therapy: Konsekuensi menurunnya peran manusia sebagai operator pelaku layanan kesehatan • Peran profesi Clinical Engineering dalam	10%

					manajemen penggunaan teknologi dalam pelayanan Kesehatan • <i>The central role of technology use in modern health care: A perspective</i> • <i>The development of the use of technology in diagnostics and therapy: Consequences of decreasing the role of humans as operators of health service actors</i> • <i>The role of the Clinical Engineering profession in the management of the use of technology in health services</i>	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					15%
9-12	Mahasiswa mampu memahami implementasi penggunaan teknologi dan permasalahan ikutan terkait: <i>Strategic Planning, Procurement, Installation & Comissioning, Maintenance and Repair, Quality Assurance, dan Technology Evaluation</i> <i>Students are able to understand the implementation of the use of technology and</i>		TUGAS 3: - Makalah 3 - Presentasi <i>ASSIGNMENT 3:</i> - <i>Paper 3</i> - <i>Presentation.</i>	- Kuliah/ diskusi - Presentasi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Berbagai issue terkait penggunaan teknologi dalam pelayanan kesehatan - Patient-Safety dalam pelayanan kesehatan dan standarisasi aspek keamanan dari penggunaan teknologi dalam pelayanan Kesehatan - Pemastian kualitas (QA) dalam pelayanan kesehatan, khususnya terkait pengelolaan penggunaan teknologi dan pemegang kendali dan	15%

	<i>associated problems: Strategic Planning, Procurement, Installation & Commissioning, Maintenance and Repair, Quality Assurance, and Technology Evaluation</i>				tanggung jawab pelaksanaannya - Evaluasi kelayakan Teknologi dan kaitannya dengan kajian untuk proses pembaharuan: Health Technpology Assesment (HTA) - <i>Various issues related to the use of technology in health services</i> - <i>Patient-Safety in health services and standardization of security aspects from the use of technology in health services</i> - <i>Quality assurance (QA) in health services, particularly related to the management of the use of technology and the holder of control and responsibility for its implementation</i> - <i>Evaluation of the feasibility of the technology and its relation to the study for the renewal process: Health Technology Assessment (HTA)</i>	
13-14	Akreditasi Rumah Sakit: Aspek CE dalam penilaian <i>Hospital Accreditation: CE Aspects in Assessment</i>		TUGAS 4 - Makalah 4 - Presentasi <i>ASSIGNMENT 4:</i> - <i>Paper 4</i>	- Kuliah/diskusi - Presentation [TM: 2x(2x50")] [BT: 2x(2x60")]	- Akreditasi Rumah Sakit: Manfaat, Aspek2 Penilaian, dan Standar Pelaksanaannya - Komponen Penilaian dalam Akreditasi Rumah Sakit	15%

			- <i>Presentation</i>	[BM: 2x(2x60'')]	terkait dengan domain fungsi profesional bidang Clinical Engineering - <i>Hospital Accreditation: Benefits, Assessment Aspects, and Implementation Standards</i> - <i>The Assessment Component in Hospital Accreditation is related to the domain of professional function in the Clinical Engineering field</i>	
15	Mahasiswa mampu memahami Etika Profesi dalam CE dan Tren Pengembangan Keilmuan Kedepannya <i>Students are able to understand Professional Ethics in CE and Future Trends in Scientific Development</i>			- Kuliah/diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Etika Profesi dalam CE dan Tren Pengembangan Keilmuan Kedepannya. <i>Professional Ethics in CE and Future Trends in Scientific Development</i>	5%
16	Evaluasi Akhir Semester <i>Final Examination</i>					20%

Catatan :

Note

6. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Dasar Clinical Engineering Basic Clinical Engineering			RA&E Edisi (<i>Edition</i>): Agt 2018 Aug 2018
	Kode (<i>Code</i>): TF185422	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: Energy Engineering and Environmental Conditioning	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan Aulia MTN	Koordinator RMK Field Coordinator Aulia MTN	Ka PRODI Head of Master Program Dr. Ridho Hantoro	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1-2	Mahasiswa mampu memahami Clinical Engineering: sejarah, perkembangan, domain kerja, dan peran strategis <i>Students are able to understand Clinical Engineering: history, development, work domain, and strategic role</i>	Quiz. <i>Quiz</i>	10%			

3-5	• Mahasiswa mampu memahami Unit pelayanan kesehatan (<i>Healthcare Units</i>): pemangku kepentingan yang terlibat, skala dan kompleksitas lingkup pelayanannya. • Mahasiswa mampu memahami Skala lingkup kompleksitas unit pelayanan kesehatan dan model kedudukan Departemen CE dalam Unit Pelayanan Kesehatan dan model CE di berbagai negara • <i>Students are able to understand Healthcare Units: the stakeholders involved, the scale and complexity of the scope of service.</i> • <i>Students are able to understand the scale of the complexity of the health care unit and the model of the position of the CE Department in the Health Service Unit and the CE model in various countries.</i>	TUGAS 1 • Makalah 1 • Presentasi <i>ASSIGNMENT 1:</i> • <i>Paper 1</i> • <i>Presentation</i>	5%	5%		
6-7	Mahasiswa mampu memahami Trend Penggunaan Teknologi dalam pelayanan kesehatan modern. <i>Students are able to understand the trend of using technology in modern health services</i>	TUGAS 2 • Makalah 2 • Presentasi <i>ASSIGNMENT 2:</i> • <i>Paper 2</i> • <i>Presentation</i>		10%		
8			7,5%	7,5%		
9-12	Mahasiswa mampu memahami implementasi penggunaan teknologi dan permasalahan ikutan terkait: <i>Strategic Planning, Procurement, Installation & Commissioning, Maintenance and Repair, Quality Assurance, dan Technology Evaluation</i>	TUGAS 3 • Makalah 3 • Presentasi <i>ASSIGNMENT 3:</i> • <i>Paper 3</i> • <i>Presentation</i>			15%	

	<i>Students are able to understand the implementation of the use of technology and associated problems: Strategic Planning, Procurement, Installation & Commissioning, Maintenance and Repair, Quality Assurance, and Technology Evaluation</i>					
13-14	Akreditasi Rumah Sakit: Aspek CE dalam penilaian <i>Hospital Accreditation: CE Aspects in Assessment</i>	TUGAS 4 • Makalah 4 • Presentasi <i>ASSIGNMENT 4:</i> • <i>Paper 4</i> • <i>Presentation</i>			5%	10%
15	Mahasiswa mampu memahami Etika Profesi dalam CE dan Tren Pengembangan Keilmuan Kedepannya <i>Students are able to understand Professional Ethics in CE and Future Trends in Scientific Development</i>					5
16	Evaluasi Akhir Semester (<i>Final Examination</i>)				5%	15%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			22.5%	22,5%	25%	30%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Fotonika Biomedis <i>Biomedical Photonics</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185423	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Aulia MTN	Koordinator RMK <i>Field Coordinator</i> Prof. Sekartedjo	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	
	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i>
	CP-MK Course Learning Outcome (CLO)
	1. Mahasiswa dapat mampu melakukan perancangan dan menganalisis sistem fotonika medis untuk penggunaan di dunia sains dan medis skala laboratorium dan klinis <i>Students can be able to design and analyze medical photonics systems for use in the world of science and medical laboratory and clinical scale.</i>
Diskripsi Singkat MK Course Description	
Pokok Bahasan / Bahan Kajian Module content	• Pendahuluan: Pembahasan posisi terminologi kajian Optika Biomedis, Biophotonics, dan Fotonika Biomedis. • Interaksi cahaya - tissue: keberlakuan, probabilitas, dan ketergantungan spektranya. • Model matematis dari interaksi cahaya - tissue: Refleksi, Absorpsi, Hamburan, Emisi, dan Polarisasi. • Pendekatan komputasional studi interaksi cahaya - tissue : Algoritma Monte Carlo. • Pendekatan pengukuran eksperimental: proses ekstraksi parameter optis dari tissue. • Ketergantungan spektral dari proses interaksi cahaya-tissue: berbagai teknik spektroskopi dalam kuantifikasi tissue: keberlakuan, proses kuantifikasi, serta kompleksitas sistem vs keterbatasan penggunaannya. • Tinjauan pemanfaatan konsep eksploitasi interaksi cahaya-tissue dalam pembangunan sistem optis untuk berbagai keperluan diagnostik dan terapi. 14. <i>Introduction: Discussion of the position of the study terminology of Biomedical Optics, Biophotonics, and Biomedical Photonics.</i> 15. <i>Light-tissue interactions: their validity, probability and spectral dependence.</i> 16. <i>Mathematical models of light-tissue interactions: Reflection, Absorption, Scattering, Emission, and Polarization.</i> 17. <i>Computational approach to the study of light-tissue interactions: Monte Carlo Algorithm.</i> 18. <i>Experimental measurement approach: the process of extracting optical parameters from tissue.</i> 19. <i>Spectral dependence of the light-tissue interaction process: various spectroscopic techniques in tissue quantification: their applicability, quantification process, and system complexity vs. limitations of their use</i> 20. <i>Overview of the utilization of the light-tissue interaction exploitation concept in the construction of optical systems for various diagnostic and therapeutic purposes</i>
Pustaka Reading Materials	Utama: Main 11. Splinter, R. and Hooper, B.A., <i>An introduction to biomedical optics</i>, CRC Press (Taylor & Francis Group), FL, 2007. 12. Tuchin, V., <i>Tissue Optics, Light Scattering Methods and Instruments for Medical Diagnostics</i>, Third Ed., SPIE Press, WA, 2015 13. Popp, J. et al. (Eds.), <i>Handbook of Biophotonics</i>, Volume 1: Basics and Techniques, Wiley-VCH, Weinheim, Germany 2011

		Pendukung: <i>Supporting</i>				
		8. -				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>	
		OS:Windows; Office, Video demo			PC & LCD Projector	
Tim Pengajar <i>Team Teaching</i>		Dr.rer.nat. Ir. Aulia Nasution, M.Sc				
Matakuliah syarat <i>Entry requirement</i>		-			Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessm ent point (%)</i> (7)
1-2	Mampu menjelaskan berbagai macam proses interaksi antara cahaya dengan tissue biologis serta masing probabilitas terjadinya, dan kebergantungan setiap interaksi yang terjadi tersebut pada seluruh rentang panjang gelombang optis / fotonik ($1\text{nm} < \lambda_{\text{opt}} < 1\text{mm}$) <i>Able to explain various kinds of interaction processes between light and biological</i>	Kedalaman dan penguasaan materi yang diberikan <i>Depth and mastery of the given material</i>	Tugas 1: Pengenalan Optika Biomedis. <i>Assignment 1: Introduction to Biomedical Optics</i>	SCL (Kuliah, diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Pendahuluan: Pembahasan posisi terminologi kajian Optika Biomedis, Biophotonics, dan Fotonika Biomedis. 2. Interaksi cahaya - tissue: keberlakuan, probabilitas, dan kebergantungan spektranya <i>1. Introduction: Discussion of the position of the study terminology of Biomedical Optics, Biophotonics, and Biomedical Photonics.</i>	15% (CP-MK1)

	<i>tissue as well as their respective probabilities of occurrence, and the dependence of each interaction that occurs in the entire optical / photonic wavelength range ($1\text{nm} < \text{opt} < 1\text{mm}$)</i>				<i>2. Light-tissue interactions: their validity, probability, and spectral dependence</i>	
3-7	Mampu menggunakan berbagai persamaan model matematis yang mendeskripsikan berbagai interaksi cahaya-tissue yang terjadi, serta pemahaman atas keberlakuan dari setiap persamaan model tersebut pada rentang panjang gelombang yang ditinjau <i>Able to use various mathematical model equations that describe various light-tissue interactions that occur, as well as understanding the applicability of each model equation in the wavelength range under consideration</i>	Ketepatan dalam memodelkan dan penguasaan matematika terkait interaksi cahaya-tissue <i>Accuracy in modeling and mastery of mathematics related to light-tissue interactions</i>	Tugas 2: Interaksi Cahaya dengan Materi <i>ASSIGNMENT 2: Interaction of Light with substance</i>	- Kuliah /diskusi - Presentasi - Eksperimen [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Model matematis dari interaksi cahaya - tissue: Refleksi, Absorpsi, Hamburan, Emisi, dan Polarisasi. 2. Pendekatan komputasional studi interaksi cahaya - tissue : Algoritma Monte Carlo. <i>1. Mathematical model of light-tissue interaction: Reflection, Absorption, Scattering, Emission, and Polarization.</i> <i>2. Computational approach to light-tissue interaction study: Monte Carlo Algorithm.</i>	15% (CP-MK1)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					20% (CP-MK1)
9-12	Memahami dan mampu menjelaskan pendekatan pengukuran eksperimental untuk dapat melakukan	Penguasaan konsep dari review berbagai eksperimen yang telah dilakukan	Tugas 3: Ekstraksi parameter disisi	- Kuliah/ diskusi - Presentasi [TM: 2x(2x50'')] [BT: 2x(2x60'')]	- Menyusun makalahsingkat mengenai berbagai eksperimen dalam bidang	30% (CP-MK1)

	proses ekstraksi parameter fisis tissue secara akurat dan spesifik <i>Students are able to Understand and explain experimental measurement approaches to be able to carry out the process of extracting physical tissue parameters accurately and specifically</i>	<i>Mastery of concepts from a review of various experiments that have been carried out</i>	<i>Assignment 3: Extraction of disis . parameters.</i>	[BM: 2x(2x60'')]	biomedis yang terdapat pada jurnal. - Presentasi hasil penyusunan makalah - <i>Compile short papers on various experiments in the biomedical field contained in the journal.</i> - <i>Presentation of the results of the preparation of papers</i>	
13-15	Mampu menjelaskan berbagai tinjauan pemanfaatan konsep eksploitasi interaksi cahaya-tissue dimanfaatkan dalam pembangunan sistem optis untuk berbagai keperluan diagnostik dan terapi <i>Able to explain various reviews of the utilization of the concept of exploitation of light-tissue interactions used in the construction of optical systems for various diagnostic and therapeutic purposes</i>	Kejelasan ide dan konsep, serta komunikasi yang presentasikan melalui makalah <i>Clarity of ideas and concepts, as well as communication presented through papers</i>	Tugas 4: - Merancang Sistem Optis untuk biomedis - Evaluasi Tugas & praktikum <i>Task 4:</i> - <i>Designing an Optical System for biomedicine</i> - <i>Evaluation & practicum</i>	- Kuliah/diskusi - Presentasi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Tinjauan pemanfaatan konsep eksploitasi interaksi cahaya-tissue dalam pembangunan sistem optis untuk berbagai keperluan diagnostik dan terapi <i>Overview of the utilization of the light-tissue interaction exploitation concept in the construction of optical systems for various diagnostic and therapeutic purposes</i>	
16	Evaluasi Akhir Semester <i>Final Examination</i>					20%

Catatan :

Note

7. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Fotonika Biomedis Biomedical Photonics		RA&E
			Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185423	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i> Aulia MTN	Koordinator RMK <i>Field Coordinator</i> Prof. Sekartedjo	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)
1-2	Mampu menjelaskan berbagai macam proses interaksi antara cahaya dengan tissue biologis	Tugas 1: Pengenalan Optika Biomedis.	15%

	serta masing probabilitas terjadinya, dan kebergantungan setiap interaksi yang terjadi tersebut pada seluruh rentang panjang gelombang optis / fotonik ($1\text{nm} < \lambda_{\text{opt}} < 1\text{mm}$) <i>Able to explain various kinds of interaction processes between light and biological tissue as well as their respective probabilities of occurrence, and the dependence of each interaction that occurs in the entire optical / photonic wavelength range ($1\text{nm} < \text{opt} < 1\text{mm}$)</i>	• <i>Assignment 1: Introduction to Biomedical Optics</i>	
3-7	Mampu menggunakan berbagai persamaan model matematis yang mendeskripsikan berbagai interaksi cahaya-tissue yang terjadi, serta pemahaman atas keberlakuan dari setiap persamaan model tersebut pada rentang panjang gelombang yang ditinjau <i>Able to use various mathematical model equations that describe various light-tissue interactions that occur, as well as understanding the applicability of each model equation in the wavelength range under consideration</i>	Tugas 2: Interaksi Cahaya dengan Materi <i>ASSIGNMENT 2:</i> • <i>Interaction of Light with substance</i>	15%
8			20%
9-12	Memahami dan mampu menjelaskan pendekatan pengukuran eksperimental untuk dapat melakukan proses ekstraksi parameter fisis tissue secara akurat dan spesifik <i>Students are able to Understand and explain experimental measurement approaches to be able to carry out the process of extracting physical tissue parameters accurately and specifically</i>	Tugas 3: Ekstraksi parameter disis <i>Assignment 3: Extraction of disis . parameters.</i>	30%

13-15	Mampu menjelaskan berbagai tinjauan pemanfaatan konsep eksploitasi interaksi cahaya-tissue dimanfaatkan dalam pembangunan sistem optis untuk berbagai keperluan diagnostik dan terapi <i>Able to explain various reviews of the utilization of the concept of exploitation of light-tissue interactions used in the construction of optical systems for various diagnostic and therapeutic purposes</i>	Tugas 4: - Merancang Sistem Optis untuk biomedis - Evaluasi Tugas & praktikum <i>Task 4:</i> - <i>Designing an Optical System for biomedicine</i> - <i>Evaluation & practicum</i>	
16	Evaluasi Akhir Semester (<i>Final Examination</i>)		20%
Total Bobot Penilaian (%) <i>Total Point</i> (%)			100%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Radiasi dan Proteksi <i>Radiation and Protection</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185424	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr Syamsul Arifin	Koordinator RMK <i>Field Coordinator</i> Totok Ruki B., ST, MT, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	
	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	1. Mampu memahami konsep fisika radiasi; 2. Mampu menganalisa karakteristik interaksi tubuh manusia dengan radiasi; 3. Mampu merancang sistem perlindungan radiasi; 1. <i>Able to understand the concept of radiation physics;</i> 2. <i>Able to analyze the characteristics of the interaction of the human body with radiation;</i> 3. <i>Able to design radiation protection system;</i>
Diskripsi Singkat MK <i>Course Description</i>	Kuliah ini membahas tentang penjelasan dan penerapan konsep-konsep Radiasi Dan Proteksi yang ada pada berbagai bidang keteknikan di industri. Cakupan materi yang diberikan terkait dengan bidang peminatan yang ada. <i>This lecture discusses the explanation and application of the concepts of Radiation and Protection that exist in various engineering fields in industry. The scope of the material provided is related to the existing field of interest..</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Konsep-konsep dasar dalam fisika radiasi, radiasi mengion dan tak mengion, jenis dan energi radiasi, interaksi radiasi dengan materi; 2. Bahan radioaktif dalam aplikasi medis; 3. Dasar-dasar dosimetri: dosis radiasi dan pengukurannya; 4. Pengaruh radiasi terhadap kesehatan manusia. 5. Batas aman radiasi. Perlindungan radiasi bagi pasien dan operator instalasi penyedia pelayanan radiasi; 6. Design sistem perlindungan radiasi pada instalasi pengguna radiasi; Radiation safety dan QA. 1. <i>Fundamental concepts in radiation physics, ionizing and non-ionizing radiation, types and energy of radiation, interaction of radiation with matter;</i> 2. <i>Radioactive materials in medical applications;</i> 3. <i>Fundamentals of dosimetry: radiation dose and its measurement;</i> 4. <i>The effect of radiation on human health.</i> 5. <i>Radiation safe limit. Radiation protection for patients and operators of radiation service provider installations;</i> 6. <i>Design of radiation protection systems at radiation user installations; Radiation safety and QA.</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	
	14. Fundamental concepts in radiation physics, ionizing and non-ionizing radiation, types and energy of radiation, interaction of radiation with matter; 15. Radioactive materials in medical applications;	

		16. Fundamentals of dosimetry: radiation dose and its measurement; 17. The effect of radiation on human health. 18. Radiation safe limit. Radiation protection for patients and operators of radiation service provider installations; 19. Design of radiation protection systems at radiation user installations; Radiation safety and QA.				
		Pendukung: Supporting -				
Media Pembelajaran Learning Media		Perangkat lunak: Software			Perangkat keras: Hardware	
		OS:Windows; Office, Video demo			PC & LCD Projector	
Tim Pengajar Team Teaching		Prof. Dr. Ir. Sekartedjo, M.Sc. Dr-Ing. Doty Dewi Risanti, ST, MT.				
Matakuliah syarat Entry requirement		-			Bahasa pengantar: Languages	Bahasa Indonesia Indonesian
Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessm ent point (%) (7)
1-2	Mampu menjelaskan dasar-dasar fisika atom Able to explain the basics of atomic physics	Kuliah, Diskusi, e-learning, flipped learning, Studying, Discussion, e-learning, flipped learning,	Kriteria: Rabrik holistik Bentuk non-test: • Review sumber-sumber rujukan Criteria: Holistic rubric Non-test form: Review of referral sources	[TM=3 mg x 2 sks x 50'] 1. Review dan meringkas artikel/ rujukan tentang radiasi dan proteksi 2. Studi kasus menghitung paparan radiasi dg contoh sederhana. 1. Review and summarize	I. Dasar-dasar Fisika Atom: 1.1 Struktur atom; 1.2 Sifat-sifat inti; 1.3 Radioaktivitas; 1.4 Peluruhan alfa; 1.5 Peluruhan beta; 1.6 Peluruhan gamma; 1.7 Energi ikat; 1.8 Model-model inti; 1.9 Interaksi radiasi nuklir 1.10 Interaksi dengan zat; 1.11 Reaksi inti;	10% (CP-MK1)

				<i>articles/references about radiation and protection</i> <i>2. Case study calculating radiation exposure with a simple example</i>	<i>I. Fundamentals of Atomic Physics:</i> <i>1.1 Atomic structure;</i> <i>1.2 Core properties;</i> <i>1.3 Radioactivity;</i> <i>1.4 alpha decay;</i> <i>1.5 Beta decay;</i> <i>1.6 Gamma decay;</i> <i>1.7 Binding energy;</i> <i>1.8 Core models;</i> <i>1.9 Nuclear radiation interactions</i> <i>1.10 Interaction with substances;</i> <i>1.11 Nuclear reactions;</i>	
3-4	Mampu menjelaskan prinsip dan teori dasar radiasi dan proteksi, beserta besaran, dan satuannya. <i>Able to explain the basic principles and theories of radiation and protection, along with their quantities and units</i>	Kuliah, e-learning, flipped learning, presentasi, dan diskusi, <i>Studying, Discussion, e-learning, flipped learning, presentation</i>	Kriteria: Rabrik skala persepsi Bentuk non-test: • Tulisan makalah • Uji kinerja dlm presentasi Tugas 2: 3. Review dan meringkas artikel/ rujukan tentang radiasi dan proteksi 4. Studi kasus menghitung paparan radiasi dg contoh sederhana. <i>Criteria:</i> <i>Perception scale factory</i> <i>Non-test form:</i>	<i>[TM= 2 mg x 2 sks x 50']</i> <i>[BT= 2 mg x 2 sks x 60']</i> <i>[BM= 2 mg x 2 sks x 60']</i>	II. Radiasi dan Proteksi: 2.1 Interaksi radiasi dengan materi: Radiasi partikel bermuatan; Radiasi X dan Gamma; Radiasi neutron; 2.2 Pembentukan radikal; 2.3 Atenuasi; 2.4 Besaran dan satuan radiologi; 2.5 Penentuan pemaparan; 2.6 Penentuan dosis serap dalam (internal dose); 2.7 Doses maksimum yang diperkenankan; 2.8 prinsip-prinsip prosedur proteksi radiasi;	5% (CP-MK1) 5% (CP-MK2)

			• Paper writing • Performance test in presentation Assignment 2: 3. Review and summarize articles/references on radiation and protection 4. Case study calculates radiation exposure with a simple example.		<i>II. Radiation and Protection:</i> <i>2.1 Interaction of radiation with matter:</i> <i>Charged particle radiation;</i> <i>X and Gamma Radiation;</i> <i>Neutron radiation;</i> <i>2.2 Radical formation;</i> <i>2.3 Attenuation;</i> <i>2.4 Radiological quantities and units;</i> <i>2.5 Determination of exposure;</i> <i>2.6 Determination of the internal dose (internal dose);</i> <i>2.7 The maximum dose allowed;</i> <i>2.8 principles of radiation protection procedures;</i>	
5-6	Mampu menjelaskan interaksi radiasi partikel alpha dan beta dengan materi <i>Able to explain the interaction of alpha and beta particle radiation with substance</i>	Kuliah, e-learning, flipped learning, presentasi, dan diskusi, Tugas 3: 1. Menyusun makalah tentang interaksi radiasi partikel alpha dan beta disertai dengan kasus aplikasinya. 2. Mengembangkan video interaksi radiasi dengan materi. <i>Studying, e-learning, flipped learning, presentations, and discussions,</i>	Kriteria: Rabrik skala persepsi Bentuk non-test: Makalah dan presentasi <i>Criteria:</i> <i>Perception scale rubric</i> <i>Non-test form:</i> <i>Papers and presentations</i>	[BT= 3 mg x 2 sks x 60'] [BM=3 mg x 2 sks x 60'] [TM= 3 mg x 2 sks x 50'] - Pembelajaran dengan Makalah dan presentasi - <i>Learning with Papers and presentations</i>	III. Interaksi radiasi dg materi 3.1. Interaction Prozesse 3.2. Interactions of Alpha Particles and Heavy Nuclei 3.2.1 Recoil Nuclei and Fission Fragments 3.2.2 Range of Alpha Particles 3.3 Beta Particle Interactions and Dose: 3.3.1 Energy Loss by Ionization 3.3.2 Energy Losses by Bremsstrahlung 3.3.3 Cerenkov Radiation 3.3.4 Attenuation of Beta Particles 3.3.5 Range Versus Energy of Beta Particles	5% (CP-MK1) 10% (CP-MK2)

		<i>Assignment 3:</i> <i>1. Compile a paper on the interaction of alpha and beta particle radiation along with the application case.</i> <i>2. Develop a video interaction of radiation with the material.</i>			3.3.6 Radiation Dose from Beta Particles 3.3.7 Beta Dose from Contaminated Surfaces 3.3.8 Beta Contamination on Skin or Clothing 3.3.9 Beta Dose from Hot Particles [3]: hal. 250 -270 <i>III. Interaction of radiation with matter</i> <i>3.1. Interaction Process</i> <i>3.2. Interactions of Alpha Particles and Heavy Nuclei</i> <i>3.2.1 Recoil Nuclei and Fission Fragments</i> <i>3.2.2 Range of Alpha Particles</i> <i>3.3 Beta Particle Interactions and Dose:</i> <i>1.3.1 Energy Loss by Ionization</i> <i>1.3.2 Energy Losses by Bremsstrahlung</i> <i>1.3.3 Cerenkov Radiation</i> <i>3.3.4 Attenuation of Beta Particles</i> <i>3.3.5 Range Versus Energy of Beta Particles</i> <i>3.3.6 Radiation Dose from Beta Particles</i> <i>3.3.7 Beta Dose from Contaminated Surfaces</i> <i>3.3.8 Beta Contamination on Skin or Clothing</i>	
--	--	--	--	--	---	--

					3.3.9 Beta Dose from Hot Particles [3]: p. 250 -270	
7,9	4.Mampu menjelaskan interaksi radiasi partikel gamma dengan materi; 5. Mampu menghitung paparan radiasi; <i>4.Able to explain the interaction of gamma particle radiation with matter;</i> <i>5. Able to calculate radiation exposure</i>	Kuliah, e-learning, flipped learning, presentasi, dan diskusi, Tugas 4: - Menyusun makalah tentang interaksi radiasi partikel gamma disertai dengan kasus aplikasinya. - Kertas kerja Studi kasus menghitung paparan radiasi sesuai dengan standar. <i>Studying, e-learning, flipped learning, presentations, and discussions, Assignment 4:</i> <i>Compile a paper on the interaction of gamma particle radiation accompanied by the application case.</i> <i>Case study working papers calculate radiation exposure according to standards.</i>	Kriteria: Rabrik skala persepsi Bentuk non-test: - Makalah dan presentasi; - Studi kasus menghitung paparan radiasi; <i>Criteria: Perception scale rubric Non-test form:</i> <i>Papers and presentations;</i> <i>Case studies calculating radiation exposure</i>	[TM= 2 mg x 2 sks x 50'] - Makalah dan presentasi; - Studi kasus menghitung paparan radiasi; <i>Papers and presentations;</i> <i>Case studies calculating radiation exposure</i>	III. Interaksi radiasi dg materi - Photon Interactions: - Photoelectric Interactions; - Compton Interactions; - Pair Production; - Photodisintegration; - Photon Attenuation and Absorption: - Attenuation (m) and Energy Absorption (μEn) Coefficients; - Effect of E and Z on Photon Attenuation/ Absorption; - Absorption Edges, Checkpoints; - Energy Transfer and Absorption by Photons: - Electronic Equilibrium; - Bragg–Gray Theory; - Exposure/Dose Calculations: - Point Sources; - Gamma Ray Constant, G; - Exposure and Absorbed Dose; - Exposure, Kerma, and Absorbed Dose; [3]: hal. 270 – 302	5% (CP-MK1) 5% (CP-MK2)

					<i>III. Interaction of radiation with matter</i> <i>a. Photon Interactions:</i> 3.4.1 Photoelectric Interactions; 3.4.2 Compton Interactions; 3.4.3 Pair Production; 3.4.4 Photodisintegration; 3.5 Photon Attenuation and Absorption: 3.5.1 Attenuation (μ) and Energy Absorption (μ_{En}) Coefficients; 3.5.2 Effect of E and Z on Photon Attenuation/Absorption; 3.6 Absorption Edges, Checkpoints; 3.7 Energy Transfer and Absorption by Photons: 3.7.1 Electronic Equilibrium; 3.7.2 Bragg–Gray Theory; 3.8 Exposure/Dose Calculations: 3.8.1 Point Sources; 3.8.2 Gamma Ray Constant, G; 3.8.3 Exposure and Absorbed Dose; 3.8.4 Exposure, Kerma, and Absorbed Dose; [3]: p. 270 - 302	
8	Evaluasi Tengah Semester (ETS) <i>Mid-Term Exam</i>					10% (CP-MK1, CP-MK2))
10-12	6. Mampu menjelaskan prinsip dan model	Kuliah,	Kriteria: Rabrik skala persepsi	[BT= 3 mg x 2 sks x 60']	IV. Radiation Shielding	10% (CP-MK3)

	matematik proteksi radiasi; Mampu merancang palikasi proteksi radiasi <i>6. Able to explain the principles and mathematical models of radiation protection; Able to design radiation protection applications</i>	e-learning, flipped learning, presentasi, dan diskusi, Tugas-5: 1. Menyusun makalah tentang proteksi radiasi, dan model matematik, 2. Merancang aplikasinya proteksi radiasi. problem karakterisasi sistem radiasi <i>Studying, e-learning, flipped learning, presentations, and discussions,</i> <i>Assignment-5:</i> 1. Compile papers on radiation protection, and mathematical models, 2. Designing radiation protection applications. radiation system characterization problem	Bentuk non-test: • Makalah dan presentasi; Merumuskan model matematik proteksi radiasi; <i>Criteria: Perception scale rubric</i> <i>Non-test form:</i> • <i>Papers and presentations;</i> <i>Formulate a mathematical model of radiation protection</i>	[BM=3 mg x 2 sks x 60'] [TM=3 mg x 2 sks x 50'] • Makalah dan presentasi; • <i>Papers and presentations</i>	4.1. Shielding of Alpha-Emitting Sources; 4.2. Shielding of Beta-Emitting Sources; 4.2.1 Attenuation of Beta Particles; 4.2.2 Bremsstrahlung Effects for Beta Shielding; 4.3. Shielding of Photon Sources 4.3.1 Shielding of Good Geometry Photon Sources; 4.3.2 Half-Value and Tenth-Value Layers; 4.3.3 Shielding of Poor Geometry Photon Sources; 4.3.4 Use of Buildup Factors; 4.3.5 Effect of Buildup on Shield Thickness; 4.3.6 Mathematical Formulations of the Buildup Factor; 4.4 Gamma Flux for Distributed Sources; 4.4.1 Line Sources; 4.4.2 Ring Sources; 4.4.3 Disc and Planar Sources; 4.4.4 Shield Designs for Area Sources; 4.4.5 Gamma Exposure from Thick Slabs; 4.4.6 Volume Sources; 4.4.7 Buildup Factors for Layered Absorbers;	
--	--	--	---	---	--	--

					4.5 Shielding of Protons and Light Ions; [3]: hal. 307 – 357 <i>IV. Radiation Shielding</i> <i>4.1. Shielding of Alpha-Emitting Sources;</i> <i>4.2. Shielding of Beta-Emitting Sources;</i> <i>4.2.1 Attenuation of Beta Particles;</i> <i>4.2.2 Bremsstrahlung Effects for Beta Shielding;</i> <i>4.3. Shielding of Photon Sources</i> <i>4.3.1 Shielding of Good Geometry Photon Sources;</i> <i>4.3.2 Half-Value and Tenth-Value Layers;</i> <i>4.3.3 Shielding of Poor Geometry Photon Sources;</i> <i>4.3.4 Use of Buildup Factors;</i> <i>4.3.5 Effect of Buildup on Shield Thickness;</i> <i>4.3.6 Mathematical Formulations of the Buildup Factor;</i> <i>4.4 Gamma Flux for Distributed Sources;</i> <i>4.4.1 Line Sources;</i> <i>4.4.2 Ring Sources;</i> <i>4.4.3 Discs and Planar Sources;</i> <i>4.4.4 Shield Designs for Area Sources;</i>	
--	--	--	--	--	---	--

					4.4.5 Gamma Exposure from Thick Slabs; 4.4.6 Volume Sources; 4.4.7 Buildup Factors for Layered Absorbers; 4.5 Shielding of Protons and Light Ions; [3]: p. 307 - 357	
13-15	Mampu menjelaskan prinsip kerja detector dan alat ukur radiasi nuklir, beserta kalibrasinya <i>Able to explain the working principle of nuclear radiation detectors and measuring instruments, along with their calibration</i>	Kuliah, e-learning, flipped learning, presentasi, dan diskusi, Tugas 6: 1. Searching beberapa jurnal tentang prediktor untuk sebuah atau lebih variabel energy 2. Mengembangkan video aplikasi alat ukur dan pengukuran proteksi radiasi <i>Studying, e-learning, flipped learning, presentations, and discussions,</i> <i>Assignment 6:</i> 1. Searching several journals about predictors for one or more energy variables 2. Developing application videos for radiation protection measuring and measuring instruments	• Ketepatan menjelaskan prinsip proteksi radiasi; • Ketepatan memodelkan proteksi radiasi secara matematik; • <i>Accurately explain the principle of radiation protection</i> • <i>The accuracy of mathematically modeling radiation protection;</i>	[BT= 3 mg x 2 sks x 60'] [BM=3 mg x 2 sks x 60'] [TM= 3 mg x 2 sks x 50'] Searching beberapa jurnal tentang prediktor untuk sebuah atau lebih variabel energy <i>Searching several journals about predictors for one or more energy variables</i>	V. Peralatan bekerja dan alat-alat pengukur Radiation Detection and Measurement: 5.1 Gas-Filled Detectors; 5.2 Crystalline Detectors/ Spectrometers; 5.3 Semiconducting Detectors; 5.4 Gamma Spectroscopy; 5.4.1 Gamma-Ray Spectra: hm £ 1.022 MeV 495; 5.4.2 Gamma-Ray Spectra: hm ¤ 1.022 MeV 500; 5.4.3 Escape Peaks and Sum Peaks; 5.4.4 Gamma Spectroscopy of Positron Emitters; 5.5. Portable Field Instruments; 5.5.1 Geiger Counters; 5.5.2 Ion Chambers; 5.5.3 Microrem Meters; 5.5.4 Alpha Radiation Monitoring; 5.5.5 Beta Radiation Surveys; 5.5.6 Removable Radioactive Surface Contamination;	10% (CP-MK3)

					[3]: hal. 489 – 509 <i>V. Working equipment and measuring tools</i> <i>Radiation Detection and Measurement:</i> <i>5.1 Gas-Filled Detectors;</i> <i>5.2 Crystalline Detectors/ Spectrometers;</i> <i>5.3 Semiconducting Detectors;</i> <i>5.4 Gamma Spectroscopy;</i> <i>5.4.1 Gamma-Ray Spectra: hm</i> <i>£1,022 MeV 495;</i> <i>5.4.2 Gamma-Ray Spectra: hm</i> <i>1,022 MeV 500;</i> <i>5.4.3 Escape Peaks and Sum Peaks;</i> <i>5.4.4 Gamma Spectroscopy of Positron Emitters;</i> <i>5.5. Portable Field Instruments;</i> <i>5.5.1 Geiger Counters;</i> <i>5.5.2 Ion Chambers;</i> <i>5.5.3 Microrem Meters;</i> <i>5.5.4 Alpha Radiation Monitoring;</i> <i>5.5.5 Beta Radiation Surveys;</i> <i>5.5.6 Removable Radioactive Surface Contamination;</i> <i>[3]: p. 489 – 509</i>	
16	Evaluasi Akhir Semester <i>Final Exam</i>					30% (CP-MK3)

Catatan :

Note

8. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	Radiasi dan Proteksi Radiation and Protection		Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185424	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i> Dr Syamsul Arifin	Koordinator RMK <i>Field Coordinator</i> Totok Ruki B., ST, MT, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK1 (5)	Bobot CP-MK1 (6)
1-2	Mampu menjelaskan dasar-dasar fisika atom	Kriteria: Rabrik holistik	10%		

	<i>Able to explain the basics of atomic physics</i>	Bentuk non-test: - Review sumber-sumber rujukan Criteria: <i>Holistic rubric</i> Non-test form: <i>Review of referral sources</i>			
3-4	Mampu menjelaskan prinsip dan teori dasar radiasi dan proteksi, beserta besaran, dan satuannya. <i>Able to explain the basic principles and theories of radiation and protection, along with their quantities and units</i>	Kriteria: Rabrik skala persepsi Bentuk non-test: - Tulisan makalah - Uji kinerja dlm presentasi Tugas 2: - Review dan meringkas artikel/ rujukan tentang radiasi dan proteksi - Studi kasus menghitung paparan radiasi dg contoh sederhana. Criteria: <i>Perception scale factory</i> Non-test form: <i>Paper writing</i> <i>Performance test in presentation</i> Assignment 2: <i>3. Review and summarize articles/references on radiation and protection</i> <i>4. Case study calculates radiation exposure with a simple example.</i>	5%	5%	
5-6	Mampu menjelaskan interaksi radiasi partikel alpha dan beta dengan materi <i>Able to explain the interaction of alpha and beta particle radiation with substance</i>	Kriteria: Rabrik skala persepsi Bentuk non-test: Makalah dan presentasi Criteria:	5%	10%	

		<i>Perception scale rubric</i> <i>Non-test form:</i> <i>Papers and presentations</i>			
7,9	4.Mampu menjelaskan interaksi radiasi partikel gamma dengan materi; 5. Mampu menghitung paparan radiasi; <i>4.Able to explain the interaction of gamma particle radiation with matter;</i> <i>5. Able to calculate radiation exposure</i>	Kriteria: Rabrik skala persepsi Bentuk non-test: • Makalah dan presentasi; • Studi kasus menghitung paparan radiasi; <i>Criteria:</i> <i>Perception scale rubric</i> <i>Non-test form:</i> • <i>Papers and presentations;</i> • <i>Case studies calculating radiation exposure</i>		5%	
8	Evaluasi Tengah Semester (ETS) <i>Mid-Term Exam</i>		5%	5%	
10-12	Mampu menjelaskan prinsip dan model matematik proteksi radiasi; Mampu merancang palikasi proteksi radiasi <i>Able to explain the principles and mathematical models of radiation protection;</i> <i>Able to design radiation protection applications</i>	Kriteria: Rabrik skala persepsi Bentuk non-test: • Makalah dan presentasi; Merumuskan model matematik proteksi radiasi; <i>Criteria:</i> <i>Perception scale rubric</i> <i>Non-test form:</i> • <i>Papers and presentations;</i> <i>Formulate a mathematical model of radiation protection</i>			10%
13-15	Mampu menjelaskan prinsip kerja detector dan alat ukur radiasi nuklir, beserta kalibrasinya <i>Able to explain the working principle of nuclear radiation detectors and measuring instruments, along with their calibration</i>	• Ketepatan menjelakan prinsip proteksi radiasi; • Ketepatan memodelkan proteksi radiasi secara matematik; • <i>Accurately explain the principle of radiation protection</i> • <i>accuracy of mathematically modeling radiation protection;</i>			10%

16	Evaluasi Akhir Semester <i>Final Exam</i>			30%
	Total Bobot Penilaian (%) <i>Total Point (%)</i>	25%	25%	50%

TF 185431 RPS RAE Material Fotonik (*Photonics Material*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>			RP
	Material Fotonik <i>Photonic Materials</i>			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185431	Bobot sks (T/P): (3/0) <i>Credits (T/P): (3/0)</i>	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 3 <i>Semester: 3</i>	
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Agus M. Hatta, Ph.D	Koordinator RMK <i>Field Coordinator</i> Dr.rer.nat Aulia MTN	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>			
	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan kerekayasaan tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (37,5%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis</i>			

	CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format</i> CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (37,5%) <i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	Mampu mendesain dan mengembangkan material maju untuk aplikasi di bidang optik dan fotonik <i>Able to design and develop advanced materials for applications in optics and photonics</i>
	Diskripsi Singkat MK <i>Course Description</i> Matakuliah Material Fotonik ini termasuk rumpun mata kuliah fotonika di Departemen Teknik Fisika FTIRS-ITS. Matakuliah Material Fotonik membahas tentang dasar-dasar dan konsep fisika dari material maju untuk aplikasi dalam bidang optik dan fotonik. Matakuliah material fotonik ini menjadi dasar pengetahuan dan ketrampilan yang harus dimiliki bagi peneliti yang bekerja di sebuah lembaga penelitian yang mempunyai riset di bidang material maju untuk aplikasi dalam bidang optik dan fotonik. Dalam matakuliah ini mahasiswa juga akan belajar tentang perancangan material maju untuk aplikasi di bidang sensor fotonik dan fotonik biomedis. <i>This Photonic Materials course belongs to the photonics course group at the Department of Engineering Physics FTIRS-ITS. The Photonic Materials course discusses the basics and physics concepts of advanced materials for applications in the field of optics and photonics. This photonic materials course forms the basis of knowledge and skills that must be possessed by researchers working in a research institution that has research in the field of advanced materials for applications in the field of optics and photonics. In this course, students will also learn about the design of advanced materials for applications in photonic sensors and biomedical photonics.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Optik Elektromagnetik 2. Optik Polarisasi dan Kristal 3. Optik Statistik 4. Optik Foton 5. Foton dan Atom 6. Foton dalam semikonduktor 7. Sumber foton semikonduktor 8. Detektor foton semikonduktor	

	9. Optik Nonlinier 10. Kristal Fotonik 11. Plasmonik 12. Metamaterial 13. Sel Surya 7. <i>Electromagnetic Optics</i> 8. <i>Polarization and Crystal Optics</i> 9. <i>Statistical Optics</i> 10. <i>Photon Optics</i> 11. <i>Photons and Atoms</i> 12. <i>Photons in semiconductors</i> 13. <i>Semiconductor photon sources</i> 14. <i>Semiconductor photon detectors</i> 15. <i>Nonlinear Optics</i> 16. <i>Photonic Crystals</i> 17. <i>Plasmonics</i> 18. <i>Metamaterials</i> 19. <i>Solar Cells</i>	
Pustaka <i>Reading Materials</i>	Utama: Main	
	1. Fundamentals of Photonics, B. A. Saleh 2. Springer Handbook of Electronic and Photonic Materials 3. Plasmonic : Fundamentals and Applications, Stefan Maier 4. Optical Metamaterial : Fundamentals and Application, Vladimir Shalaev 5. Materials Science and Engineering an Introduction - 8th ed - W.D. Callister (solution manual)	
	Pendukung : Supporting	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: Software	Perangkat keras : Hardware
	OS:Windows; Office, Video demo, Matlab	PC & LCD Projector

Team Teaching		Agus M. Hatta, Ph.D				
Matakuliah syarat						
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1	Mahasiswa mampu menjelaskan dan memahami konsep dasar <i>electromagnetic optic</i> serta mampu menjelaskan arti fisis dari konsep tersebut <i>Students are able to explain and understand the basic concepts of electromagnetic optics and are able to explain the physical meaning of the concept</i>	1. Ketepatan menjelaskan konsep dasar <i>electromagnetic optic</i> 2. Ketepatan menjelaskan arti fisis dari konsep tersebut <i>1. Accuracy in explaining the basic concepts of electromagnetic optics</i> <i>2. Accuracy in explaining the physical meaning of the concept</i>	Non-test : Penyusunan presentasi berisi materi : 1. Konsep elektromagnetik dari cahaya 2. Medium dielektrik 3. Gelombang elektromagnetik monokromatik 4. Elemen gelombang elektromagnetik 5. Absorpsi dan dispersi 6. Penjalaran pulsa pada medium dispersif <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Fundamentals of Photonics, B. A. Saleh (Bab. 5) 2. Jurnal ilmiah yang berhubungan dengan elektromagnetik <i>1. Fundamentals of Photonics, B. A. Saleh (Chapter 5)</i> <i>2. Scientific journals related to electromagnetics</i>	7%

			1. Electromagnetic concept of light 2. Dielectric medium 3. Monochromatic electromagnetic waves 4. Electromagnetic wave element 5. Absorption and dispersion 6. Pulse propagation in a dispersive medium			
2	Mahasiswa mampu menjelaskan dan memahami konsep dasar polarisasi serta mampu menjelaskan konsep dasar dari Kristal optik <i>Students are able to explain and understand the basic concepts of polarization and are able to explain the basic</i>	1. Ketepatan menjelaskan konsep dasar polarisasi 2. Ketepatan menjelaskan konsep dasar kristal optik <i>1. Accuracy explains the basic concept of polarization</i> <i>2. Accuracy explains the basic concept of optical crystal</i>	Non-test : Penyusunan presentasi berisi materi : 1. Polarisasi dari cahaya 2. Refleksi dan refraksi 3. Konsep optika pada medium anisotropik 4. Efek Faraday pada medium optik 5. Konsep optika pada liquid crystal 6. Divais yang memanfaatkan polarisasi	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Fundamentals of Photonics, B. A. Saleh (Bab. 6) 2. Jurnal ilmiah yang berhubungan dengan polarisasi dan kristal optic <i>1. Fundamentals of Photonics, B. A. Saleh (Chapter 6)</i> <i>2. Scientific journals dealing with polarization and optical crystals</i>	7%

	<i>concepts of optical crystals</i>		<i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> <i>1. Polarization of light</i> <i>2. Reflection and refraction</i> <i>3. Optical concepts in anisotropic media</i> <i>4. Faraday effect on optical medium</i> <i>5. Optical concepts in liquid crystal</i> <i>6. Devices that utilize polarization</i>			
3	Mahasiswa mampu menjelaskan dan memahami konsep dasar statistika optik <i>Students are able to explain and understand the basic concepts of optical statistics</i>	1. Ketepatan menjelaskan konsep dasar statistika optik 2. Ketepatan menjelaskan aplikasi statistika optik <i>1. Accuracy in explaining the basic concepts of optical statistics</i> <i>2. The accuracy of explaining the application of optical statistics</i>	Non-test : Penyusunan presentasi berisi materi : 1. Sifat statistik dari cahaya 2. Interferensi pada cahaya yang memiliki koherensi sebagian 3. Transmisi cahaya yang memiliki koherensi sebagian pada sistem optik 4. Polarisasi Sebagian	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60'	1. Fundamentals of Photonics, B. A. Saleh (Bab. 10) 2. Jurnal ilmiah yang berhubungan dengan statistika optic <i>1. Fundamentals of Photonics, B. A. Saleh (Chapter 10)</i> <i>2. Scientific journals related to optical statistics</i>	7%

			<i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> <i>1. Statistical properties of light</i> <i>2. Interference in partially coherent light</i> <i>3. Partially coherent light transmission in optical system</i> <i>4. Partial polarization</i>	•BM = 1 mg x 2 sks x 60'		
4	Mahasiswa mampu menjelaskan dan memahami konsep dasar foton dalam optika <i>Students are able to explain and understand the basic concepts of photons in optics</i>	- Ketepatan menjelaskan konsep dasar foton dalam optika - Ketepatan menjelaskan aplikasi sistem yang memanfaatkan foton <i>1. Accuracy in explaining the basic concept of photons in optics</i> <i>2. Accuracy describes the application of the system utilizing photons</i>	Non-test : Penyusunan presentasi berisi materi : - Sifat-sifat foton <i>Photon Streams</i> - Keadaan kuantum dari cahaya <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	- Fundamentals of Photonics, B. A. Saleh (Bab. 11) - Jurnal ilmiah yang berhubungan dengan kuantum <i>1. Fundamentals of Photonics, B. A. Saleh (Chapter 11)</i> <i>2. Scientific journals related to quantum</i>	7%

			1. <i>Photonic properties</i> 2. <i>Photon Streams</i> 3. <i>The quantum state of light</i>			
5	Mahasiswa mampu menjelaskan dan memahami konsep dasar foton dan atom <i>Students are able to explain and understand the basic concepts of photons and atoms</i>	1. Ketepatan menjelaskan konsep dasar foton dan atom 1. <i>Accuracy in explaining the basic concepts of photons and atoms</i>	Non-test : Penyusunan presentasi berisi materi : 1. atom, molekul, dan benda padat 2. Interaksi foton dan atom 3. Cahaya termal 4. Cahaya luminansi <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> 1. <i>atoms, molecules and solids</i> 2. <i>The interaction of photons and atoms</i> 3. <i>Thermal light</i> 4. <i>Luminance light</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Fundamentals of Photonics, B. A. Saleh (Bab. 12) 2. Jurnal ilmiah yang berhubungan dengan kuantum 1. <i>Fundamentals of Photonics, B. A. Saleh (Chapter 12)</i> 2. <i>Scientific journals related to quantum</i>	7%

6	Mahasiswa mampu menjelaskan dan memahami konsep dasar foton dalam semikonduktor sebagai sumber cahaya dan detector <i>Students are able to explain and understand the basic concepts of photons in semiconductors as light sources and detectors</i>	1. Ketepatan menjelaskan konsep dasar foton dan semikonduktor <i>1. Accurately explain the basic concepts of photons and semiconductors</i>	Non-test : Penyusunan presentasi berisi materi : 1. Semikonduktor 2. Interaksi foton dengan elektron dan <i>holes</i> <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> <i>1. Semiconductor</i> <i>2. The interaction of photons with electrons and holes</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Fundamentals of Photonics, B. A. Saleh (Bab. 15) 2. Jurnal ilmiah yang berhubungan dengan kuantum dan semikonduktor <i>1. Fundamentals of Photonics, B. A. Saleh (Chapter 15)</i> <i>2. Scientific journals related to quantum and semiconductor</i>	7%
7	Mahasiswa mampu menjelaskan aplikasi dari semikonduktor dalam bidang optik dan fotonik <i>Students are able to explain the application of semiconductors</i>	1. Ketepatan menjelaskan konsep dasar foton dan semikonduktor 2. Ketepatan menjelaskan konsep dasar sumber cahaya dan detektor <i>1. Accurately explain the basic concepts of photons and semiconductors</i>	Non-test : Penyusunan presentasi berisi materi : 1. <i>Light Emitting Diode</i> 2. Semikonduktor untuk <i>Laser Amplifier</i> 3. <i>Semiconductor injection Laser</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50'	1. Fundamentals of Photonics, B. A. Saleh (Bab. 16-17) 2. Jurnal ilmiah yang berhubungan dengan kuantum dan semikonduktor, LED, dan fotodiode <i>1. Fundamentals of Photonics, B. A. Saleh (Chapters 16-17)</i> <i>2. Scientific journals dealing with quantum and semiconductors, LEDs, and photodiodes</i>	7%

	<i>in the field of optics and photonics</i>	<i>2. Accuracy explains the basic concepts of light sources and detectors</i>	4. Sifat-sifat semikonduktor sebagai fotodetektor 5. Fotodioda 6. <i>Avalanche Photodiode</i> <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> <i>1. Light Emitting Diode</i> <i>2. Semiconductor for Laser Amplifier</i> <i>3. Semiconductor injection Laser</i> <i>4. Properties of semiconductors as photodetectors</i> <i>5. Photodiode</i> <i>6. Avalanche Photodiode</i>	•BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'		
8	Evaluasi Tengah Semester (ETS) <i>Mid-Term Exam</i>					15%
9	Mahasiswa mampu menjelaskan aplikasi dari	1. Ketepatan menjelaskan desain dan aplikasi dari semikonduktor dalam bidang fotonik	Non-Test : Penyusunan presentasi dan makalah berisi materi :	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50'	1. Jurnal ilmiah yang berhubungan dengan kuantum dan semikonduktor dan bidang riset	7%

	semikonduktor dalam bidang optik dan fotonik <i>Students are able to explain the application of semiconductors in the field of optics and photonics</i>	<i>1. Accurately describe the design and application of semiconductors in the photonic field</i>	1. Desain semikonduktor sebagai sensor dan detektor 2. Desain semikonduktor terkait dengan bidang riset <i>Non-Test : Preparation of presentations and papers containing the following materials: 1. Design of semiconductors as sensors and detectors 2. Semiconductor design related to research field</i>	•BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	<i>1. Scientific journals related to quantum and semiconductor and research fields</i>	
10	Mahasiswa mampu menjelaskan konsep dasar optika nonlinier <i>Students are able to explain the basic concepts of nonlinear optics.</i>	1. Ketepatan menjelaskan konsep dasar optika nonlinier 2. Ketepatan menjelaskan aplikasi konsep dasar optika nonlinier <i>1. Accuracy in explaining the basic concepts of nonlinear optics 2. Accuracy in explaining the application of the basic</i>	Non-Test : Penyusunan presentasi berisi materi : 1. Medium optik nonlinier 2. Optika nonlinier orde 2 3. Optika nonlinier orde 3 4. Teori cahaya dari <i>three wave mixing</i> 5. Teori cahaya dari <i>four wave mixing</i> 6. Medium nonlinier anisotropik	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Fundamentals of Photonics, B. A. Saleh (Bab. 19) 2. Jurnal ilmiah yang berhubungan dengan <i>nonlinear optics</i> <i>1. Fundamentals of Photonics, B. A. Saleh (Chapter 19) 2. Scientific journals dealing with nonlinear optics</i>	7%

		<i>concepts of nonlinear optics</i>	7. Medium nonlinier dispersive <i>Non-Test :</i> <i>The preparation of the presentation contains the following materials:</i> <i>1. Nonlinear optical medium</i> <i>2. 2 order nonlinear optics</i> <i>3. 3 order nonlinear optics</i> <i>4. Light theory of three wave mixing</i> <i>5. Light theory of four wave mixing</i> <i>6. Anisotropic nonlinear medium</i> <i>7. Dispersive nonlinear medium</i>			
11	Mahasiswa mampu menjelaskan konsep dan aplikasi dari kristal fotonik	1. Ketepatan menjelaskan konsep dasar kristal fotonik 2. Ketepatan menjelaskan aplikasi kristal fotonik dalam bidang biomedis dan sensor	Non-Test : Penyusunan presentasi berisi materi : 1. <i>Photonic Crystal Lattice</i> 2. Aplikasi <i>Photonic Crystal</i> untuk pencitraan dan sensor	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Photonic Crystal Springer 2. Jurnal ilmiah yang berhubungan dengan <i>photonic crystal</i> <i>1. Photonic Crystal Springer</i> <i>2. Scientific journals related to photonic crystal</i>	7%)

	<i>Students are able to explain the concepts and applications of photonic crystals</i>	1. Accuracy in explaining the basic concept of photonic crystal 2. Accuracy explains the application of photonic crystals in biomedical and sensor fields	Non-Test : The preparation of the presentation contains the following materials: 1. Photonic Crystal Lattice 2. Photonic Crystal applications for imaging and sensors	Lectures, review paper journals and discussions •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'		
12-13	Mahasiswa Mahasiswa mampu menjelaskan konsep dan aplikasi dari material plasmonic <i>Students Students are able to explain the concepts and applications of plasmonic materials</i>	1. Ketepatan menjelaskan konsep dasar plasmon 2. Ketepatan menjelaskan aplikasi material plasmonik dalam bidang biomedis dan sensor 1. Accuracy in explaining the basic concept of plasmon 2. Accuracy in explaining the application of plasmonic materials in biomedical and sensor fields	Non-Test : Penyusunan presentasi berisi materi : 1. Surface Plasmon Resonance (SPR) 2. Aplikasi SPR untuk sensor Non-Test : The preparation of the presentation contains the following materials: 1. Surface Plasmon Resonance (SPR) 2. SPR application for sensors	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' Lectures, review paper journals and discussions •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'	1. Plasmonic : Fundamentals and Applications, Stefan Maier 2. Jurnal ilmiah yang berhubungan dengan SPR 1. Plasmonic : Fundamentals and Applications, Stefan Maier 2. Scientific journals related to SPR	7%

14	Mahasiswa mampu menjelaskan konsep dan aplikasi dari metamaterial <i>Students are able to explain the concepts and applications of metamaterials</i>	1. Ketepatan menjelaskan konsep dasar metamaterial, material dengan indeks bias negatif dan nol 2. Ketepatan menjelaskan aplikasi metamaterial <i>1. Accuracy in explaining the basic concepts of metamaterials, materials with a negative and zero refractive index</i> <i>2. Accuracy describes the application of metamaterials</i>	Non-Test : Penyusunan presentasi berisi materi : 1. Material dengan indeks bias negatif 2. Material dengan indeks bias nol 3. Aplikasi metamaterial untuk sensor <i>Non-Test :</i> <i>The preparation of the presentation contains the following materials:</i> <i>1. Materials with a negative refractive index</i> <i>2. Materials with zero refractive index</i> <i>3. Application of metamaterials for sensors</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Optical Metamaterial : Fundamentals and Application, Vladimir Shalaev 2. Jurnal ilmiah yang berhubungan dengan metamaterial <i>1. Optical Metamaterial : Fundamentals and Application, Vladimir Shalaev</i> <i>2. Scientific journals related to metamaterials</i>	7%
15	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di	1. Ketepatan menggunakan konsep optik pada material 2. Ketepatan menjelaskan aplikasi di bidang riset yang sedang dilakukan	Non-Test : Penyusunan presentasi dan makalah berisi materi : 1. Konsep dasar material yang didesain	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	1. Jurnal ilmiah yang berhubungan dengan riset yang sedang dilakukan dan material maju	7%

	industri atau lainnya <i>Students are able to design sensors for physical quantity monitoring applications in industry or others</i>	<i>1. The accuracy of using optical concepts on materials</i> <i>2. Accuracy in explaining the application in the field of research that is being carried out</i>	<i>Non-Test :</i> <i>Preparation of presentations and papers containing the following materials:</i> <i>1. The basic concept of the designed material</i>	<i>Lectures, review paper journals and discussions</i> • <i>TM = 1 mg x 2 sks x 50'</i> • <i>BT = 1 mg x 2 sks x 60'</i> • <i>BM = 1 mg x 2 sks x 60'</i>	<i>1. Scientific journals related to current research and advanced materials</i>	
16	Evaluasi Akhir Semester <i>Final Exam</i>					12%

Catatan :

9. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	Material Fotonik Photonic Materials		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185431	Bobot sks (T/P): (3/0) Credits (T/P): (3/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: <i>Instrumentation and Control Engineering</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Agus M. Hatta, Ph.D	Koordinator RMK Field Coordinator Dr.rer.nat Aulia MTN	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)
1	Mahasiswa mampu menjelaskan dan memahami konsep dasar <i>electromagnetic optic</i> serta mampu menjelaskan arti fisis dari konsep tersebut <i>Students are able to explain and understand the basic concepts of electromagnetic optics and are able to explain the physical meaning of the concept</i>	Non-test : Penyusunan presentasi berisi materi : 1. Konsep elektromagnetik dari cahaya 2. Medium dielektrik 3. Gelombang elektromagnetik monokromatik 4. Elemen gelombang elektromagnetik 5. Absorpsi dan dispersi 6. Penjalaran pulsa pada medium dispersif <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> <i>1. Electromagnetic concept of light</i>	7%

		2. <i>Dielectric medium</i> 3. <i>Monochromatic electromagnetic waves</i> 4. <i>Electromagnetic wave element</i> 5. <i>Absorption and dispersion</i> 6. <i>Pulse propagation in a dispersive medium</i>	
2	Mahasiswa mampu menjelaskan dan memahami konsep dasar polarisasi serta mampu menjelaskan konsep dasar dari Kristal optik <i>Students are able to explain and understand the basic concepts of polarization and are able to explain the basic concepts of optical crystals</i>	Non-test : Penyusunan presentasi berisi materi : 1. Polarisasi dari cahaya 2. Refleksi dan refraksi 3. Konsep optika pada medium anisotropik 4. Efek Faraday pada medium optik 5. Konsep optika pada <i>liquid crystal</i> 6. Divais yang memanfaatkan polarisasi <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> 1. <i>Polarization of light</i> 2. <i>Reflection and refraction</i> 3. <i>Optical concepts in anisotropic media</i> 4. <i>Faraday effect on optical medium</i> 5. <i>Optical concepts in liquid crystal</i> 6. <i>Devices that utilize polarization</i>	7%
3	Mahasiswa mampu menjelaskan dan memahami konsep dasar statistika optik <i>Students are able to explain and understand the basic concepts of optical statistics</i>	Non-test : Penyusunan presentasi berisi materi : 1. Sifat statistik dari cahaya 2. Interferensi pada cahaya yang memiliki koherensi sebagian 3. Transmisi cahaya yang memiliki koherensi sebagian pada sistem optik 4. Polarisasi Sebagian <i>Non-test:</i> <i>The preparation of the presentation contains the following materials:</i> 1. <i>Statistical properties of light</i> 2. <i>Interference in partially coherent light</i> 3. <i>Partially coherent light transmission in optical system</i> 4. <i>Partial polarization</i>	7%

4	Mahasiswa mampu menjelaskan dan memahami konsep dasar foton dalam optika <i>Students are able to explain and understand the basic concepts of photons in optics</i>	Non-test : Penyusunan presentasi berisi materi : 1. Sifat-sifat foton 2. <i>Photon Streams</i> 3. Keadaan kuantum dari cahaya <i>Non-test: The preparation of the presentation contains the following materials: 1. Photonic properties 2. Photon Streams 3. The quantum state of light</i>	7%
5	Mahasiswa mampu menjelaskan dan memahami konsep dasar foton dan atom <i>Students are able to explain and understand the basic concepts of photons and atoms</i>	Non-test : Penyusunan presentasi berisi materi : 1. atom, molekul, dan benda padat 2. Interaksi foton dan atom 3. Cahaya termal 4. Cahaya luminansi <i>Non-test: The preparation of the presentation contains the following materials: 1. atoms, molecules and solids 2. The interaction of photons and atoms 3. Thermal light 4. Luminance light</i>	7%
6	Mahasiswa mampu menjelaskan dan memahami konsep dasar foton dalam semikonduktor sebagai sumber cahaya dan detector <i>Students are able to explain and understand the basic concepts of photons in semiconductors as light sources and detectors</i>	Non-test : Penyusunan presentasi berisi materi : 1. Semikonduktor 2. Interaksi foton dengan elektron dan <i>holes</i> <i>Non-test: The preparation of the presentation contains the following materials: 1. Semiconductor 2. The interaction of photons with electrons and holes</i>	7%
7	Mahasiswa mampu menjelaskan aplikasi dari semikonduktor dalam bidang optik dan fotonik	Non-test : Penyusunan presentasi berisi materi : 1. <i>Light Emitting Diode</i>	7%

	<i>Students are able to explain the application of semiconductors in the field of optics and photonics</i>	2. Semikonduktor untuk Laser Amplifier 3. Semiconductor injection Laser 4. Sifat-sifat semikonduktor sebagai fotodetektor 5. Fotodioda 6. Avalanche Photodiode Non-test: The preparation of the presentation contains the following materials: 1. Light Emitting Diode 2. Semiconductor for Laser Amplifier 3. Semiconductor injection Laser 4. Properties of semiconductors as photodetectors 5. Photodiode 6. Avalanche Photodiode	
8	Evaluasi Tengah Semester Mid Term Exam		15%
9	Mahasiswa mampu menjelaskan aplikasi dari semikonduktor dalam bidang optik dan fotonik <i>Students are able to explain the application of semiconductors in the field of optics and photonics</i>	Non-Test : Penyusunan presentasi dan makalah berisi materi : 1. Desain semikonduktor sebagai sensor dan detektor 2. Desain semikonduktor terkait dengan bidang riset Non-Test : Preparation of presentations and papers containing the following materials: 1. Design of semiconductors as sensors and detectors 2. Semiconductor design related to research field	7%
10	Mahasiswa mampu menjelaskan konsep dasar optika nonlinier <i>Students are able to explain the basic concepts of nonlinear optics.</i>	Non-Test : Penyusunan presentasi berisi materi : 1. Medium optik nonlinier 2. Optika nonlinier orde 2 3. Optika nonlinier orde 3 4. Teori cahaya dari <i>three wave mixing</i> 5. Teori cahaya dari <i>four wave mixing</i> 6. Medium nonlinier anisotropik 7. Medium nonlinier dispersive Non-Test :	7%

		<i>The preparation of the presentation contains the following materials:</i> 1. Nonlinear optical medium 2. 2 order nonlinear optics 3. 3 order nonlinear optics 4. Light theory of three wave mixing 5. Light theory of four wave mixing 6. Anisotropic nonlinear medium 7. Dispersive nonlinear medium	
11	Mahasiswa mampu menjelaskan konsep dan aplikasi dari kristal fotonik <i>Students are able to explain the concepts and applications of photonic crystals</i>	Non-Test : Penyusunan presentasi berisi materi : 1. Photonic Crystal Lattice 2. Aplikasi Photonic Crystal untuk pencitraan dan sensor Non-Test : <i>The preparation of the presentation contains the following materials:</i> 1. Photonic Crystal Lattice 2. Photonic Crystal applications for imaging and sensors	7%
12-13	Mahasiswa Mahasiswa mampu menjelaskan konsep dan aplikasi dari material plasmonic <i>Students Students are able to explain the concepts and applications of plasmonic materials</i>	Non-Test : Penyusunan presentasi berisi materi : 1. Surface Plasmon Resonance (SPR) 2. Aplikasi SPR untuk sensor Non-Test : <i>The preparation of the presentation contains the following materials:</i> 1. Surface Plasmon Resonance (SPR) 2. SPR application for sensors	7%
14	Mahasiswa mampu menjelaskan konsep dan aplikasi dari metamaterial <i>Students are able to explain the concepts and applications of metamaterials</i>	Non-Test : Penyusunan presentasi berisi materi : 1. Material dengan indeks bias negatif 2. Material dengan indeks bias nol 3. Aplikasi metamaterial untuk sensor Non-Test : <i>The preparation of the presentation contains the following materials:</i> 1. Materials with a negative refractive index 2. Materials with zero refractive index	7%

		<i>3. Application of metamaterials for sensors</i>	
15	Mahasiswa mampu merancang sensor untuk aplikasi pemantauan besaran fisis di industri atau lainnya <i>Students are able to design sensors for physical quantity monitoring applications in industry or others</i>	Non-Test : Penyusunan presentasi dan makalah berisi materi : 1. Konsep dasar material yang didesain <i>Non-Test : Preparation of presentations and papers containing the following materials: 1. The basic concept of the designed material</i>	7%
16	Evaluasi Akhir Semester (EAS) <i>Final Exam</i>		12%

TF185432 RPS RAE Perangkat Fotonik (*Photonic Devices*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS</i>		RP
	Perangkat Fotonik <i>Photonic Devices</i>		Edisi: Agt 2018
Kode (Code): TF185432	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: <i>Photonics Engineering</i>	Smt: 2/4 Semester: 2/4
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Agus M. Hatta, Ph.D	Koordinator RMK Field Coordinator Dr. Aulia MT Nasution	Ka PRODI Head of Master Program Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra-maupun multidisiplin ilmu. (30%)		

	<i>PLO-2 Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (20%) <i>PLO-5 Are able to effectively communicate in both oral and written format.</i> CP-6. Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (50%) <i>PLO-6. Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions.</i>
	CP-MK CPMK 1 Mahasiswa mampu menjelaskan prinsip-prinsip pemanduan cahaya (CP1) (20%) <i>CLO 1 Students are able to explain the principles of guiding light</i> CPMK 2 Mahasiswa mampu membuat tulisan kritis terkait dengan desain pemandu gelombang pada fiber optik (CP5, CP6) (30%) <i>CLO 2 Students are able to make critical writings related to design of waveguide on optical fiber</i> CPMK 3 Mahasiswa Mampu menganalisa prinsip pembangkitan cahaya khususnya pada teknologi perkembangan LED dan Lasers saat ini (CP5, CP6) (50%) <i>CLO 3 Students are able to analyze the principle of light generation, especially in the current development of LED and Laser technolog</i>
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini membahas pengetahuan dasar tentang optik, semikonduktor, dan gelombang elektromagnetik; Mata kuliah ini akan membahas perangkat fotonik secara komprehensif. khususnya serat optik dan laser. <i>This course discusses basic knowledge of optics, semiconductors, and electromagnetic waves; This course will discuss photonic devices comprehensively. particularly optical fiber and lasers.</i>
Pokok Bahasan / Bahan Kajian <i>Module content</i>	Dalam Matakuliah ini mahasiswa akan mempelajari pokok bahasan-pokok bahasan sebagai berikut: • Pengantar perangkat fotonik • Pemandu gelombang • Pemandu gelombang planar dan mode dalam fiber optik • Finite difference method and Beam propagation method • Integrated Optics • Perangkat aktif dan pembangkitan cahaya • Laser Semikonduktor dan LED

	<i>In this course, students will study the following topics:</i> • <i>Introduction to photonic devices</i> • <i>Waveguide</i> • <i>Planar waveguide and optical fiber mode</i> • <i>Finite difference method and Beam propagation method</i> • <i>Integrated Optics</i> • <i>Active devices and light generation</i> • <i>Semiconductor Lasers and LEDs</i> • <i>Photodetectors: quantization of electromagnetic waves</i>	
Pustaka <i>Reading Materials</i>	Utama:	
	1. Liu, JM., Photonics Devices. Cambridge. Cambridge University Press 2. Saleh, B. E. A., and M. C. Teich. Fundamentals of Photonics. New York, NY: Wiley, 1991. ISBN: 9780471839651. 3. Springer Handbook – Electronic and Photonic Materials, Springer	
	Pendukung :	
	1. B. A. Saleh, M. C. Teich, Fundamental of Photonics, Wiley-Interscience, 2013. 2. Jurnal terkait sensor fotonik: d. Photonics Sensors: http://www.springer.com/physics/optics+%26+lasers/journal/13320 e. Sensors and Actuators A: Physical http://www.sciencedirect.com/science/journal/09244247 f. Applied Optics : http://www.opticsinfobase.org/ao/	
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak :	Perangkat keras :
	OS:Windows; Office, Video demo	PC & LCD Projector
Tim Pengajar <i>Team Teaching</i>	Sekartedjo, Agus Muhamad Hatta	
Matakuliah syarat <i>Prerequisite courses</i>	Fisika Teknik Lanjut; <i>Advanced Engineering Physics</i>	

Mg Ke- (1)	Sub-Capaian Pembelajaran MK (2)	Indikator Penilaian (3)	Kriteria dan Bentuk Penilaian (4)	Metode / Strategi Pembelajaran (5)	Materi Pembelajaran (6)	Bobot (7)
1	Mahasiswa mampu memahami dasar-dasar	Ketepatan dalam menjelaskan dasar-dasar	-	SCL (Kuliah dan diskusi) [TM: 1x(2x50")] [BT: 1x(2x60")]	Pengantar perangkat fotonik <i>Introduction to photonics</i>	10% (CPMK1)

	dari perangkat fotonik <i>Students are able to explain and apply the concepts of optics and photonics</i>	dari perangkat fotonik <i>Appropriateness in explaining and applying optical and photonic concepts</i>		[BM: 1x(2x60'')]	<i>devices</i>	
2-3	Mahasiswa mampu menjelaskan prinsip kerja dari pemandu gelombang	Ketepatan menjelaskan prinsip kerja dari pemandu gelombang Ketepatan menjelaskan mode pemanduan gelombang pada fiber optik <i>Appropriateness in explaining the working principle of waveguide</i> <i>Appropriateness in describing the waveguide mode in optical fiber</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a short paper</i> TUGAS 1: Mahasiswa melakukan review tentang prinsip pemanduan gelombang EM <i>ASSIGNMENT 1: Students review the principle of electromagnetic waveguide</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Pemandu gelombang Pemandu gelombang planar dan mode dalam fiber optik <i>Wave guide</i> <i>Planar waveguide</i> <i>Mode in optical fiber</i>	
4-5	Mahasiswa mampu menjelaskan prinsip finite different methods (FDM) dan beam propagation methods (BPM) <i>Students are able to explain the principles of finite different methods (FDM) and beam</i>	Ketepatan menjelaskan prinsip finite different methods (FDM) dan beam propagation methods (BPM) <i>Appropriateness in explaining the principles of finite different methods (FDM) and beam</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a paper</i> TUGAS 2: Mahasiswa melakukan kajian komprehensif tentang FDM dan BPM <i>ASSIGNMENT 2:</i>	K SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Finite different methods (FDM) Beam propagation methods (BPM) <i>Finite different methods (FDM)</i> <i>Beam propagation methods (BPM)</i>	10% (CPMK2)

	<i>propagation methods (BPM)</i>	<i>propagation methods (BPM)</i>	<i>Students conduct a comprehensive study of FDM and BPM</i>			
6-7	Mahasiswa mampu menjelaskan building blocks pada integrated optics <i>Students are able to explain building blocks of integrated optics</i>	Ketepatan dalam menjelaskan building blocks pada integrated optics <i>Appropriateness in explaining the building blocks of integrated optics</i>	Non-test: Penulisan makalah singkat <i>Non-test: Writing a paper</i> TUGAS 3: Mahasiswa melakukan kajian komprehensif tentang building block pada integrated optics dan penyusunnya <i>ASSIGNMENT 3: Students conduct a comprehensive study of building blocks on integrated optics and their constituents</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	Building blocks of planar Integrated optics Straight waveguides Bends Tapers Directional Couplers Y-junctions Crossovers <i>Building blocks of planar Integrated optics Straight waveguides Bends Tapers Directional Couplers Y-junctions Crossovers</i>	10% (CPMK2)
	Evaluasi Tengah Semester (ETS)/ <i>Mid Term Examination</i>					10% (CPMK1) 10% (CPMK2)
9-10	Mahasiswa mampu menjelaskan prinsip kerja perangkat aktif dan proses pembangkitan cahaya <i>Students are able to explain the working principle of active devices</i>	Ketepatan dalam menjelaskan prinsip kerja perangkat aktif dan proses pembangkitan cahaya <i>Appropriateness explaining the working principle of active devices and the</i>	Non-test: Penulisan makalah Doing presentation <i>Non-test: Writing a paper Doing presentation</i> TUGAS 4:	SCL (Kuliah dan diskusi) [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	Perangkat Aktif Pembangkitan Cahaya <i>Active Devices Light Generation</i>	10% (CPMK3)

	<i>and the light generation process</i>	<i>process of generating light</i>	Mahasiswa melakukan review artikel ilmiah terkait dengan perangkat aktif dan proses pembangkitan cahaya <i>ASSIGNMENT 4:</i> <i>Students review some scientific articles related to active devices and light generation processes</i>			
11-15	Mahasiswa mampu menjelaskan ragam Laser Semikonduktor dan LED beserta prinsip kerjanya <i>Students are able to explain various Semiconductor Lasers and LEDs, and their working principles</i>	Mahasiswa mampu menjelaskan ragam Laser Semikonduktor dan LED <i>Appropriateness in explaining various Semiconductor Lasers and LEDs, and their working principles</i>	Non-test: Penulisan makalah Doing presentation <i>Non-test:</i> <i>Writing a paper</i> <i>Doing presentation</i> TUGAS 5: Mahasiswa melakukan review artikel ilmiah terkait dengan perangkat semikonduktor, LED, dan Lasers <i>ASSIGNMENT 5:</i> <i>Students review scientific articles related to semiconductor devices, LEDs, and Lasers</i>	SCL (Kuliah dan diskusi) [TM: 5x(2x50'')] [BT: 5x(2x60'')] [BM: 5x(2x60'')]	Dasar perangkat semikonduktor Teknologi semikonduktor LED Lasers <i>Basics of semiconductor devices</i> <i>Semiconductor technology</i> <i>LED</i> <i>Lasers</i>	20% (CPMK3)
16	Evaluasi Akhir Semester (EAS)/ <i>Final Term Examination</i>					20% (CPMK3)

Catatan : Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran

Notes: Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step

		RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS			RA&E
		Perangkat Fotonik Photonic Devices			Edisi: Agt 2018
Kode (Code): TF185432	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi Field of Specialization: Photonics Engineering			Smt: 2/4 Semester: 2/4
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Agus M. Hatta, Ph.D	Koordinator RMK Field Coordinator Dr. Aulia MT Nasution			Ka PRODI Head of Master Program Dr. Ridho Hantoro
Mg ke (1)	Sub Capaian Pembelajaran (2)	Bentuk Asesmen /Penilaian (3)	Bobot CPMK1 (4)	Bobot CPMK2 (5)	Bobot CPMK3 (6)
2-3	Mahasiswa mampu menjelaskan prinsip kerja dari pemandu gelombang	Non-test: Penulisan makalah singkat <i>Non-test:</i> <i>Writing a short paper</i> TUGAS 1: Mahasiswa melakukan review tentang prinsip pemanduan gelombang EM <i>ASSIGNMENT 1:</i> <i>Students review the principle of electromagnetic waveguide</i>	10%		
4-5	Mahasiswa mampu menjelaskan prinsip finite different methods (FDM) dan beam propagation methods (BPM)	Non-test: Penulisan makalah singkat <i>Non-test:</i>		10%	

	<i>Students are able to explain the principles of finite different methods (FDM) and beam propagation methods (BPM)</i>	<i>Writing a paper</i> TUGAS 2: Mahasiswa melakukan review artikel ilmiah Mahasiswa melakukan kajian komprehensif tentang FDM dan BPM. Mahasiswa membandingkan keduanya. Mahasiswa menulis tulisan kritis terkait keduanya. <i>ASSIGNMENT 2:</i> <i>Students review some scientific articles</i> <i>Students conduct a comprehensive study of FDM and BPM</i> <i>Students compare the both (FDM and BPM).</i> <i>Students write critical writings related to both.</i>			
6-7	Mahasiswa mampu menjelaskan building blocks pada integrated optics <i>Students are able to explain building blocks of integrated optics</i>	Non-test: Penulisan makalah singkat <i>Non-test:</i> <i>Writing a paper</i> TUGAS 3: Mahasiswa melakukan review artikel ilmiah Mahasiswa melakukan kajian komprehensif tentang building block pada integrated optics dan penyusunnya Mahasiswa dapat menjelaskan kegunaan dari setiap penyusun dari building block pada integrated optics. <i>ASSIGNMENT 3:</i> <i>Students review some scientific articles</i> <i>Students conduct a comprehensive study of building blocks on integrated optics and their constituents</i> <i>Students explain the use of each constituent of the building block in integrated optics.</i>		10%	
8	Evaluasi Tengah Semester / <i>Mid Term Examination</i>		10%	10%	

9-10	Mahasiswa mampu menjelaskan prinsip kerja perangkat aktif dan proses pembangkitan cahaya <i>Students are able to explain the working principle of active devices and the light generation process</i>	Non-test: Penulisan makalah Doing presentation <i>Non-test: Writing a paper Doing presentation</i> TUGAS 4: Mahasiswa melakukan review artikel ilmiah terkait dengan perangkat aktif dan proses pembangkitan cahaya <i>ASSIGNMENT 4: Students review some scientific articles related to active devices and light generation processes</i>			10%
11-15	Mahasiswa mampu menjelaskan ragam Laser Semikonduktor dan LED beserta prinsip kerjanya <i>Students are able to explain various Semiconductor Lasers and LEDs, and their working principles</i>	Non-test: Penulisan makalah Doing presentation <i>Non-test: Writing a paper Doing presentation</i> TUGAS 5: Mahasiswa melakukan review artikel ilmiah terkait dengan perangkat semikonduktor, LED, dan Lasers Mahasiswa mendeskripsikan perkembangan teknologi LED dan Laser <i>ASSIGNMENT 5: Students review scientific articles related to semiconductor devices, LEDs, and Lasers Students describe the development of LED and Laser technologies.</i>			20%
16	Evaluasi Akhir Semester / <i>Final Term Examination</i>				20%
Total			20%	30%	50%

Catatan : Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran

Notes: Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step

TF185433 RPS RAE Pengembangan Sistem Fotonik (Fotonic System Development)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Pengembangan Sistem Fotonik <i>Photonic System Development</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185433	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Agus M. Hatta, Ph.D	Koordinator RMK <i>Field Coordinator</i> Dr.rer.nat Aulia MTN	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (37,5%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis</i> CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format</i>	

	CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (37,5%) <i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations</i> CP-MK Course Learning Outcome (CLO) 1. Mampu menjelaskan prinsip kerja dan teknologi komponen-komponen utama dalam Sistem Fotonik. 2. Mampu menjelaskan ragam dan keterkinian Sistem Fotonik. 3. Mampu merancang Sistem Fotonik sederhana 4. Mampu mengevaluasi kinerja Sistem Fotonik 5. Mampu membuat karya tulis dan presentasi hasil dari rancangan dan evaluasi Sistem Fotonik <i>1. Able to explain the working principle and technology of the main components in the Photonic System.</i> <i>2. Be able to explain the variety and up-to-date of Photonic Systems.</i> <i>3. Able to design simple Photonic System</i> <i>4. Able to evaluate the performance of Photonic Systems</i> <i>5. Able to make written works and presentation of the results of the design and evaluation of the Photonic System.</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini berkaitan dengan pengembangan wawasan dan gagasan tentang Sistem Fotonik, baik dari aspek konsep maupun pemanfaatannya di berbagai bidang aplikasi. <i>This course is related to the development of insights and ideas about Photonic Systems, both in terms of concepts and their use in various fields of application.</i>
Pokok Bahasan / Bahan Kajian Module content	11. Tinjauan Sistem Fotonik 12. Ragam Sistem Fotonik 13. Keterkinian Sistem Fotonik 14. Perancangan Sistem Fotonik 15. Evaluasi kinerja Sistem Fotonik 16. Laporan dan presentasi perancangan Sistem Fotonik <i>1. Photonic System Overview</i>

	2. <i>Variety of Photonic Systems</i> 3. <i>Photonic System Update</i> 4. <i>Photonic System Design</i> 5. <i>Evaluate the performance of the Photonic System</i> 6. <i>Photonic System design reports and presentations</i>					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	1. R. Manzel, Photonics, Springer 2. Mool C. Gupta & John Ballato, The Handbook of Photonics,2nd ed., CRC Press 2007					
	Pendukung : <i>Supporting</i> - B. A. Saleh, M. C. Teich, Fundamental of Photonics, Wiley-Interscience, 2013. - Jurnal terkait pengembangan sistem fotonik: - Photonics Sensors: http://www.springer.com/physics/optics+%26+lasers/journal/13320 - Sensors and Actuators A: Physical http://www.sciencedirect.com/science/journal/09244247 - Applied Optics : http://www.opticsinfobase.org/ao/					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras : <i>Hardware</i>		
	OS:Windows; Office, Video demo, Matlab			PC & LCD Projector		
Team Teaching	Agus M. Hatta, Ph.D, Prof. Sekartedjo					
Matakuliah syarat	Fisika Teknik Lanjut					
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-2	Mahasiswa mampu menjelaskan konsep dasar komponen pembentuk sistem metrologi	Ketepatan menjelaskan tujuan, kerangka materi dan metoda evaluasi <i>Accuracy in explaining objectives, material framework and evaluation method</i>		Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50'	Pendahuluan : tinjauan posisi mata kuliah dalam kurikulum, kerangka materi dan metoda evaluasi. <i>Introduction: review of the position of courses in the curriculum, material framework and evaluation methods.</i>	10% (CPMK-1)

	<i>Students are able to explain the basic concepts of the components that make up a metrology system</i>			•BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'		
3-4	Mahasiswa mampu menghubungkan komponen menjadi suatu sistem metrologi yang tepat <i>Students are able to connect components into an appropriate metrological system</i>	Ketepatan menjelaskan prinsip kerja dan karakteristik sumber cahaya kohe-ren dan inkoheren <i>Exactly explains the working principle and characteristics of cohesive and incoherent light sources</i>		Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'	Tinjauan prinsip kerja dan karakteristik sumber cahaya koheren dan inkoheren <i>Overview of the working principle and characteristics of coherent and incoherent light sources</i>	5% (CPMK-1) 10% (CPMK-2)
5-7	Mahasiswa mampu memilih metrologi optik yang sesuai untuk menyelesaikan permasalahan <i>Students are able to choose the appropriate optical metrology to solve problems</i>	Ketepatan menjelaskan prinsip kerja dan karakteristik komponen optik <i>Accuracy explains the working principle and characteristics of optical components</i>	Evaluasi Tugas & Praktikum <i>Task Evaluation & Practicum</i>	Kuliah, Review paper journal dan diskusi •TM = 3 mg x 2 sks x 50' •BT = 3 mg x 2 sks x 60' •BM = 3 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 3 mg x 2 sks x 50' •BT = 3 mg x 2 sks x 60' •BM = 3 mg x 2 sks x 60'	Tinjauan prinsip kerja dan karakteristik komponen optik : pemantul, pembias, pemandu gelombang, sensor /detektor, attenuator, filter, penguat, modulator, polarisator, optika terpadu, dll. <i>Overview of the working principle and characteristics of optical components: reflectors, refractors, wave guides, sensors/detectors, attenuators, filters, amplifiers,</i>	15% (CPMK-2)

					<i>modulators, polarizers, integrated optics, etc.</i>	
8	Evaluasi Tengah Semester (ETS) Mid-Term Exam					5% (CPMK-1) 5% (CPMK-2)
9-11	Mahasiswa mampu mengevaluasi permasalahan untuk aplikasi industri, kedokteran, pertanian <i>Students are able to evaluate problems for industrial, medical, agricultural applications</i>	Ketepatan menjelaskan aplikasi sistem fotonik di berbagai bidang. <i>Accuracy describes the application of photonic systems in various fields.</i>	Evaluasi Tugas <i>Task Evaluation</i>	Kuliah, Review paper journal dan diskusi •TM = 3 mg x 2 sks x 50' •BT = 3 mg x 2 sks x 60' •BM = 3 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 3 mg x 2 sks x 50' •BT = 3 mg x 2 sks x 60' •BM = 3 mg x 2 sks x 60'	Tinjauan aplikasi sistem fotonik di bidang : pengukuran, pengendalian, proses, monitoring, penyaluran informasi dan pencitraan (display). <i>Review of photonic system applications in the fields of: measurement, control, process, monitoring, distribution of information and imaging (display).</i>	15 % (CPMK-3)
12-15	Mahasiswa mampu membuat desain sistem fotonik untuk aplikasi industri, kedokteran, pertanian <i>Students are able to design photonic systems for industrial, medical,</i>	Ketepatan menjelaskan konsep perancangan sistem fotonik <i>Accuracy in explaining the concept of photonic system design</i>	Evaluasi Tugas & praktikum <i>Task Evaluation & practicum</i>	Kuliah, Review paper journal dan diskusi •TM = 4 mg x 2 sks x 50' •BT = 4 mg x 2 sks x 60' •BM = 4 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 4 mg x 2 sks x 50' •BT = 4 mg x 2 sks x 60' •BM = 4 mg x 2 sks x 60'	Konsep perancangan sistem fotonik a. kriteria/requirements : input, proses, output. b. tahapan perancangan: parameterisasi, pemodelan, validasi <i>Photonic system design concept</i> a. criteria/requirements : input, process, output. b. design stages: parameterization, modeling, validation	15 % (CPMK-4)

	<i>agricultural applications</i>					
16	Evaluasi Akhir Semester <i>Final Exam</i>					10% (CPMK-3) 10% (CMPK-4)

Catatan :

- Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Pengembangan Sistem Fotonik Photonic System Development		RA&E
			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185433	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: <i>Instrumentation and Control Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Agus M. Hatta, Ph.D	Koordinator RMK Field Coordinator Dr.rer.nat Aulia MTN	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK3 (7)
1-2	Mahasiswa mampu menjelaskan konsep dasar komponen pembentuk sistem metrologi <i>Students are able to explain the basic concepts of the components that make up a metrology system</i>	Ketepatan menjelaskan tujuan, kerangka materi dan metoda evaluasi <i>Accuracy in explaining objectives, material framework and evaluation method</i>	10%			
3-4	Mahasiswa mampu menghubungkan komponen menjadi suatu sistem metrologi yang tepat <i>Students are able to connect components into an appropriate metrological system</i>	Ketepatan menjelaskan prinsip kerja dan karakteristik sumber cahaya kohe-ren dan inkoheren <i>Exactly explains the working principle and characteristics of cohesive and incoherent light sources</i>	5%	10%		

5-7	Mahasiswa mampu memilih metrologi optik yang sesuai untuk menyelesaikan permasalahan <i>Students are able to choose the appropriate optical metrology to solve problems</i>	Ketepatan menjelaskan prinsip kerja dan karakteristik komponen optik <i>Accuracy explains the working principle and characteristics of optical components</i>		15%		
8	Evaluasi Tengah Semester <i>Mid Term Exam</i>		5%	5%		
9-11	Mahasiswa mampu mengevaluasi permasalahan untuk aplikasi industri, kedokteran, pertanian <i>Students are able to evaluate problems for industrial, medical, agricultural applications</i>	Ketepatan menjelaskan aplikasi sistem fotonik di berbagai bidang. <i>Accuracy describes the application of photonic systems in various fields.</i>			15%	
12-15	Mahasiswa mampu membuat desain sistem fotonik untuk aplikasi industri, kedokteran, pertanian <i>Students are able to design photonic systems for industrial, medical, agricultural applications</i>	Ketepatan menjelaskan konsep perancangan sistem fotonik <i>Accuracy in explaining the concept of photonic system design</i>				15%
16	Evaluasi Akhir Semester (EAS) <i>Final Exam</i>				10%	10%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Komunikasi Data Optik <i>Optical Data Communication</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185434	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Instrumentasi dan Kontrol <i>Field of Specialization: Instrumentation and Control Engineering</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i> Agus M. Hatta, Ph.D	Koordinator RMK <i>Field Coordinator</i> Dr.rer.nat Aulia MTN	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Mampu mengaplikasikan pengetahuan matematika, fisika, dan rekayasa tingkat lanjut secara kritis untuk menyelesaikan permasalahan yang kompleks. (37,5%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis</i>	
	CP-MK	CP-5: Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format</i> CP-6.I: Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter (37,5%) <i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations</i>	

	Course Learning Outcome (CLO)	
	l. Mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik m. Mampu merancang komponen/sistem komunikasi data optik n. Mampu mengevaluasi kinerja komponen/sistem komunikasi data optik o. Mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan/analisa dari komponen/sistem komunikasi data optik <i>a. Able to explain and apply the concepts of optics and photonics in optical data communication</i> <i>b. Able to design optical data communication components/systems</i> <i>c. Able to evaluate the performance of optical data communication components/systems</i> <i>d. Able to make written reports and scientific presentations of the results of the design/analysis of optical data communication components/systems</i>	
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari tentang komunikasi data berdasarkan prinsip-prinsip optik. <i>This course studies data communication based on optical principles.</i>	
Pokok Bahasan / Bahan Kajian Module content	17. Review optika dan fotonika dalam sistem komunikasi data optik 18. Pengantar Sistem Komunikasi Optik 19. Perambatan Sinyal Optik 20. Pembangkitan Sinyal, Penguatan, dan Modulasi Optik 21. Deteksi Sinyal Optik 22. Perancangan Sistem Komunikasi Optik 23. Evaluasi Kinerja Komponen dan Sistem Komunikasi Optik <i>1. Review of optics and photonics in optical data communication systems</i> <i>2. Introduction to Optical Communication Systems</i> <i>3. Optical Signal Propagation</i> <i>4. Signal Generation, Gain, and Optical Modulation</i> <i>5. Optical Signal Detection</i> <i>6. Optical Communication System Design</i> <i>7. Performance Evaluation of Optical Communication Components and Systems</i>	
Pustaka Reading Materials	Utama: Main	
	1. G. P. Agrawal, "Fiber-Optic Communication Systems,," Fourth Edition, John Wiley&Sons, 2010. 2. G. Keiser, Optical Fiber Communications, Mc Graw Hill, 2000	
	Pendukung :	

		Supporting 1. E. Säckinger, Broadband Circuits for Optical Fiber Communication,” John Wiley & Sons, 2005. 2. A. K. Majumdar, J. C. Ricklin, “Free-Space Laser Communications-Principles and Advances,” Springer, 2008				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak: <i>Software</i>		Perangkat keras : <i>Hardware</i>		
		OS:Windows; Office, Video demo, Matlab		PC & LCD Projector		
Team Teaching		Agus M. Hatta, Ph.D, Dr.rer.nat Aulia MTN				
Matakuliah syarat						
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-2	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	Ketepatan menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam sistem komunikasi data optik <i>Accurately of explaining and applying various sensors.</i>	-	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50’ •BT = 2 mg x 2 sks x 60’ •BM = 2 mg x 2 sks x 60’ <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50’ •BT = 2 mg x 2 sks x 60’ •BM = 2 mg x 2 sks x 60’	Review optika dan fotonika dalam sistem komunikasi data optik <i>Review of optics and photonics in optical data communication systems</i>	
3	Mahasiswa mampu menjelaskan dan menerapkan	Ketepatan menjelaskan konsep sistem komunikasi optik	Non-Test Tugas 1: Mahasiswa mengerjakan tugas mereview jurnal	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50’ •BT = 1 mg x 2 sks x 60’	Pengantar Sistem Komunikasi Optik <i>Introduction to Optical Communication Systems</i>	10% (CPMK-1)

	konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	<i>Accurately of explaining the concept of optical communication system</i>	terkait konsep sistem komunikasi optik <i>Non-Test</i> <i>Task 1:</i> <i>Students work on the task of reviewing journals related to the concept of optical communication systems</i>	•BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'		
4	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	Ketepatan menjelaskan dan menerapkan perambatan sinyal optik dalam berbagai medium/struktur <i>Accurately explain and apply optical signal propagation in various mediums/structures</i>	Non-Test Tugas 2: Mahasiswa mengerjakan tugas mereview jurnal terkait konsep komunikasi data optik <i>Non-Test</i> <i>Task 2:</i> <i>Students work on the task of reviewing journals related to the concept of optical data communication</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	Perambatan Sinyal Optik <i>Optical Signal Propagation</i>	10% (CPMK-1)
5-6	Mahasiswa mampu menjelaskan dan menerapkan	Ketepatan menjelaskan pembangkitan sinyal, penguatan dan modulasi optik	Non-Test Tugas 3: Mahasiswa mengerjakan tugas mereview jurnal	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60'	Pembangkitan Sinyal, Penguatan, dan Modulasi Optik	10% (CPMK-1)

	konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	<i>Accurately describes signal generation, optical amplification and modulation</i>	terkait konsep modulasi optik <i>Non-Test Task 3: Students work on an assignment to review journals related to the concept of optical modulation</i>	•BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'	<i>Signal Generation, Gain, and Optical Modulation</i>	
7	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	Ketepatan dalam menjelaskan deteksi sinyal optik <i>Accurately in explaining optical signal detection</i>	Non-Test Tugas 4: Mahasiswa mengerjakan tugas mereview jurnal terkait konsep deteksi sinyal optik <i>Non-Test Task 4: Students work on an assignment to review journals related to the concept of optical signal detection</i>	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	Deteksi Sinyal Optik <i>Optical Signal Detection</i>	10% (CPMK-1)
8	Evaluasi Tengah Semester (ETS) <i>Mid-Term Exam</i>					15% (CPMK-1)

9-12	Mahasiswa mampu merancang komponen/sistem komunikasi data optik <i>Students are able to design optical data communication components/systems</i>	Kedalaman perancangan sistem komunikasi serat optik <i>Depth of fiber optic communication system design</i>	Non-Test Tugas 5: Mahasiswa merancang proyek terkait sistem komunikasi serat optik <i>Non-Test Task 5: Students design projects related to fiber optic communication systems</i>	Kuliah, Review paper journal dan diskusi •TM = 4 mg x 2 sks x 50' •BT = 4 mg x 2 sks x 60' •BM = 4 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 4 mg x 2 sks x 50' •BT = 4 mg x 2 sks x 60' •BM = 4 mg x 2 sks x 60'	Perancangan Sistem Komunikasi Optik <i>Optical Communication System Design</i>	10 % (CPMK-2)
13-14	Mahasiswa mampu mengevaluasi kinerja komponen/sistem komunikasi data optik <i>Students are able to evaluate the performance of optical data communication components/systems</i>	Ketepatan evaluasi kinerja komponen dan sistem komunikasi optik <i>Accuracy of performance evaluation of optical communication components and systems</i>	Non-Test Tugas 6: Mahasiswa melakukan analisa kinerja beberapa komponen dan sistem komunikasi optik berdasarkan literatur <i>Non-Test Task 6: Students analyze the performance of several components and optical communication systems based on literature</i>	Kuliah, Review paper journal dan diskusi •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 2 mg x 2 sks x 50' •BT = 2 mg x 2 sks x 60' •BM = 2 mg x 2 sks x 60'	Evaluasi Kinerja Komponen dan Sistem Komunikasi Optik <i>Performance Evaluation of Optical Communication Components and Systems</i>	10 % (CPMK-2) 10% (CPMK-3)
15	Mahasiswa mampu membuat laporan tertulis	Ketepatan laporan ilmiah dan kemahiran dalam presentasi ilmiah	Non-Test Tugas 6: Mahasiswa membuat presentasi dan laporan	Kuliah, Review paper journal dan diskusi •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60'	Laporan dan presentasi hasil rancangan/analisa komponen/sistem komunikasi data optik	20 % (CPMK-3)

	dan presentasi secara ilmiah hasil dari rancangan/analisa dari komponen/sistem komunikasi data optik <i>Students are able to make written reports and scientific presentations of the results of the design/analysis of optical data communication components/systems</i>	<i>Accuracy of scientific reports and proficiency in scientific presentations</i>	terkait sistem komunikasi serat optik <i>Non-Test Task 6: Students make presentations and reports related to fiber optic communication systems</i>	•BM = 1 mg x 2 sks x 60' <i>Lectures, review paper journals and discussions</i> •TM = 1 mg x 2 sks x 50' •BT = 1 mg x 2 sks x 60' •BM = 1 mg x 2 sks x 60'	<i>Reports and presentations on the design/analysis of components/optical data communication systems</i>	
16	Evaluasi Akhir Semester <i>Final Exam</i>					20% (CPMK-2: 10%; CMPK-3: 10%)

Catatan :

11. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			RA&E
	Komunikasi Data Optik Optical Data Communication			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185434	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Instrumentasi dan Kontrol Field of Specialization: <i>Instrumentation and Control Engineering</i>	Smt: 3 <i>Semester: 3</i>	
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Agus M. Hatta, Ph.D	Koordinator RMK Field Coordinator Dr.rer.nat Aulia MTN	Ka PRODI Head of Master Program Dr. Ridho Hantoro	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1-2	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication.</i>	TUGAS 1 ASSIGNMENT 1 Mahasiswa mengerjakan tugas mereview jurnal terkait konsep sistem komunikasi optik <i>Students work on the task of reviewing journals related to the concept of optical communication systems</i>	8%			

3-4	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	TUGAS 2 ASSIGNMENT 2 Mahasiswa mengerjakan tugas mereview jurnal terkait konsep komunikasi data optik <i>Students work on the task of reviewing journals related to the concept of optical data communication</i>	7%			
5-6	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	TUGAS 3 ASSIGNMENT 3 Mahasiswa mengerjakan tugas mereview jurnal terkait konsep modulasi optik <i>Students work on an assignment to review journals related to the concept of optical modulation</i>	7%			
7	Mahasiswa mampu menjelaskan dan menerapkan konsep-konsep optika dan fotonika dalam komunikasi data optik <i>Students are able to explain and apply the concepts of optics and photonics in optical data communication</i>	TUGAS 4 ASSIGNMENT 4 Mahasiswa mengerjakan tugas mereview jurnal terkait konsep deteksi sinyal optik <i>Students work on an assignment to review journals related to the concept of optical signal detection</i>	7%			
8	Evaluasi Tengah Semester Mid Term Exam		15%			
9-10	Mahasiswa mampu merancang komponen/sistem komunikasi data optik <i>Students are able to design optical data communication components/systems</i>	TUGAS 5 ASSIGNMENT 5 Mahasiswa merancang proyek terkait sistem komunikasi serat optik <i>Students design projects related to fiber optic communication systems</i>		10%		

11-14	Mahasiswa mampu mengevaluasi kinerja komponen/sistem komunikasi data optik <i>Students are able to evaluate the performance of optical data communication components/systems</i>	TUGAS 6 ASSIGNMENT 6 Mahasiswa melakukan analisa kinerja beberapa komponen dan sistem komunikasi optik berdasarkan literatur <i>Students analyze the performance of several components and optical communication systems based on literature</i>		10%	10%	
15	Mahasiswa mampu membuat laporan tertulis dan presentasi secara ilmiah hasil dari rancangan/analisa dari komponen/sistem komunikasi data optik <i>Students are able to make written reports and scientific presentations of the results of the design/analysis of optical data communication components/systems</i>	TUGAS 7 ASSIGNMENT 7 Mahasiswa membuat presentasi dan laporan terkait sistem komunikasi serat optik <i>Students make presentations and reports related to fiber optic communication systems</i>			20%	
16	Evaluasi Akhir Semester (EAS) Final Exam			10%	10%	

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	SISTEM KONTROL PROSES LANJUT <i>Advanced Process Control System</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185435	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Rekayasa Instrumentasi <i>Field of Specialization: Instrumentation Engineering</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Totok Ruki B., ST, MT, PhD	Koordinator RMK <i>Field Coordinator</i> Totok Ruki B., ST, MT, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37,5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i>	
	CP-5 Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (50%) <i>Graduates are able to effectively communicate in both oral and written format</i>	
	CP-6 Lulusan mampu secara mandiri mengembangkan metode inovatif, keterampilan dan alat yang diperlukan dalam merancang dan mengoptimalkan sistem instrumentasi dan kontrol di industri di bawah batasan operasional tertentu. (37,5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations.</i>		
	CP-MK <i>Course Learning Outcome (CLO)</i>		
	1. Mahasiswa mampu menganalisis dinamika proses serta merancang sistem control pada industri proses <i>Students are able to analyze process dynamics and design control systems in the process industry</i>		
Diskripsi Singkat MK <i>Course Description</i>	Kuliah ini membahas tentang sifat dinamika sebuah proses di industri dan teori serta penerapan sistem kontrol pada industri proses.. <i>This course discusses the dynamic nature of a process in industry and the theory and application of control systems in the process industry.</i>		
Pokok Bahasan / Bahan Kajian <i>Module content</i>	Model dinamika proses serta Kontrol Lanjut <i>Process dynamics models and advanced controls</i>		
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>		
	20. Piotr Tatjewski, Advanced control of industrial process: structures and algorithm 21. Bob Connel: Basic math for process control 22. Martin Polke, Proces control: sistem engineering 23. Michael J Grimble; Robust industrial control sistem: optimal design approach for polynomial sistem		
	Pendukung: <i>Supporting</i>		
	-		
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras: <i>Hardware</i>	
	-	PC & LCD Projector	
Tim Pengajar <i>Team Teaching</i>	Totok Ruki B., ST, MT, PhD		
Matakuliah syarat <i>Entry requirement</i>	1. Matematika Teknik Lanjut 2. Dinamika Sistem Lanjut 3. Instrumentasi Lanjut	Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>

Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessment point (%) (7)
1-2	Mahasiswa mampu menganalisis dinamika proses. <i>Students are able to analyze the dynamics of the process.</i>	Ketepatan dalam menjelaskan prinsip dasar dinamika proses. <i>Accuracy in explaining the basic principles of process dynamics.</i>	Tugas 1: • Makalah – opini tentang prinsip dasar dinamika proses. • Presentasi <i>Assignments 1:</i> • <i>Papers – opinions on the basic principles of process dynamics.</i> • <i>Presentation</i>	- Kuliah - Diskusi - E learning [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Dinamika Proses <i>Process Dynamics</i>	10% (CP-MK1)
3-4		Ketepatan dalam mengenali instrumentasi pada dinamika proses. <i>Accuracy in recognizing instrumentation in process dynamics.</i>	Tugas 2: • Makalah – kajian tentang instrumentasi pada dinamika proses. • Presentasi makalah <i>Assignments 2:</i> • <i>Papers – studies on instrumentation on process dynamics.</i> • <i>Paper presentation</i>	- Kuliah - Diskusi - E learning [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]		10% (CP-MK1)
5-7		Ketepatan dalam merancang dan mensimulasikan dinamika proses beserta instrumennya	Tugas 3: • Makalah – merancang dan	- Kuliah - Diskusi - E learning		10% (CP-MK1)

		<i>Accuracy in designing and simulating process dynamics and their instruments</i>	mensimulasikan dinamika proses beserta instrumennya. • Presentasi makalah <i>Assignments 3:</i> • <i>Papers – design and simulate process dynamics and their instruments.</i> • <i>Paper presentation</i>	[TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]		
8	Evaluasi Tengah Semester (ETS) Mid-Term Exam					20% (CP-MK1)
9-10	Mahasiswa mampu merancang sistem control pada industri proses. <i>Students are able to design control systems in the process industry.</i>	Ketepatan dalam menjelaskan prinsip dasar industri proses <i>Accuracy in explaining the basic principles of the process industry</i>	Tugas 4: • Makalah – tentang prinsip dasar industri proses. • Presentasi makalah <i>Assignments 4:</i> • <i>Papers – on the basic principles of the process industry.</i> • <i>Paper presentation</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Sistem Kontrol pada Industri Proses <i>Control Systems in Process Industries</i>	10% (CP-MK1)
11-12		Ketepatan dalam menganalisis instrumentasi pada industri proses <i>Accuracy in analyzing instrumentation in the process industry</i>	Tugas 5: • Makalah– tentang menganalisis instrumentasi pada industri proses. • Presentasi makalah <i>Assignments 5:</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]		10% (CP-MK1)

			• <i>Papers – on analyzing instrumentation in the process industry.</i> • <i>Paper presentation</i>			
13-15		Kepakaran dalam merancang instrumentasi dan control system untuk industri proses. <i>Expertise in designing instrumentation and control systems for the process industry</i>	Tugas 6: • Makalah – tentang instrumentasi dan control system untuk industry proses. • Presentasi <i>Assignments:</i> • <i>Papers – on instrumentation and control systems for the process industry.</i> • <i>Presentation</i>	Kuliah, diskusi, review jurnal [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]		10% (CP-MK1)
16	Evaluasi Akhir Semester <i>Final Exam</i>					20% (CP-MK1)

Catatan :

Note

9. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS		RA&E
	SISTEM KONTROL PROSES LANJUT Advanced Process Control System		Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185435	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization:</i> <i>Energy Engineering and Environmental Conditioning</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i> Totok Ruki B., ST, MT, PhD	Koordinator RMK <i>Field Coordinator</i> Totok Ruki B., ST, MT, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)
1-2	Mahasiswa mampu menganalisis dinamika proses. <i>Students are able to analyze the dynamics of the process.</i>	Tugas 1: • Makalah – opini tentang prinsip dasar dinamika proses. • Presentasi <i>Assignments 1:</i> • <i>Papers – opinions on the basic principles of process dynamics.</i> • <i>Presentation</i>	10%

3-4		Tugas 2: • Makalah – kajian tentang instrumentasi pada dinamika proses. • Presentasi makalah <i>Assignments 2:</i> • <i>Papers – studies on instrumentation on process dynamics.</i> • <i>Paper presentation</i>	10%
5-7		Tugas 3: • Makalah – merancang dan mensimulasikan dinamika proses beserta instrumennya. • Presentasi makalah <i>Assignments 3:</i> • <i>Papers – design and simulate process dynamics and their instruments.</i> • <i>Paper presentation</i>	10%
8	Evaluasi Tengah Semester (ETS) Mid-Term Exam		20%
9-10	Mahasiswa mampu merancang sistem control pada industri proses. <i>Students are able to design control systems in the process industry.</i>	Tugas 4: • Makalah – tentang prinsip dasar industri proses. • Presentasi makalah <i>Assignments 4:</i> • <i>Papers – on the basic principles of the process industry.</i> - • <i>Paper presentation</i>	10%
11-12		Tugas 5: • Makalah– tentang menganalisis instrumentasi pada industri proses. • Presentasi makalah <i>Assignments 5:</i>	10%

		• <i>Papers – on analyzing instrumentation in the process industry.</i> • <i>Paper presentation</i>	
13-15		Tugas 6: • Makalah – tentang instrumentasi dan control system untuk industry proses. • Presentasi <i>Assignments:</i> • <i>Papers – on instrumentation and control systems for the process industry.</i> • <i>Presentation</i>	10%
16	Evaluasi Akhir Semester <i>Final Exam</i>		20%
Total Bobot Penilaian (%) <i>Total Point</i> (%)			100%

Elective Courses (*Energy Engineering and Environmental Conditioning*)

TF185150 RPS RAE Mekanika Fluida (*Fluid Mechanics*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI SARJANA TEKNIK FISIKA FTI ITS <i>BACHELOR PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Mekanika Fluida <i>Fluid Mechanics</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185150	Bobot sks (T/P): (3/0) <i>Credits (T/P): (3/0)</i>	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Gunawan Nugroho, PhD	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-1: Mampu menerapkan pengetahuan matematika, fisika, dan rekayasa. <i>Able to apply knowledge of mathematics, physics, and engineering</i> CP-4: Mampu mengidentifikasi, memformulasi, dan menyelesaikan masalah rekayasa di bidang teknik fisika <i>Able to identify, formulate, and solve engineering problems in engineering physics.</i>	
	CP-MK <i>Course Learning Outcome (CLO)</i>	a. Mahasiswa mampu menjelaskan konsep dasar mekanika fluida serta jenis-jenis aliran (20%) <i>Students are able to explain the basic concepts of fluid mechanics and the types of flow</i> b. Mahasiswa mampu menyajikan perhitungan mekanika fluida serta menerapkannya dalam kasus atau permasalahan mekanika fluida (30%) <i>Students are able to present fluid mechanics calculations and apply them in fluid mechanics cases or problems</i>	

	c. Mahasiswa mampu menyelesaikan permasalahan mekanika fluida untuk masing-masing jenis aliran (aliran internal dan aliran eksternal), baik dengan kinerja individu maupun secara berkelompok dalam kerjasama tim (40%) <i>Students are able to solve fluid mechanics problems for each type of flow (internal flow and external flow), both with individual performance and in groups in teamwork</i> d. Mahasiswa dapat menyelesaikan permasalahan mesin-mesin fluid melalui penerapan konsep mekanika fluida yang tepat. (10%) <i>Students can solve the problems of fluid machines through the application of proper fluid mechanics concepts.</i>
Diskripsi Singkat MK <i>Course Description</i>	Matakuliah ini termasuk rumpun matakuliah energi di Departemen Teknik Fisika FIT-ITS. Matakuliah ini membahas tentang konsep dan kategori aliran. Termasuk didalamnya perhitungan untuk jenis-jenis aliran dalam pipa, eksternal dan kanal terbuka untuk menjelaskan dan menghitung keperluan aplikasi. <i>This course belongs to the energy course group at the Department of Engineering Physics FIT-ITS. This course discusses the concepts and categories of flow. It includes calculations for types of flow in pipes, externals and open channels to define and calculate application requirements.</i>
Pokok Bahasan / Bahan Kajian <i>Module content</i>	1. Konsep dan Kategori Aliran Fluida: Aliran incompressible, aliran compressible, aliran subsonik, transonik dan supersonik, aliran internal dan eksternal, aliran laminar dan turbulen. <i>Fluid Flow Concepts and Categories: Incompressible flow, compressible flow, subsonic, transonic and supersonic flow, internal and external flow, laminar and turbulent flow</i> 2. Formulasi volume kontrol: Volume kontrol massa, momentum, momen of momentum, energi dan entropi, penerapan teorema divergen dalam pembentukan volume control diferensial. <i>Formulation of control volume: Volume control of mass, momentum, moment of momentum, energy and entropy, application of the divergent theorem in the formation of differential control volume</i> 3. Formulasi diferensial: Uraian gaya potensial dan gesek dari elemen fluida diferensial, prinsip aturan rantai untuk persamaan Euler dan Navier-Stokes yang umum, penurunan prinsip Bernoulli untuk aliran steady dan non viscous, aliran irrotational (optional). <i>Differential formulation: Description of the potential and frictional forces of differential fluid elements, the principle of the chain rule for the general Euler and Navier-Stokes equations, the derivation of Bernoulli's principle for steady and non-viscous flow, irrotational flow (optional).</i> 4. Aliran internal: Aliran laminar diantara dua plat infinite, aliran laminar dalam pipa; penerapan prinsip Bernoulli untuk aliran viscous dan rugi momentum untuk aliran laminar dan turbulen, teorema Buckingham pi (optional). <i>Internal flow: Laminar flow between two infinite plates, laminar flow in a pipe; application of Bernoulli's principle for viscous flow and momentum loss for laminar and turbulent flow, Buckingham's theorem pi (optional).</i> 5. Aliran eksternal: Prinsip terjadinya boundary layer dan konsekuensinya, persamaan boundary layer (penyelesaian Prandtl dan Blasius), korelasi eksperimental boundary layer untuk aliran turbulen, pembentukan gaya drag dan lift untuk aliran melalui benda, kanal terbuka <i>External flow: Principle of boundary layer formation and its consequences, boundary layer equations (Prandtl and Blasius solutions), experimental correlation of boundary layers for turbulent flow, formation of drag and lift forces for flow through bodies, open channels</i> 6. Mesin-mesin fluida: persamaan umum dari volume kontrol momen of momentum, formulasi kinerja: pompa, kompresor dan turbin, analisis performansi mesin fluida dalam berbagai beban. <i>Turbo machinery: general equations of volume control moment of momentum, performance formulations: pumps, compressors and turbines, performance analysis of fluid engines under various loads. Introduction to smart grids in energy distribution</i>

Pustaka <i>Reading Materials</i>		Utama: <i>Main</i>				
		1. Fox, R.W, "Introduction to Fluid Mechanics", John Wiley & Son, 1994 2. Munson, "Fundamental of Fluid Mechanics" 3. Yunus Cengel," Fluid Mechanics: Fundamental & Application" 4. Frank M White, Introduction of Fluid Mechanics"				
		Pendukung : <i>Supporting</i> Wylie, B., "Fluid Mechanics", Mc Graw-Hill, 1990				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak : <i>Software</i>			Perangkat keras : <i>Hardware</i>	
		Power Point, Supporting Software			LCD. LAPTOP. PC	
Tim Pengajar <i>Team Teaching</i>		Gunawan Nugroho, Ridho Hantoro, Roekmono, Harsono Hadi, Samsul Arifin, Erna Septyaningrum, Nur Laila Hamidah				
Matakuliah syarat <i>Entry requirement</i>		Fisika Rekayasa I, Termodinamika <i>Engineering Physics I, Thermodynamics</i>				
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1	Mahasiswa mampu menjelaskan scope dan definisi mekanika fluida serta memberi contoh kasus mekanika fluida [CP-1] <i>Students are able to explain the scope and</i>	- Ketepatan mengidentifikasi sifat utama dari fluida dan menggunakannya dalam analisa perilaku fluida - Ketepatan dalam menjelaskan kompresibilitas fluida - Menggunakan konsep viskositas, tekanan vapor dan tegangan permukaan	- Jumlah sifat fluida yang mampu di jelaskan dan disebutkan, serta ketepatan dalam menganalisa perilaku fluida tersebut - Keterampilan dalam menyelesaikan soal-soal terkait dengan kompresibilitas fluida - Keterampilan dalam menyelesaikan soal mengenai konsep viskositas, tekanan	Diskusi kelompok; kuliah & Brainstorming [TM] : 1 x (3x50') [BT] : 1 x(3x50') [BM] : 1 x (3x60')] Tugas-1: 1. Mengerjakan soal-soal dari buku text sesuai dengan indikator penilaian 2. Membuat deskripsi satu contoh-contoh	1. Karakteristik flida 2. Analisa siffta fluida 3. Viskositas 4. Kompresibilitas fluida 5. Tekanan vapor 6. Tegangan permukaan 7. Contoh kasus penerapan mekanika fluida <i>1. Characteristics of fluid</i> <i>2. Analysis of fluid properties</i> <i>3. Viscosity</i> <i>4. Fluid compressibility</i>	5%

	<i>definition of fluid mechanics and give examples of fluid mechanics cases [CP-1]</i>	• Ketepatan dalam memberikan contoh kasus mekanika fluida • <i>Accuracy in identifying the main properties of fluids and using them in fluid behavior analysis</i> • <i>Accuracy in explaining the compressibility of fluids</i> • <i>Using the concepts of viscosity, vapor pressure and surface tension</i> • <i>Accuracy in providing examples of fluid mechanics cases</i>	vapor dan tegangan permukaan • Kasus mekanika fluida yang upto date serta referensi yang digunakan • <i>The number of fluid properties that can be described and mentioned, as well as the accuracy in analyzing the behavior of the fluid</i> • <i>Skills in solving problems related to fluid compressibility</i> • <i>Skills in solving problems regarding the concepts of viscosity, vapor pressure and surface tension</i> • <i>Up-to-date cases of fluid mechanics and references used</i>	penerapan mekanika fluida <i>Group discussion; lectures & Brainstorming [TM] : 1 x (3x50')</i> <i>[BT] : 1 x(3x50')</i> <i>[BM] : 1 x (3x60')]</i> Task 1: 1. <i>Doing questions from the textbook in accordance with the assessment indicators</i> 2. <i>Describe one example of the application of fluid mechanics</i>	5. <i>Vapor pressure</i> 6. <i>Surface tension</i> 7. <i>Examples of the application of fluid mechanics</i>	
2, 3	Mahasiswa mampu menyajikan formulasi fluida statik [CP-1] <i>Students are able to present</i>	• Ketepatan dalam menentukan tekanan pada beberapa lokasi pada fluida yang diam • Ketepatan dalam menjelaskan konsep manometer dan	• Tahapan dalam menentukan tekanan hidrostatik serta akurasi perhitungan yang dihasilkan • Tahapan dalam menentukan tekanan	1. Diskusi analisis hukum newton untuk aliran fluida 2. Kuliah dan Brainstorming [TM] : 2 x (3x50') [BT] : 2 x (3x50')	1. Persamaan dasar fluida statis 2. Variasi tekanan pada fluida statik 3. Sistem hidrolik 4. Gaya Hidrostatik 5. Gaya angkat dan kestabilan	10%

	<i>static fluid formulations</i> [CP-1]	mengaplikasikan persamaan yang sesuai untuk menentukan tekanan • Ketepatan dalam menghitung gaya tekan hidrodinamik pada bidang datar dan bidang lengkung yang terendam • Ketepatan dalam menghitung gaya apung dan mendiskusikan kestabilan benda • <i>Accuracy in determining pressure at several locations in a fluid at rest</i> • <i>Accuracy in explaining the concept of the manometer and applying the appropriate equations to determine pressure</i> • <i>Accuracy in calculating the hydrodynamic compressive force in</i>	dengan konsep manometer • Tahapan dalam menentukan gaya tekan hidrostatik serta akurasi hasil perhitungan yang dilakukan • Kesesuaian parameter dan konsep yang digunakan dalam menentukan kestabilan benda terapung atau tenggelam • <i>Stages in determining the hydrostatic pressure and the accuracy of the resulting calculations</i> • <i>Stages in determining pressure with the concept of a manometer</i> • <i>The stages in determining the hydrostatic compressive force and the accuracy of the calculations carried out</i> • <i>The suitability of parameters and concepts used in</i>	[BM : 2 x(3x60')] Tugas-2: • Mengerjakan soal dikelas secara mandiri dari buku text utama sesuai dengan indikator penilaian yang dibebankan • Mencari referensi mengenai bentuk-bentuk bangunan apung atau yang tenggelam, kemudian menganalisa berdasarkan teori kestabilan Quiz 1.a: Soal mengenai perhitungan perhitungan gaya tekan hidrostatik 1. <i>Discussion of Newton's law of analysis for fluid flow</i> 2. <i>Lectures and Brainstorming</i> [TM] : 2 x (3x50')	1. <i>The basic equation of static fluid</i> 2. <i>Pressure variation in static fluid</i> 3. <i>Hydraulic system</i> 4. <i>Hydrostatic Force</i> 5. <i>Lifting force and stability</i>	
--	--	--	--	---	--	--

		<i>the submerged plane and curved plane</i> • <i>Accuracy in calculating buoyancy and discussing the stability of objects</i>	<i>determining the stability of floating or sinking objects</i>	[BT] : 2 x (3x50') [BM] : 2 x (3x60') <i>Task-2:</i> • <i>Doing class questions independently from the main text-book in accordance with the assigned assessment indicators</i> • <i>Looking for references regarding the forms of floating or sinking buildings, then analyzing based on the theory of stability</i> <i>Quiz 1.a:</i> <i>Problems regarding the calculation of the hydrostatic compressive force</i>		
4, 5	Mahasiswa mampu memahami dan menjelaskan dinamika fluida dalam formulasi kontrol volume integral [CP-4]	• Ketepatan dalam mengaplikasikan dan menjelaskan hukum dasar • Mampu menggunakan hukum konservasi massa dan konservasi momentum untuk	• Menguasai perhitungan dan penggunaan volume integral dalam dinamika fluida • Menyelesaikan permasalahan dinamika fluida dengan kontrol volume integral	1. Diskusi penjabaran formulasi integral dalam konservasi momentum dan massa 2. Kuliah dan Brainstorming [TM: 2 x (3x50')	1. Hukum dasar tentang sistem 2. Formulasi kontrol volume 3. Konservasi massa 4. Konservasi momentum (linier momentum dan angular momentum)	10%

	<i>Students are able to understand and explain fluid dynamics in integral volume control formulation [CP-4]</i>	aplikasi dinamika fluida • Mampu menggunakan hukum pertama dan kedua termodinamika untuk aplikasi dinamika fluida • <i>Accuracy in applying and explaining the basic law</i> • <i>Be able to use the law of conservation of mass and conservation of momentum for fluid dynamics applications</i> • <i>Be able to use the first and second laws of thermodynamics for fluid dynamics applications</i>	• <i>Mastering the calculation and use of integral volumes in fluid dynamics</i> • <i>Solve fluid dynamics problems with integral volume control</i>	[BT]: 2 x (3x50') [BM]: 2 x (3x60") Tugas-3: Diskusi mengenai penurunan persamaan konservasi massa dan momentum dalam formulasi integral Tugas-4: • Mengerjakan soal penyelesaian kasus dinamika fluida dengan menggunakan konsep konservasi massa dan momentum • Mengerjakan soal penyelesaian kasus dinamika fluida dengan menggunakan hukum pertama dan kedua termodinamika Quiz 1.b: Soal mengenai penggunaan hukum	5. Hukum pertama dan kedua termodinamika dalam formulasi dinamika fluida 6. Asas pembentukan kontrol volume differential (pengayaan) 1. <i>The basic law of the system</i> 2. <i>Volume control formulation</i> 3. <i>Mass conservation</i> 4. <i>Conservation of momentum (linear momentum and angular momentum)</i> 5. <i>The first and second laws of thermodynamics in the formulation of fluid dynamics</i> 6. <i>The principle of forming differential volume control (enrichment)</i>	
--	--	---	---	---	---	--

				konservasi massa dan momentum dalam formulasi kontrol volume integral 1. <i>Discussion on the elaboration of integral formulations in the conservation of momentum and mass</i> 2. <i>Lectures and Brainstorming</i> <i>[TM: 2 x (3x50') [BT]: 2 x (3x50') [BM]: 2 x (3x60")</i> <i>Task-3: Discussion about the derivation of mass and momentum conservation equations in integral formulation</i> <i>Task-4:</i> 1. <i>Work on solving fluid dynamics cases using the concepts of mass and momentum conservation</i>		
--	--	--	--	---	--	--

				2. <i>Work on solving fluid dynamics cases using the first and second laws of thermodynamics</i> <i>Quiz 1.b: Problems regarding the use of the laws of conservation of mass and momentum in the formulation of integral volume control</i>		
6-7	Mahasiswa mampu menjelaskan dinamika fluida dengan volume kontrol diferensial [CP-4] <i>Students are able to explain fluid dynamics with differential control volume [CP-4]</i>	- Ketepatan dalam menjelaskan elemen kinematik dari suatu aliran - Ketepatan dalam menjelaskan kondisi medan kecepatan yang dibutuhkan untuk memenuhi persamaan kontinuitas - Kemampuan analisa dengan menggunakan persamaan Navier Stokes	- Menjelaskan elemen kinematik aliran serta kondisi-kondisinya dengan tepat - Menggunakan matematika/kalkulus dalam merumuskan gerak fluida dalam kontrol volume diferensial dalam bentuk persamaan Euler dan Navier-Stokes - Menyelesaikan permasalahan dinamika fluida dengan kontrol volume diferensial	1. Diskusi di kelas 2. Brainstorming dan kuliah [TM]: 2 x (3x50') [BT]: 2 x (3x50') [BM]: 2 x (3x60') Tugas -5(kelompok): Diskusi kelompok mengenai: - dasar-dasar persamaan CFD - aplikasi CFD Quiz 1.c: mengerjakan soal perhitungan tentang	1. Asas-asas pembentukan volume kontrol diferensial dan kaidah aturan rantai 2. Formulasi persamaan umum konservasi massa (kontinuitas) 3. Formulasi persamaan umum konservasi momentum dalam bentuk persamaan Euler dan Navier-Stokes 4. Pengenalan CFD <i>1. Principles of differential control volume formation and chain rule rules</i> <i>2. Formulation of the general equation for conservation of mass (continuity)</i>	10%

		• Accuracy in explaining the kinematic elements of a flow • Accuracy in describing the velocity field conditions required to satisfy the continuity equation • Ability to analyze using the Navier Stokes equation	• Describe the kinematic elements of flow and their conditions accurately • Using mathematics/calculus in formulating fluid motion in differential volume control in the form of Euler and Navier-Stokes equations • Solve fluid dynamics problems with differential volume control	penerapan formulasi diferensial baik persamaan Euler maupun Navier-Stokes 1. Discussion in class 2. Brainstorming and lecture [TM]: 2 x (3x50') [BT]: 2 x (3x50') [BM]: 2 x (3x60') Task -5(group): Group discussion on: a. the basics of the CFD equation b. CFD app Quiz 1.c: working on calculation problems regarding the application of differential formulations both Euler and Navier-Stokes . equations	3. Formulation of the general equation for the conservation of momentum in the form of the Euler and Navier-Stokes . equations 4. Introduction to CFD	
8	Evaluasi Tengah Semester – Review Aktifitas Minggu ke 1 sd Minggu ke 7 dan evaluasi hasil luaran Mid Term Exam – Review of Week 1 to Week 7 activities and evaluate the results					15%
9-10	Mahasiswa mampu menjelaskan	• Ketepatan dalam mengidentifikasi dan memahami	• Menjabarkan dan memformulasikan profil aliran internal	• Diskusi di kelas • Brainstorming dan kuliah	1. Pengenalan aliran internal 2. Fully developed laminar flow	10%

	fenomena aliran internal [CP-1] <i>Students are able to explain the phenomenon of internal flow [CP-1]</i>	karakteristik aliran internal • Ketepatan dalam mengidentifikasi dan memahami karakteristik aliran laminar dan turbulen di dalam pipa • <i>Accuracy in identifying and understanding internal flow characteristics</i> • <i>Accuracy in identifying and understanding the characteristics of laminar and turbulent flow in pipes</i>	dalam koordinat kartesian dan silinder • Menjabarkan dan memformulasikan aliran laminar dan turbulen dalam pipa • Kasus aliran internal yang up to date dan kesesuaian serta kualitas referensi yang digunakan • <i>Describe and formulate the internal flow profile in Cartesian and cylindrical coordinates</i> • <i>Describe and formulate laminar and turbulent flow in pipes</i> • <i>Up to date internal flow cases and the suitability and quality of the references used</i>	[TM: 2 x (3x50')] [BT]: 2 x (3x50')] [BM]: 2 x (3x60')] Tugas 6(kelompok): Tugas kelompok membuat makalah studi kasus aliran internal dalam kasus <i>duct</i> dan pipa, serta melakukan analisa profil aliran dalam kasus tersebut Quiz 2.a: 1. mengerjakan soal mengenai formulasi aliran laminar dan turbulen • <i>Discussion in class</i> • <i>Brainstorming and lecture</i> [TM: 2 x (3x50')] [BT]: 2 x (3x50')] [BM]: 2 x (3x60')] <i>Task 6(group):</i> <i>The group task is to write a case study paper on internal flow in the case of ducts and pipes, and</i>	3. Shear stress distribution 4. Turbulence velocity profile pada pipa 1. <i>Introduction of internal flow</i> 2. <i>Fully developed laminar flow</i> 3. <i>Shear stress distribution</i> 4. <i>Turbulence velocity profile on pipe</i>	
--	---	--	--	---	---	--

				<i>analyze the flow profile in these cases</i> <i>Quiz 2.a: Work on problems regarding the formulation of laminar and turbulent flow</i>		
11-12	Mahasiswa mampu memahami dan menjelaskan kerugian tekanan pada kasus aliran internal [CP-4] <i>Students are able to understand and explain pressure losses in the case of internal flow [CP-4]</i>	• Ketepatan menjabarkan konsep kehilangan momentum dalam persamaan Bernoulli • Ketepatan dalam menghitung koefisien gesek untuk berbagai geometri dan sambungan • <i>Accurately describe the concept of loss of momentum in the Bernoulli equation</i> • <i>Accuracy in calculating the coefficient of friction for various geometries and joints</i>	• Kesesuaian hasil analisa kasus menggunakan prinsip Bernoulli sebagai asas umum dalam menyelesaikan permasalahan mekanika fluida • Mampu menggunakan moody diagram menentukan koefisien losses untuk berbagai jenis pipa • Mampu menghitung besarnya losses yang diakibatkan oleh aksesoris pipa • <i>The suitability of the results of case analysis using Bernoulli's principle as a general principle in solving fluid mechanics problems</i>	Kuliah & Brainstorming [TM]: 2 x (3x50') [BT:(2)x(3x50'') BM:(2)x(3x60'')] Tugas-7: 1. Menghitung kehilangan momentum dengan persamaan Bernoulli 2. Menghitung loss pada pipa dengan menggunakan Moody diagram serta menghitung losses aksesoris lain Quiz 2.b: 1. Menghitung total losses pada sistem perpipaan	1. Konsep kehilangan momentum dalam persamaan Bernoulli 2. Diagram moody dan korelasi-korelasi yang umum dipakai 3. Prosedur perhitungan pasangan variabel-variabel yang belum diketahui dalam menentukan kehilangan momentum aliran internal 4. Perhitungan losses pada aksesoris sistem perpipaan <i>1. The concept of loss of momentum in the Bernoulli equation</i> <i>2. Moody diagrams and commonly used correlations</i> <i>3. The procedure for calculating pairs of unknown variables in</i>	10%

			• Able to use moody diagrams to determine the coefficient of losses for various types of pipes • Able to calculate the amount of losses caused by pipe accessories	Lectures & Brainstorming [TM]: 2 x (3x50') [BT]:(2)x(3x50") [BM]:(2)x(3x60")] Task-7: 1. Calculating the loss of momentum with the Bernoulli equation 2. Calculating pipe losses using Moody diagrams and calculating losses for other accessories Quiz 2.b: Calculating the total losses in the piping system	determining the internal flow momentum loss 4. Calculation of losses in piping system accessories	
13	Mahasiswa mampu memahami dan menjelaskan fenomena syarat dan fenomena aliran eksternal [CP-4] <i>Students are able to understand and explain conditional phenomena and</i>	• Ketepatan dalam mengidentifikasi keistimewaan dari aliran eksternal • Ketepatan dalam menjelaskan karakteristik dasar dari boundary layer, termasuk aliran laminar, transitional dan turbulen • Ketepatan dalam menghitung parameter boundary layer	• Memformulasikan konsep tentang <i>boundary layer</i> dalam volume kontrol integral dan diferensial • Mengaplikasikan konsep boundary layer dalam penyelesaian permasalahan aliran eksternal • Kualitas kasus dipilih (up to date) dan kesesuaian serta kualitas referensi yang digunakan	1. Diskusi di kelas 2. Kuliah dan brainstorming [TM]: 1 x (3x50') [BT]: 1 x (3x50') [BM]: 1 x (3x60') Tugas 8(kelompok): 1. Tugas kelompok menggunakan konsep boundary layer dalam menganalisa kasus mekanika fluida Quiz 2.c:	1. Konsep boundary layer 2. <i>displacement thickness</i> 3. <i>momentum thickness</i> 4. penyelesaian Blasius dalam <i>boundary layer flow</i> 1. <i>The concept of boundary layer</i> 2. <i>displacement thickness</i> 3. <i>momentum thickness</i> 4. <i>Blasius solution in boundary layer flow</i>	5%

	<i>external flow phenomena [CP-4]</i>	• <i>Accuracy in identifying the features of external flows</i> • <i>Accuracy in explaining the basic characteristics of the boundary layer, including laminar, transitional and turbulent flow</i> • <i>Accuracy in calculating boundary layer parameters</i>	• <i>Formulate the concept of boundary layer in integral and differential control volume</i> • <i>Applying the boundary layer concept in solving external flow problems</i> • <i>The quality of the selected cases (up to date) and the suitability and quality of the references used</i>	1. Menghitung parameter karakteristik boundary untuk suatu kasus mekanika fluida • <i>Discussion in class</i> • <i>Lectures and brainstorming</i> [TM]: 1 x (3x50') [BT]: 1 x (3x50') [BM]: 1 x (3x60') <i>Task 8(group):</i> <i>The group task uses the boundary layer concept in analyzing the case of fluid mechanics</i> <i>Quiz 2.c:</i> <i>Calculating boundary characteristic parameters for a fluid mechanics case</i>		
14	Mahasiswa mampu memahami kehilangan momentum dalam aliran eksternal [CP-4]	• Ketepatan mahasiswa dalam menganalisis dan menentukan <i>skin friction coefficients</i> untuk aliran laminar dan turbulen, • Ketepatan mahasiswa untuk dapat	• Membuat presentasi dan menganalisis berbagai kasus aliran eksternal • Tahapan serta akurasi perhitungan daya lift dan drag	• Kuliah & Brainstorming • Diskusi kelompok [TM]: 1 x (3x50') [BT]: 1 x (3x50') [BM]: 1 x (3x60')]	1. <i>Skin friction coefficients</i> untuk aliran laminar dan turbulen 2. Separasi aliran 3. gaya <i>lift</i> dan gaya <i>drag</i> 4. <i>streamlining</i>	5%

	<i>Student is able to understand loss of momentum in external flow [CP-4]</i>	menjelaskan fenomena boundary layer separation • Ketepatan dana menganalisa dan menentukan gaya <i>lift</i> dan <i>drag</i> pada aliran melalui suatu benda • <i>Student accuracy in analyzing and determining skin friction coefficients for laminar and turbulent flow,</i> • <i>The accuracy of students to be able to explain the phenomenon of boundary layer separation</i> • <i>Accuracy and analyze and determine the lift and drag forces on the flow through an object</i>	• Jumlah yang mampu diselesaikan dengan menggunakan konsep aliran eksternal • Kualitas kasus dipilih (up to date) dan kesesuaian serta kualitas referensi yang digunakan • <i>Make presentations and analyze various external flow cases</i> • <i>Stages and accuracy of lift and drag power calculations</i> • <i>The amount that can be solved using the concept of external flow</i> • <i>The quality of the selected cases (up to date) and the suitability and quality of the references used</i>	Tugas-9: Mencari kasus tentang lift dan drag Quiz 2.d: Menghitung gaya lift dan drag untuk kasus mekanika fluida • <i>Lectures & Brainstorming</i> • <i>Group discussion</i> [TM]: 1 x (3x50') [BT]: 1 x (3x50') [BM]: 1 x (3x60')] <i>Task-9:</i> <i>Looking for cases about lift and drag</i> <i>Quiz 2.d:</i> <i>Calculating lift and drag forces for the case of fluid mechanics</i>	1. <i>Skin friction coefficients for laminar and turbulent flow</i> 2. <i>Flow separation</i> 3. <i>lift force and drag force</i> 4. <i>streaming</i>	
15	Mahasiswa mampu memahami dan menjelaskan prinsip kerja mesin-mesin fluida [CP-1]	• Ketepatan mahasiswa dalam menjabarkan segitiga kecepatan dalam kerja mesin-mesin fluida	• Membuat presentasi hasil perhitungan dan melakukan analisa dalam menentukan performa mesin-mesin fluida	• Diskusi di kelas • kuliah dan brainstorming [TM]: 1 x (3x50') [BT]: 1 x (3x50') [BM]: 1 x (3x60')	1. Segitiga kecepatan, 2. performa pompa dan kompresor, 3. performa turbin 1. <i>Velocity triangle,</i>	5%

	<i>Students are able to understand and explain the working principle of fluid machines [CP-1]</i>	<i>The students' accuracy in describing the velocity triangle in the work of fluid machines</i>	<i>Make a presentation of the calculation results and perform analysis in determining the performance of fluid machines</i>	Tugas 10 (kelompok): Membuat makalah dan mempresentasikannya presentasi <i>Discussion in class</i> <i>lectures and brainstorming</i> <i>[TM]: 1 x (3x50')</i> <i>[BT]: 1 x (3x50')</i> <i>[BM]: 1 x (3x60')</i> <i>Task 10 (group):</i> <i>Make a paper and present it a presentation</i>	<i>2. pump and compressor performance</i> <i>3. turbine performance</i>	
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam – Evaluation of Week 9-15 activities and evaluation of the results</i>					15%

Catatan : Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

		RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Mekanika Fluida Fluid Mechanics em				RAE	
						Edisi: Agt 2018 <i>Edition: Aug 2018</i>	
Kode (Code): TF185150		Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>			Smt: 3 <i>Semester: 3</i>	
OTORISASI (Authorization)		Pengembang RP Contact Person – Learning Plan Dr. Suyanto	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD			Ka PRODI Head of Master Program Dr. Ridho Hantoro	
Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)		Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (47)
1	Mahasiswa mampu menjelaskan scope dan definisi mekanika fluida serta memberi contoh kasus mekanika fluida [CP-1] <i>Students are able to explain the scope and definition of fluid mechanics and give examples of fluid mechanics cases [CP-1]</i>	Tugas-1: 1. Mengerjakan soal-soal dari buku text sesuai dengan indikator penilaian 2. Membuat deskripsi satu contoh-contoh penerapan mekanika fluida <i>Task 1:</i> 1. <i>Doing questions from the textbook in accordance with the assessment indicators</i>		5%			

		<i>2. Describe one example of the application of fluid mechanics</i>				
2, 3	Mahasiswa mampu menyajikan formulasi fluida statik [CP-1] <i>Students are able to present static fluid formulations [CP-1]</i>	Tugas-2: • Mengerjakan soal dikelas secara mandiri dari buku text utama sesuai dengan indikator penilaian yang dibebankan • Mencari referensi mengenai bentuk-bentuk bangunan apung atau yang tenggelam, kemudian menganalisa berdasarkan teori kestabilan Quiz 1.a: Soal mengenai perhitungan gaya tekan hidrostatik <i>Task-2:</i> • <i>Doing class questions independently from the main text-book in accordance with the assigned assessment indicators</i> • <i>Looking for references regarding the forms of floating or sinking buildings, then analyzing based on the theory of stability</i> <i>Quiz 1.a:</i> <i>Problems regarding the calculation of the hydrostatic compressive force</i>	10%			
4, 5	Mahasiswa mampu memahami dan menjelaskan dinamika fluida dalam formulasi kontrol volume integral [CP-4]	Tugas-3: Diskusi mengenai penurunan persamaan konservasi massa dan momentum dalam formulasi integral		10%		

	<i>Students are able to understand and explain fluid dynamics in integral volume control formulation [CP-4]</i>	Tugas-4: • Mengerjakan soal penyelesaian kasus dinamika fluida dengan menggunakan konsep konservasi massa dan momentum • Mengerjakan soal penyelesaian kasus dinamika fluida dengan menggunakan hukum pertama dan kedua termodinamika Quiz 1.b: Soal mengenai penggunaan hukum konservasi massa dan momentum dalam formulasi kontrol volume integral <i>Task-3: Discussion about the derivation of mass and momentum conservation equations in integral formulation</i> <i>Task-4:</i> • <i>Work on solving fluid dynamics cases using the concepts of mass and momentum conservation</i> • <i>Work on solving fluid dynamics cases using the first and second laws of thermodynamics</i> <i>Quiz 1.b: Problems regarding the use of the laws of conservation of mass and momentum in the formulation of integral volume control</i>				
--	--	---	--	--	--	--

6-7	Mahasiswa mampu menjelaskan dinamika fluida dengan volume kontrol diferensial [CP-4] <i>Students are able to explain fluid dynamics with differential control volume [CP-4]</i>	Tugas -5(kelompok): Diskusi kelompok mengenai: - dasar-dasar persamaan CFD - aplikasi CFD Quiz 1.c: mengerjakan soal perhitungan tentang penerapan formulasi diferensial baik persamaan Euler maupun Navier-Stokes <i>Task -5(group):</i> <i>Group discussion on:</i> <i>the basics of the CFD equation</i> <i>CFD app</i> <i>Quiz 1.c:</i> <i>working on calculation problems regarding the application of differential formulations both Euler and Navier-Stokes . equations</i>		10%		
8	Evaluasi Tengah Semester – Review Aktivitas Minggu ke 1 sd Minggu ke 7 dan evaluasi hasil luaran <i>Mid Term Exam – Review of Week 1 to Week 7 activities and evaluate the results</i>		5%	10%		
9-10	Mahasiswa mampu menjelaskan fenomena aliran internal [CP-1] <i>Students are able to explain the phenomenon of internal flow [CP-1]</i>	Tugas 6(kelompok): Tugas kelompok membuat makalah studi kasus aliran internal dalam kasus <i>duct</i> dan pipa, serta melakukan analisa profil aliran dalam kasus tersebut Quiz 2.a: 1. mengerjakan soal mengenai formulasi aliran laminar dan turbulen <i>Task 6(group):</i>			10%	

		<i>The group task is to write a case study paper on internal flow in the case of ducts and pipes, and analyze the flow profile in these cases</i> <i>Quiz 2.a: Work on problems regarding the formulation of laminar and turbulent flow</i>				
11-12	Mahasiswa mampu memahami dan menjelaskan kerugian tekanan pada kasus aliran internal [CP-4] <i>Students are able to understand and explain pressure losses in the case of internal flow [CP-4]</i>	Tugas-7: 1. Menghitung kehilangan momentum dengan persamaan Bernoulli 2. Menghitung loss pada pipa dengan menggunakan Moody diagram serta menghitung losses aksesoris lain Quiz 2.b: Menghitung total losses pada sistem perpipaan <i>Task-7:</i> 1. Calculating the loss of momentum with the Bernoulli equation 2. Calculating pipe losses using Moody diagrams and calculating losses for other accessories <i>Quiz 2.b: Calculating the total losses in the piping system</i>			10%	
13	Mahasiswa mampu memahami dan menjelaskan fenomena syarat dan fenomena aliran eksternal [CP-4] <i>Students are able to understand and explain conditional phenomena and external flow phenomena [CP-4]</i>	Tugas 8(kelompok): Tugas kelompok menggunakan konsep boundary layer dalam menganalisa kasus mekanika fluida Quiz 2.c: Menghitung parameter karakteristik boundary untuk suatu kasus mekanika fluida			10%	

		<i>Task 8(group):</i> <i>The group task uses the boundary layer concept in analyzing the case of fluid mechanics</i> <i>Quiz 2.c:</i> <i>Calculating boundary characteristic parameters for a fluid mechanics case</i>				
14	Mahasiswa mampu memahami kehilangan momentum dalam aliran eksternal [CP-4] <i>Student is able to understand loss of momentum in external flow [CP-4]</i>	Tugas-9: Mencari kasus tentang lift dan drag Quiz 2.d: Menghitung gaya lift dan drag untuk kasus mekanika fluida <i>Task-9:</i> <i>Looking for cases about lift and drag</i> <i>Quiz 2.d:</i> <i>Calculating lift and drag forces for the case of fluid mechanics</i>			5%	
15	Mahasiswa mampu memahami dan menjelaskan prinsip kerja mesin-mesin fluida [CP-1] <i>Students are able to understand and explain the working principle of fluid machines [CP-1]</i>	Tugas 10 (kelompok): Membuat makalah dan mempresentasikannya presentasi <i>Task 10 (group):</i> <i>Make a paper and present it a presentation</i>				5%
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam – Evaluation of Week 9-15 activities and evaluation of the results</i>				10%	5%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			20%	30%	40%	10%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>			RP
	Sistem Distribusi Energi <i>Energy Distribution System</i>			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185315	Bobot sks (T/P): (2/0) <i>Credits (T/P): (2/0)</i>	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>		Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Suyanto	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD		Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>			
	CP-2: Lulusan mampu mengembangkan dan menerapkan berpikir kritis dan kreatif, dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu (18.75%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-3: Lulusan mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (18.75%) <i>Graduates are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data.</i> CP-5: Lulusan mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format</i> CP-6.E: Lulusan mampu mengembangkan metode inovatif, keterampilan dan alat secara mandiri untuk merancang dan mengoptimalkan sistem energi terbarukan dan berkelanjutan dalam berbagai kondisi parameter (37.5%)			

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing renewable and sustainable energy system under various parameter condition</i>	
	CP-MK Course Learning Outcome (CLO)	a. Mahasiswa mampu memahami dan menjelaskan tentang konsep dan teknologi energi distribusi energi. Berbagai macam topik yang dibahas termasuk Status dan teknologi smart grid beserta implementasinya <i>Students are able to understand and explain the concepts and technologies of energy distribution of energy. A wide variety of topics were discussed including Status and smart grid technology and its implementation.</i> b. Mahasiswa mampu melakukan identifikasi smart grid <i>Students are able to conduct an identification on smart grid</i> c. Mahasiswa mampu melakukan perhitungan efisiensi dan mengoptimisasi smart grid, baik secara individu maupun kelompok <i>Students are able to calculate efficiency and optimize smart grid system, both individually and in a group</i> d. Mahasiswa mampu menganalisa dampak penggunaan smart grid, baik secara individu maupun kelompok <i>Students are able to analyse the effect of smart grid, both individually and in a group</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari tantangan pentingnya smart grid, dasar-dasar dan efisiensi distribusi listrik terutama untuk sistem energi terbarukan dan menganalisa anatomi smart grid, implementasinya, serta dampaknya <i>This course studies the challenges of the importance of the smart grid, the basics and efficiency of electricity distribution, especially for renewable energy systems and analyzes the anatomy of the smart grid, its implementation, and its impact</i>	
Pokok Bahasan / Bahan Kajian Module content	1. Pengantar smart grid dalam pendistribusian energi <i>Introduction to smart grids in energy distribution</i> 2. Smart grid dalam distribusi energi <i>Smart grid in energy distribution</i> 3. Prinsip-prinsip dasar smart grid <i>The basic principles of the smart grid</i> 4. Anatomi smart grid <i>The anatomy of the smart grid</i> 5. Implementasi smart grid dalam sistem energi terbarukan <i>Implementation of smart grids in renewable energy systems</i> 6. Dampak smart grid <i>Smart grid impact</i>	
Pustaka Reading Materials	Utama: Main	
	Sioshansi, FP; Integrating Renewable, Distributed and Efficient Energy, 2011	

		Pendukung : <i>Supporting</i> Gellings CW: The Smart Grid: Enabling Energy Efficiency and Demand Response, 2009				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak : <i>Software</i> Power Point, Supporting Software			Perangkat keras : <i>Hardware</i> LCD. LAPTOP. PC	
Tim Pengajar <i>Team Teaching</i>		Dr. Suyanto, ST, MT				
Matakuliah syarat <i>Entry requirement</i>						
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-2	Mahasiswa mampu menjelaskan tentang tantangan pentingnya smart grid. <i>Students are able to explain the challenges of the importance of a smart grid</i>	- Ketepatan menjelaskan bentuk-bentuk - Tantangan dari pentingnya smart grid - Menjelaskan dengan rinci tentang pentingnya smart grid <i>Accuracy in interpreting forms</i> <i>The challenge of the importance of the smart grid</i> <i>Describe in detail the importance of a smart grid</i>	Tugas 1: - Review literatur - Membuat makalah pentingnya smart grid - Ppt <i>Assessment 1</i> <i>Literature review</i> <i>Writing out the importance of the smart grid</i> <i>Ppt</i>	Kuliah Diskusi E-learning TM = 2 mg x 2 sks x 50' BT = 2 mg x 2 sks x 60' BM = 2 mg x 2 sks x 60' <i>Lecture</i> <i>Discussion</i> <i>E-learning</i> <i>TM = 2 weeks x 2 sks x 50'</i> <i>BT = 2 weeks x 2 sks x 60'</i> <i>BM = 2 weeks x 2 sks x 60'</i>	Pentingnya smart grid <i>The importance of a smart grid</i>	10%
3-4	Mahasiswa mampu menjelaskan tentang dasar-dasar distribusi energi terutama	- Menjelaskan dasar-dasar dari smart grid - Memformulasikan penggunaan smart grid dalam persamaan	Tugas 2: Penyusunan makalah tentang dasar-dasar dari smart grid	Kuliah Diskusi E-learning TM = 2 mg x 2 sks x 50' BT = 2 mg x 2 sks x 60' BM = 2 mg x 2 sks x 60'	Efisiensi energi listrik dalam produksi daya dan pengiriman	10%

	dama sistem energi terbarukan <i>Students are able to explain the basics of energy distribution, especially in renewable energy systems</i>	- Melakukan analisa dari penggunaannya <i>Explains the basics of a smart grid</i> <i>Formulate the use of the smart grid in the equation</i> <i>Perform analysis of its use</i>	- Menyelesaikan persamaan-persamaan dalam kajian smart grid - Presentasi ppt dari analisa yang didapat <u>Assessment 2</u> <i>Preparation of papers on the basics of the smart grid</i> <i>Solve the equations in the smart grid study</i> <i>Presentation of ppt from the analysis obtained</i>	<i>Lecture Discussion E-learning</i> <i>TM = 2 weeks x 2 sks x 50'</i> <i>BT = 2 weeks x 2 sks x 60'</i> <i>BM = 2 weeks x 2 sks x 60'</i>	<i>Electric Energy Efficiency in Power Production & Delivery</i>	
5-7	Mahasiswa mampu menjelaskan tentang efisiensi distribusi listrik terutama untuk sistem energi terbarukan <i>Students are able to explain the efficiency of electricity distribution, especially for renewable energy systems</i>	- Keterampilan menjelaskan tentang efisiensi distribusi listrik terutama untuk sistem energi terbarukan - Menjelaskan penggunaan smart grid untuk sistem listrik yang benar - Membuat jaringan/design dari smart grid <i>Skills in explaining the efficiency of electricity distribution, especially for renewable energy systems</i> <i>Describe the use of a smart grid for the</i>	<u>Tugas 3:</u> - Menyusun makalah tentang efisiensi distribusi listrik terutama untuk sistem energi terbarukan - Presentasi ppt tentang penggunaan smart grid untuk sistem listrik yang benar <u>Tugas 4:</u> Membuat jaringan/design dari smart grid dan dipresentasikan dengan ppt <u>Assessment 3</u> <i>Prepare a paper on the efficiency of electricity distribution, especially for renewable energy systems</i>	Kuliah Diskusi E-learning <i>TM = 3 mg x 2 sks x 50'</i> <i>BT = 3 mg x 2 sks x 60'</i> <i>BM = 3 mg x 2 sks x 60'</i> <i>Lecture Discussion E-learning</i> <i>TM = 3 weeks x 2 sks x 50'</i> <i>BT = 3 weeks x 2 sks x 60'</i> <i>BM = 3 weeks x 2 sks x 60'</i>	- Efisiensi enegi listrik pada end-user - Menggunakan Smart Grid untuk Berkembang - Sistem Tenaga yang Sempurna - Arsitektur IntelliGrid SM Untuk Smart Grid <i>Electric End-use Energy Efficiency</i> <i>Using a Smart Grid to Evolve</i> <i>The Perfect Power System</i> <i>The IntelliGrid SM Architecture For the Smart Grid</i>	15%

		<i>correct electrical system</i> • <i>Creating a network / design from a smart grid</i>	• <i>A ppt presentation on using a smart grid for the correct power system</i> Assessment 4 • <i>Creating a network / design from a smart grid and presented with ppt</i>			
8	Evaluasi Tengah Semester – Review Aktifitas Minggu ke 1 sd Minggu ke 7 dan evaluasi hasil luaran <i>Mid Term Exam – Review of Week 1 to Week 7 activities and evaluate the results</i>					10%
9-11	Mahasiswa mampu menganalisa anatomi smart grid <i>Students are able to analyze the smart grid anatomy</i>	• Menjelaskan kebutuhan pemanfaatan smart grid • Menjelaskan konsep dari Dynamic Energy System • Menjelaskan bagian-bagian dari smart grid • Kebijakan dan program dari efisiensi energi • <i>Describe the need for using a smart grid</i> • <i>Explain the concept of a Dynamic Energy System</i> • <i>Describe the parts of the smart grid</i> • <i>Energy efficiency policies and programs</i>	Tugas 5: • Menjelaskan konsep dari Dynamic Energy System, part, kebutuhan smart grid, dan kebijakan yang mengaturnya dari efisiensi energi dalam bentuk makalah • Presentasi ppt (Poin Pertama) Assessment 5 • Explain the concept of <i>the Dynamic Energy System, parts, the need for smart grids, and policies that regulate energy efficiency in the form of a paper.</i> • <i>Presentation ppt (First Point)</i>	Kuliah Diskusi E-learning TM = 2 mg x 2 sks x 50' BT = 2 mg x 2 sks x 60' BM = 2mg x 2 sks x 60' <i>Lecture Discussion E-learning TM = 2 weeks x 2 sks x 50' BT = 2 weeks x 2 sks x 60' BM = 2weeks x 2 sks x 60'</i>	• Smart Grid -Mengaktifkan Respons Permintaan— Konsep Sistem Energi Dinamis • Pelabuan Energi SM sebagai Bagian dari Jaringan Cerdas • Kebijakan & Program untuk Mendorong Efisiensi Energi Penggunaan Akhir • <i>The Smart Grid -Enabling Demand Response—The Dynamic Energy Systems Concept</i> • <i>The Energy Port SM as Part of the Smart Grid</i> • <i>Policies & Programs to Encourage End-use Energy Efficiency</i>	15%
11-13	Mahasiswa mampu menganalisa implementasi dari smart grid	Menanalisa implementasi dari smart grid di sektor penjualan (Pasar)	Tugas 6: • Mereview jurnal • Membuat makalah tentang implemantasi smart grid di sektor penjualan	Kuliah Diskusi E-learning TM = 3 mg x 2 sks x 50' BT = 3 mg x 2 sks x 60' BM = 3 mg x 2 sks x 60'	Implementasi pasar <i>Market Implementation</i>	15%

	<i>Students are able to analyze the implementation of the smart grid</i>	<i>Analyze the implementation of the smart grid in the sales sector (Market)</i>	• Presentasi ppt Implementasi smart grid di sektor penjualan Assessment 6 • Review journals • Creating a paper on smart grid implementation in the sales sector • Presentation of ppt Smart grid implications in the sales sector	<i>Lecture</i> <i>Discussion</i> <i>E-learning</i> <i>TM = 3 weeks x 2 sks x 50'</i> <i>BT = 3 weeks x 2 sks x 60'</i> <i>BM = 3 weeks x 2 sks x 60'</i>		
14-15	Mahasiswa mampu menganalisa dampak dari penggunaan smart grid <i>Students are able to analyze the impact of using a smart grid</i>	Kemampuan menganalisa dampak dari penggunaan smart grid <i>Ability to analyze the impact of using a smart grid</i>	Tugas 7: • Mereview jurnal • Membuat makalah tentang dampak penggunaan smart grid • Presentasi ppt tentang dampak penggunaan smart grid Assessment 7 • Review journals • Creating a paper on the impact of using a smart grid • A ppt presentation on the impact of using a smart grid	Kuliah Diskusi E-learning TM = 2 mg x 2 sks x 50' BT = 2 mg x 2 sks x 60' BM = 2 mg x 2 sks x 60' <i>Lecture</i> <i>Discussion</i> <i>E-learning</i> <i>TM = 2 weeks x 2 sks x 50'</i> <i>BT = 2 weeks x 2 sks x 60'</i> <i>BM = 2 weeks x 2 sks x 60'</i>	• Alternatif Teknologi Penggunaan Akhir Listrik yang Efisien • Perencanaan Sisi Permintaan • Evaluasi Sisi Permintaan • <i>Efficient Electric End-use Technology Alternatives</i> • <i>Demand-side Planning</i> • <i>Demand-side Evaluation</i>	15%
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam – Evaluation of Week 9-15 activities and evaluation of the results</i>					10%

Catatan : Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

		RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS				RAE		
		Sistem Distribusi Energi Energy Distribution System				Edisi: Agt 2018 <i>Edition: Aug 2018</i>		
Kode (Code): TF185315		Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>			Smt: 3 <i>Semester: 3</i>		
OTORISASI (Authorization)		Pengembang RP Contact Person – Learning Plan Dr. Suyanto	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD			Ka PRODI Head of Master Program Dr. Ridho Hantoro		
Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)			Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot CP-MK4 (7)
1-2	Mahasiswa mampu menjelaskan tentang tantangan pentingnya smart grid. <i>Students are able to explain the challenges of the importance of a smart grid</i>	Tugas 1: - Review literatur - Membuat makalah pentingnya smart grid - Ppt Assessment 1 <i>Literature review</i> <i>Writing out the importance of the smart grid Ppt</i>				10%		

3-4	Mahasiswa mampu menjelaskan tentang dasar-dasar distribusi energi terutama damu sistem energi terbarukan <i>Students are able to explain the basics of energy distribution, especially in renewable energy systems</i>	Tugas 2: - Penyusunan makalah tentang dasar-dasar dari smart grid - Menyelesaikan persamaan-persamaan dalam kajian smart grid - Presentasi ppt dari analisa yang didapat Assessment 2 <i>Preparation of papers on the basics of the smart grid</i> <i>Solve the equations in the smart grid study</i> <i>Presentation of ppt from the analysis obtained</i>	10%			
5-7	Mahasiswa mampu menjelaskan tentang efisiensi distribusi listrik terutama untuk sistem energi terbarukan <i>Students are able to explain the efficiency of electricity distribution, especially for renewable energy systems</i>	Tugas 3: - Menyusun makalah tentang efisiensi distribusi listrik terutama untuk sistem energi terbarukan - Presentasi ppt tentang penggunaan smart grid untuk sistem listrik yang benar Tugas 4: Membuat jaringan/design dari smart grid dan dipresentasikan dengan ppt Assessment 3 <i>Prepare a paper on the efficiency of electricity distribution, especially for renewable energy systems</i> <i>A ppt presentation on using a smart grid for the correct power system</i> Assessment 4 <i>Creating a network / design from a smart grid and presented with ppt</i>			15%	
8	Evaluasi Tengah Semester – Review Aktifitas Minggu ke 1 sd Minggu ke 7 dan evaluasi hasil luaran <i>Mid Term Exam – Review of Week 1 to Week 7 activities and evaluate the results</i>			5%	5%	
9-11	Mahasiswa mampu menganalisa anatomi smart grid <i>Students are able to analyze the smart grid anatomy</i>	Tugas 5: Menjelaskan konsep dari Dynamic Energy System, part, kebutuhan smart grid, dan kebijakan yang mengaturnya dari efisiensi energi dalam bentuk makalah	15%			

		- Presentasi ppt (Poin Pertama) <u>Assessment 5</u> - Explain the concept of <i>the Dynamic Energy System, parts, the need for smart grids, and policies that regulate energy efficiency in the form of a paper.</i> <i>Presentation ppt (First Point)</i>				
11-13	Mahasiswa mampu menganalisa implementasi dari smart grid <i>Students are able to analyze the implementation of the smart grid</i>	<u>Tugas 6:</u> - Mereview jurnal - Membuat makalah tentang implemantasi smart grid di sektor penjualan - Presentasi ppt Implematasi smart grid di sektor penjualan <u>Assessment 6</u> <i>Review journals</i> <i>Creating a paper on smart grid implementation in the sales sector</i> <i>Presentation of ppt Smart grid implications in the sales sector</i>		15%		
14-15	Mahasiswa mampu menganalisa dampak dari penggunaan smart grid <i>Students are able to analyze the impact of using a smart grid</i>	<u>Tugas 7:</u> - Mereview jurnal - Membuat makalah tentang dampak penggunaan smart grid - Presentasi ppt tentang dampak penggunaan smart grid <u>Assessment 7</u> <i>Review journals</i> <i>Creating a paper on the impact of using a smart grid</i> <i>A ppt presentation on the impact of using a smart grid</i>				15%
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam – Evaluation of Week 9-15 activities and evaluation of the results</i>			5%		5%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			100%			

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Keberlanjutan dan Kebijakan Energi <i>Sustainable and Energy Policy</i>		RP Edisi: Agt 2018 Edition: Aug 2018
	Kode (Code): TF185317	Bobot sks (T/P): (2/0) Credits (T/P): (2/0) Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>	Smt: 3 Semester: 2
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Ridho Hantoro	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Dr. Ridho Hantoro
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	CP-2: Lulusan mampu mengembangkan dan menerapkan berpikir kritis dan kreatif, dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu (18.75%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-3: Lulusan mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta mampu menganalisis dan mengevaluasi data teknis dan data penelitian. (18.75%) <i>Graduates are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data.</i> CP-5: Lulusan mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format</i> CP-6.E: Lulusan mampu mengembangkan metode inovatif, keterampilan dan alat secara mandiri untuk merancang dan mengoptimalkan sistem energi terbarukan dan berkelanjutan dalam berbagai kondisi parameter (37.5%)	

	<i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing renewable and sustainable energy system under various parameter condition</i> CP-MK Course Learning Outcome (CLO) p. Mahasiswa mampu menjelaskan dan menerapkan konsep – konsep keberlanjutan energi. <i>Students are able to explain and apply the concept of sustainable energy</i> q. Mahasiswa mampu menjelaskan dan menyarikan tentang kebijakan dan keberlanjutan energi dengan baik. (CP-2) (18.75%) <i>Students are able to explain and summarize energy policies and sustainability well</i> r. Mahasiswa mampu memberikan alternatif dan penyelesaian kriteria dalam mengkuantifikasi dan mencapai keberlanjutan energi (CP-6) (37.5%) <i>Students are able to provide alternatives and completion of criteria in quantifying and achieving energy sustainability</i> s. Mahasiswa mampu melakukan perhitungan untuk keberlanjutan energi dan mempresentasikannya (CP-5) (CP-3) (43.75%) <i>Students are able to do calculations for energy sustainability and present them</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari tentang pengembangan keilmuan yakni keberlanjutan energi, kriteria keberlanjutan energi, skema pemenuhan keberlanjutan energi, MCDM (multi criteria decision making) dan AHP (analytical hierarchy process). Pengembangan keilmuan ini merupakan kewajiban bagi semua mahasiswa Magister untuk mengembangkan keberlanjutan energi dalam meningkatkan kompetensi pemenuhan energi baik dengan cara MCDM dan AHP. <i>This course studies scientific development, namely energy sustainability, energy sustainability criteria, energy sustainability fulfillment schemes, MCDM (multi criteria decision making) and AHP (analytical hierarchy process). This scientific development is an obligation for all Master students to develop energy sustainability in increasing energy fulfillment competencies both by means of MCDM and AHP.</i>
Pokok Bahasan / Bahan Kajian Module content	1. Konsep keberlanjutan energi: Definisi; Aspek pembentuk; Kondisi energi dunia dan dalam negeri <i>The concept of energy sustainability: Definition; Forming aspects; World and domestic energy conditions</i> 2. Jenis-jenis energi fosil dan terbarukan <i>The types of fossil and renewable energies</i> 3. Ketersediaan energi fosil dan terbarukan <i>Availability of fossil and renewable energy</i> 4. Tren dan tantangan <i>Trends and challenges</i> 5. Konsumsi energi pada sector-sektor pengguna energi (transportasi, industry, komersial, rumah tangga, dll) <i>Energy consumption in energy user sectors (transportation, industry, commercial, household, etc.)</i> 6. Kontribusi (energy-mix) pada sector-sektor pengguna energi (transportasi, industry, komersial, rumah tangga, dll) <i>Contribution (energy-mix) to energy user sectors (transportation, industry, commercial, household, etc.)</i> 7. AHP (Saaty) <i>AHP (Saaty)</i> 8. Penyusunan hirarki, kriteria, sub-kriteria keberlanjutan energi

	<i>Arrangement of energy sustainability hierarchy, criteria, sub-criteria</i> 11. Prediksi ketersediaan dan kebutuhan dengan kondisi saat ini <i>Predict availability and demand under current conditions</i> 12. Bauran energi dunia dan nasional <i>World and national energy mix</i>					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	Sustainable Energy without the Hot Air, by David MacKay, UIT Cambridge, 2008. Sustainable Development–Energy, Engineering and Technologies – Manufacturing and Environment, Chaouki Ghenai, InTech 2012 Handbook of Sustainable Energy, Ibon Galarraga, Edward Elgar Publishing Limited, 2011					
	Pendukung : <i>Supporting</i>					
	L. Saaty, AHP Method for MCDM					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras : <i>Hardware</i>		
	Power Point, Support Software			LCD. LAPTOP. PC		
Team Teaching	Harsono Hadi, PhD, Dr. Suyanto, Dr. Ridho Hantoro, Gunawan Nugroho, PhD					
Matakuliah syarat	TF195101 Advanced Engineering Physics TF195102 Advanced Engineering Mathematics					
Mg Ke- (1)	Sub-CP-MK (2)	Indikator Penilaian (3)	Kriteria & Bentuk Penilaian (4)	Metode Pembelajaran [Estimasi Waktu] (5)	Materi Pembelajaran [Pustaka] (6)	Bobot Penilaian (%) (7)
1-2	Mahasiswa dapat menjelaskan konsep keberlanjutan energy dan aspek-aspek yang mempengaruhinya <i>Students can explain the concept of energy sustainability and the aspects that influence it</i>	Ketepatan dalam menjelaskan konsep keberlanjutan energy dan aspek-aspek yang mempengaruhinya <i>The accuracy of explaining the concept of energy sustainability and the aspects that influence it</i>	Tugas 1: - Review literatur - Presentasi tentang konsep keberlanjutan energy <i>Assessment 1:</i> - Literature review - Presentation on energy sustainability concept	Kuliah Diskusi Presentasi Tugas [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')] <i>Lecture</i> <i>Discussion</i> <i>Presentation of Assignments</i>	Konsep keberlanjutan energi: - Definisi - Aspek pembentuk - Kondisi energi dunia dan dalam negeri <i>Energy sustainability concept:</i> - Definition - Forming aspects - World and domestic energy conditions	10%

				[TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]		
3-4	Mahasiswa mampu mengidentifikasi dan mengkuantifikasi jenis dan ketersediaan energy fosil dunia dan Indonesia. <i>Students are able to identify and quantify the types and availability of fossil energy in the world and Indonesia.</i> Mahasiswa mampu mengidentifikasi dan mengkuantifikasi jenis dan ketersediaan energy terbarukan dunia dan Indonesia. <i>Students are able to identify and quantify the types and availability of renewable energy in the world and Indonesia.</i>	Ketepatan dalam mengidentifikasi dan mengkuantifikasi jenis dan ketersediaan energy fosil dunia dan Indonesia. <i>The accuracy of identifying and quantifying the types and availability of fossil energy in the world and Indonesia.</i> Ketepatan dalam mengidentifikasi dan mengkuantifikasi jenis dan ketersediaan energy terbarukan dunia dan Indonesia. <i>The accuracy of identifying and quantifying the types and</i>	Tugas 2: - Penyusunan makalah tentang tipe dan ketersediaan energi fosil dan energi terbarukan - Presentasi Assessment 2: - Preparation of papers on type and availability of fossil and renewable energy - Presentation	Kuliah Diskusi Presentasi Tugas [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')] <i>Lecture Discussion Presentation of Assignments [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]</i>	- Jenis-jenis energi fosil dan terbarukan - Ketersediaan energi fosil dan terbarukan. - Tren dan tantangan <i>Fossil and renewable energy types</i> <i>Fossil and renewable energy availability.</i> <i>Trends and challenges</i>	10%
5-6	Mahasiswa mampu mengidentifikasi dan mengkuantifikasi	Ketepatan mahasiswa dalam mengidentifikasi dan	Tugas 3: Tugas Mandiri analisa konsumsi energi dan	Kuliah Diskusi Presentasi Tugas	Konsumsi energi pada sector-sektor pengguna energi (transportasi,	10%

	konsumsi energy dunia dan Indonesia. Mahasiswa mampu menganalisis kontribusi pemakaian masing-masing jenis energi fosil dan terbarukan pada aspek utama konsumsi energi <i>Students are able to identify and quantify world and Indonesian energy consumption.</i> <i>Students are able to analyze the contribution of the use of each type of fossil and renewable energy in the main aspects of energy consumption</i>	mengkuantifikasi konsumsi energy dunia dan Indonesia. Ketepatan mahasiswa dalam menganalisis kontribusi pemakaian masing-masing jenis energi fosil dan terbarukan pada aspek utama konsumsi energi <i>The accuracy of identifying and quantifying world and Indonesian energy consumption.</i> <i>The accuracy of analyzing the contribution of the use of each type of fossil and renewable energy in the main aspects of energy consumption</i>	peran sumber-sumber energi dalam memenuhi kebutuhan tersebut <i>Assessment 3:</i> <i>Individual assignment in analyzing the energy consumption and contribution of each energy resource on fulfilling the demand.</i>	[TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")] <i>Lecture Discussion Presentation of Assignments</i> [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	industry, komersial, rumah tangga, dll) - Kontribusi (energy-mix) pada sector-sektor pengguna energi (transportasi, industry, komersial, rumah tangga, dll) <i>Energy user sectors (transportation, industry, commercial, household, etc.)</i> <i>Contribution (energy-mix) to energy user sectors (transportation, industry, commercial, household)</i>	
7	Mahasiswa mampu menyusun hirarki dan kriteria keberlanjutan energi <i>Students are able to compile a hierarchy and criteria for energy sustainability.</i>	Ketepatan dalam menyusun hirarki dan kriteria keberlanjutan energi <i>The accuracy of compiling a hierarchy and criteria for energy sustainability.</i>	Tugas 4: - Tugas mandiri tentang hirarki dan kriteria keberlanjutan energi <i>Assessment 4:</i> <i>Independent task on compiling a hierarchy and criteria for energy sustainability</i>	Kuliah Diskusi Presentasi Tugas [TM: 1x(2x50")] [BT: 1x(2x60")] [BM: 1x(2x60")] <i>Lecture Discussion</i>	- AHP (Saaty) - Penyusunan hirarki, kriteria, sub-kriteria keberlanjutan energi <i>AHP</i> <i>Arrangement of energy sustainability hierarchy, criteria, sub-criteria</i>	5%

				<i>Presentation of Assignments</i> [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]		
8	Evaluasi Tengah Semester <i>Mid Term Exam</i>					15%
9	<i>lihat mg 7</i> <i>See week 7</i>	<i>lihat mg 7</i> <i>See week 7</i>	<i>lihat mg 7</i> <i>See week 7</i>	Kuliah Diskusi Presentasi Tugas [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')] <i>Lecture Discussion Presentation of Assignments</i> [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	• AHP (Saaty) • Penyusunan hirarki, kriteria, sub-kriteria keberlanjutan energi • <i>AHP</i> • <i>Arrangement of energy sustainability hierarchy, criteria, sub-criteria</i>	5%
10-11	Mahasiswa mampu menyusun dan memberikan pembobotan tingkat kepentingan hirarki dan kriteria keberlanjutan energi <i>Students are able to compile and weight the level of importance of the hierarchy and</i>	Ketepatan dalam menyusun dan memberikan pembobotan tingkat kepentingan hirarki dan kriteria keberlanjutan energi <i>The accuracy of compiling and weighting the level of importance of the hierarchy and criteria for energy sustainability</i>	<u>Tugas 6:</u> • Presentasi tentang pembobotan tingkat kepentingan hirarki dan kriteria keberlanjutan energi • Menyusun makalah <i>Assessment: 6</i> • <i>Presentation on the level of importance of the hierarchy and criteria for energy sustainability</i>	Kuliah Diskusi Presentasi Tugas [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')] <i>Lecture Discussion Presentation of Assignments</i> [TM: 2x(2x50'')]	• AHP (Saaty) • Penyusunan hirarki, kriteria, sub-kriteria keberlanjutan energi • <i>AHP</i> • <i>Arrangement of energy sustainability hierarchy, criteria, sub-criteria</i>	10%

	<i>criteria for energy sustainability</i>		<i>Writing a paper/report</i>	<i>[BT: 2x(2x60")]</i> <i>[BM: 2x(2x60")]</i>		
12-13	Mahasiswa mampu menjabarkan dasar pembobotan hirarki dan kriteria keberlanjutan energi. Mahasiswa mampu menganalisa dan membuat prioritas aspek-aspek penting keberlanjutan energi <i>Students are able to describe the basic hierarchical weighting and energy sustainability criteria.</i> <i>Students are able to analyze and prioritize important aspects of energy sustainability</i>	Ketepatan dalam menjabarkan dasar pembobotan hirarki dan kriteria keberlanjutan energi. Ketepatan dalam menganalisa dan membuat prioritas aspek-aspek penting keberlanjutan energi <i>The accuracy of describing the basic hierarchical weighting and energy sustainability criteria.</i> <i>Students are able to analyze and prioritize important aspects of energy sustainability</i>	<u>Tugas 7:</u> - Tugas Mandiri tentang potensi energi geothermal. - Presentasi tentang kesetimbangan energi terbarukan geothermal - Menyusun makalah teknologi konversi energi geothermal <i>Assessment: 6</i> <i>Presentation on the level of importance of the hierarchy and criteria for energy sustainability</i> <i>Writing a paper/report</i>	Kuliah Diskusi Presentasi Tugas [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")] <i>Lecture Discussion Presentation of Assignments</i> [TM: 1x(2x50")] [BT: 1x(2x60")] [BM: 1x(2x60")]	- AHP (Saaty) - Referensi/teori/data pendukung pembobotan hirarki, kriteria, sub-kriteria keberlanjutan energi <i>AHP</i> <i>Reference / theory / supporting data weighting of energy sustainability hierarchy, criteria, sub-criteria</i>	10%
14-15	Mahasiswa mampu membuat prediksi ketersediaan dan kebutuhan energi. Mahasiswa mampu membuat scenario keberlanjutan energi dengan data prediksi	Ketepatan dalam membuat prediksi ketersediaan dan kebutuhan energi. Ketepatan dalam membuat scenario keberlanjutan energi dengan data prediksi ketersediaan dan kebutuhan energi saat ini.	<u>Tugas 8:</u> - Tugas Mandiri tentang prediksi ketersediaan dan kebutuhan energi serta scenario keberlanjutan energi <i>Assessment 8:</i> <i>Independent Tasks regarding prediction of</i>	Kuliah Diskusi Presentasi Tugas [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")] <i>Lecture Discussion</i>	- Prediksi ketersediaan dan kebutuhan dengan kondisi saat ini - Bauran energi dunia dan nasional <i>Prediction of availability and demand under current conditions</i>	10%

	ketersediaan dan kebutuhan energi saat ini. <i>Students are able to make predictions of energy availability and demand.</i> <i>Students are able to create energy sustainability scenarios with predictive data of current energy supply and demand.</i>	<i>The accuracy of making predictions of energy availability and demand.</i> <i>The accuracy of creating energy sustainability scenarios with predictive data of current energy supply and demand</i>	<i>energy supply and demand as well as energy sustainability scenarios</i>	<i>Presentation of Assignments</i> <i>[TM: 2x(2x50")]</i> <i>[BT: 2x(2x60")]</i> <i>[BM: 2x(2x60")]</i>	<i>World and national energy mix</i>	
16	Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam – Evaluation of Week 9-15 activities and evaluation of the results</i>					15%

Catatan :

12. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

	RENCANA ASSESSMENT & EVALUASI (RAE) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Keberlanjutan dan Kebijakan Energi Sustainable and Energy Policy		RA&E
			Edisi: Agt 2018 Edition: Aug 2018
Kode (Code): TF185317	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: Energy Engineering and Environmental Conditioning	Smt: 3 Semester: 2
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Ridho Hantoro	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Dr. Ridho Hantoro

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1-2	Mahasiswa dapat menjelaskan konsep keberlanjutan energy dan aspek-aspek yang mempengaruhinya <i>Students can explain the concept of energy sustainability and the aspects that influence it</i>	Tugas 1: Review literatur Presentasi tentang konsep keberlanjutan energy <i>Assessment 1:</i> <i>Literature review</i> <i>Presentation on energy sustainability concept</i>	10%			
3-4	Mahasiswa mampu mengidentifikasi dan mengkuantifikasi jenis dan ketersediaan energy fosil dunia dan Indonesia.	Tugas 2: Penyusunan makalah tentang tipe dan ketersediaan energi fosil dan energi terbarukan Presentasi	5%	5%		

	<i>Students are able to identify and quantify the types and availability of fossil energy in the world and Indonesia.</i> Mahasiswa mampu mengidentifikasi dan mengkuantifikasi jenis dan ketersediaan energy terbarukan dunia dan Indonesia. <i>Students are able to identify and quantify the types and availability of renewable energy in the world and Indonesia.</i>	<i>Assessment 2:</i> <i>Preparation of papers on type and availability of fossil and renewable energy</i> <i>Presentation</i>				
5-6	Mahasiswa mampu mengidentifikasi dan mengkuantifikasi konsumsi energy dunia dan Indonesia. Mahasiswa mampu menganalisis kontribusi pemakaian masing-masing jenis energi fosil dan terbarukan pada aspek utama konsumsi energi <i>Students are able to identify and quantify world and Indonesian energy consumption.</i> <i>Students are able to analyze the contribution of the use of each type of fossil and renewable energy in the main aspects of energy consumption</i>	Tugas 3: Tugas Mandiri analisa konsumsi energi dan peran sumber-sumber energi dalam memenuhi kebutuhan tersebut <i>Assessment 3:</i> <i>Individual assignment in analyzing the energy consumption and contribution of each energy resource on fulfilling the demand.</i>		10%		
7	Mahasiswa mampu menyusun hirarki dan kriteria keberlanjutan energi <i>Students are able to compile a hierarchy and criteria for energy sustainability.</i>	Tugas 4: Tugas mandiri tentang hirarki dan kriteria keberlanjutan energi <i>Assessment 4:</i> <i>Independent task on compiling a hierarchy and criteria for energy sustainability</i>			5%	
Evaluasi Tengah Semester Mid Term Exam				10%	5	

9	lihat mg 7 <i>See week 7</i>	lihat mg 7 <i>See week 7</i>			5%	
10-11	Mahasiswa mampu menyusun dan memberikan pembobotan tingkat kepentingan hirarki dan kriteria keberlanjutan energi <i>Students are able to compile and weight the level of importance of the hierarchy and criteria for energy sustainability</i>	<u>Tugas 6:</u> •Presentasi tentang pembobotan tingkat kepentingan hirarki dan kriteria keberlanjutan energi •Menyusun makalah <i>Assessment: 6</i> <i>Presentation on the level of importance of the hierarchy and criteria for energy sustainability</i> <i>Writing a paper/report</i>			5%	5%
12-13	Mahasiswa mampu menjabarkan dasar pembobotan hirarki dan kriteria keberlanjutan energi. Mahasiswa mampu menganalisa dan membuat prioritas aspek-aspek penting keberlanjutan energi <i>Students are able to describe the basic hierarchical weighting and energy sustainability criteria.</i> <i>Students are able to analyze and prioritize important aspects of energy sustainability</i>	<u>Tugas 7:</u> •Tugas Mandiri tentang potensi energi geothermal. •Presentasi tentang kesetimbangan energi terbarukan geothermal •Menyusun makalah teknologi konversi energi geothermal <i>Assessment: 6</i> <i>Presentation on the level of importance of the hierarchy and criteria for energy sustainability</i> <i>Writing a paper/report</i>			5%	5%
14-15	Mahasiswa mampu membuat prediksi ketersediaan dan kebutuhan energi. Mahasiswa mampu membuat scenario keberlanjutan energi dengan data prediksi ketersediaan dan kebutuhan energi saat ini. <i>Students are able to make predictions of energy availability and demand.</i>	<u>Tugas 8:</u> •Tugas Mandiri tentang prediksi ketersediaan dan kebutuhan energi serta scenario keberlanjutan energi <i>Assessment 8:</i> <i>Independent Tasks regarding prediction of energy supply and demand as well as energy sustainability scenarios</i>				10%

	<i>Students are able to create energy sustainability scenarios with predictive data of current energy supply and demand.</i>					
Evaluasi Akhir Semester – Evaluasi aktifitas Minggu ke 9 – 15 dan evaluasi hasil luaran <i>Final Exam – Evaluation of Week 9-15 activities and evaluation of the results</i>					5%	10%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Energi Biomassa <i>Biomass Energy</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185341	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Pilihan <i>Field of Specialization: Elective</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i>	Koordinator RMK <i>Field Coordinator</i> Dr. Ir. Totok Soehartanto, DEA	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengidentifikasi, merancang, melaksanakan, dan mengembangkan metodologi yang sesuai serta menganalisis dan menginterpretasi data dengan tepat. (25%) <i>Are able to identify, design, implement, and develop appropriate methodologies as well as analyze and interpret data appropriately.</i>	
	CP-3 Mampu merancang komponen, sistem, atau proses dalam bidang rekayasa teknik fisika sesuai kebutuhan dan batasan operasional yang realistis. (25%) <i>Are able to design components, systems, or processes in the field of engineering physics according to needs and realistic operational constraints.</i>	
	CP-4 Mampu berpikir kritis, kreatif dan inovatif dalam mengidentifikasi, memformulasi, mengevaluasi dan menyelesaikan masalah kereakayaan yang berkembang di bidang teknik fisika. (25%) <i>Are able to think critically, creatively, and innovatively in identifying, formulating, evaluating, and solving engineering problems that develop in the field of engineering physics.</i>	

	CP-5 Mampu menggunakan teknik, keterampilan, dan peralatan rekayasa yang tersedia dan diperlukan dalam bidang teknik fisika. (25%) <i>Are able to use engineering techniques, skills, and engineering tools that are available and needed in the field of engineering physics.</i> CP-MK Course Learning Outcome (CLO) 1. Mahasiswa mampu mengklasifikasikan dan mengkarakteristikan Biomassa beserta kandungan energinya. (CP-2) (15%) <i>Students are able to can classify and characterize Biomass and its energy content.</i> 2. Mahasiswa mampu menjelaskan mekanisme dan teknik konversi fisik Biomassa agar dapat dipergunakan sebagai bahan bakar. (CP-4) (15%) <i>Students are able to explain the mechanics and techniques of physical conversion of Biomass so that it can be used as fuel.</i> 3. Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui termokimia. (CP-4) (15%) <i>Students are able to explain the technique of converting Biomass into energy through thermochemistry.</i> 4. Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia. (CP-4) (15%) <i>Students are able to explain the technique of converting Biomass into energy through biochemistry.</i> 5. Mahasiswa mampu melakukan Life Cycle Analysis dari Biomassa. (CP-3, CP-5) (40%) <i>Students are able to perform Life Cycle Analysis of Biomass.</i>
Diskripsi Singkat MK Course Description	Mata kuliah ENERGI BIOMASSA merupakan mata kuliah pilihan pada program studi Pasca Sarjana Teknik Fisika FTIRS-ITS bidang study Rekayasa Energi Terbarukan. Mata kuliah ini membahas tentang sumber-sumber Biomassa, klasifikasi, dan karakteristik Biomassa, serta teknologi untuk konversi bentuk fisik Biomassa agar praktis dipergunakan sebagai bahan bakar. Teknik konversi lainnya yang akan dibahas pada mata kuliah ini adalah teknik konversi Biomassa melalui Termokimia dan melalui Biokimia. <i>The BIOMASS ENERGY course is an elective course in the Postgraduate Engineering Physics FTIRS-ITS study program in the field of Renewable Energy Engineering. This course discusses the sources of Biomass, classification, and characteristics of Biomass, as well as technology for converting the physical form of Biomass so that it is practically used as fuel. Other conversion techniques that will be discussed in this course are Biomass conversion techniques through Thermochemistry and Biochemistry.</i>
Pokok Bahasan / Bahan Kajian Module content	1. Sumber, Karakteristik, Klasifikasi : Sumber-sumber Biomassa, klasifikasinya, ketersediaannya, karakteristik komposisi, kandungan energi, siklus karbon 2. Konversi Fisik : Parameter, perhitungan dan teknologi pemakaian langsung, pemaletan, dan pemadatan/briketisasi 3. Konversi Termokimia : Pembakaran, gasifikasi, pirolisis, karbonisasi, pencairan hidrotermal, biodiesel 4. Konversi Biokimia : Biomethane, fermentasi, silase, pengomposan 5. Life Cycle analysis (LCA) : Penilaian daur hidup, analisis siklus hidup, penilaian dampak siklus hidup <i>14. Source, Characteristics, Classification:</i>

	<i>Sources of Biomass, its classification, availability, compositional characteristics, energy content, carbon cycle</i> 15. <i>Physical Conversion: Parameters, calculation, and technology of direct application, palletizing, and compaction/briquetting</i> 16. <i>Thermochemical Conversion: Combustion, gasification, pyrolysis, carbonization, hydrothermal liquefaction, biodiesel</i> 17. <i>Biochemical Conversion: Biomethane, fermentation, silage, composting</i> 18. <i>Life Cycle Analysis (LCA): Life cycle assessment, life cycle analysis, life cycle impact assessment</i>					
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>					
	3. Biomass Processing Technologies, Vladimir Strezov, Tim J. Evans, CRC Press					
	4. The Handbook of Biomass Combustion and Co-firing, Sjaak van Loo and Jaap Koppejan, Earthscan in the UK and USA					
	Pendukung: <i>Supporting</i>					
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>			Perangkat keras: <i>Hardware</i>		
	OS:Windows; Office, Video demo			PC & LCD Projector		
Tim Pengajar <i>Team Teaching</i>	Dr. Ir. Totok Soehartanto, DEA					
Matakuliah syarat <i>Entry requirement</i>	- Teknologi Konversi Energi (<i>Energy Conversion Technology</i>)			Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>	
Mg Ke-Week (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessment point (%)</i> (7)
1-2	Mahasiswa mengetahui sumber-sumber Energi Biomassa, klasifikasi, ketersediaan, karakteristik, dan kandungan energinya.	Dapat menyebutkan dan menjelaskan sumber-sumber Energi Biomassa klasifikasi, karakteristiknya, dan kandungan energinya.	Tugas Mandiri : Review materi dan Latihan soal <i>Independent Assignment:</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	1. Potensi Biomassa di Indonesia 2. Klasifikasi Biomassa karakteristik	15%

	<i>Students know the sources of Biomass Energy, its classification, availability, characteristics, and energy content.</i> Tugas 1 <i>Assignment 1</i>	<i>Be able to name and explain the sources of Biomass Energy, their classification, characteristics, and energy content.</i> Dapat menghitung potensi Biomassa <i>Be able to calculate Biomass potential</i>	<i>Material Review and Exercises</i> Tugas mandiri: Mencari contoh Biomassa dan mengkarakteristikan <i>Independent Assignment: Looking for the examples of Biomass and characterize</i>		7. <i>Potential of Biomass in Indonesia</i> 8. <i>Classification of Biomass characteristics</i> - Mencari contoh Biomassa dan mengkarakteristikan <i>Looking for the examples of Biomass and characterize</i>	
3-4	Mahasiswa memahami <i>Cyclus Carbon</i> <i>Students understand Cyclus Carbon</i> Mahasiswa mengetahui teknologi untuk mengkonversi fisik Biomassa agar lebih praktis sebagai bahan bakar <i>Students know the technology for converting physical Biomass into more practical fuel</i>	Dapat menyebutkan siklus karbon dan peristiwa fisika yang ada di dalamnya <i>Be able to name carbon cyclus and physical case that occurred in it</i> Dapat menjelaskan teknologi konversi fisik Biomassa <i>Be able to explain Biomass physical conversion technology</i>	Makalah + ppt <i>Paper + PPT</i>	SCL(Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	Konsep <i>cyclus carbon</i> <i>Concept of carbon cyclus</i> Teknologi briketisasi Biomassa <i>Biomass briquette technology</i>	
5-6	Tugas 2 <i>Assignment 2</i>	Dapat menghitung besaran-besaran fisika dalam teknologi Biomassa	Tugas mandiri : Mencari contoh briketisasi Biomassa Menghitung kalor briket	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Mencari contoh briketisasi Biomassa - Menghitung kalor briket Biomassa - Konsep teknik thermokimia	5%

	Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui thermokimia <i>Students are able to explain the technique of converting Biomass into energy through thermochemistry</i>	<i>Be able to calculate physical quantities in Biomass technology</i> Dapat menjelaskan teknik konversi Biomassa menjadi energi melalui thermokimia <i>Be able to explain the technique of converting Biomass into energy through thermochemistry</i>	<i>Independent Assignment: Looking for examples of Biomass briquettes Calculating the heat of Biomass briquettes</i> Makalah + ppt <i>Paper + PPT</i>		- Looking for examples of Biomass briquettes - Calculating the heat of Biomass briquettes - Thermochemical engineering concept	
7	Tugas 3 <i>Assignment 3</i>	Dapat menghitung energi Biomassa melalui thermokimia <i>Be able to calculate Biomass energy through thermochemistry</i>	Tugas mandiri : Mencari contoh teknik konversi Biomassa melalui thermokimia <i>Independent Assignment: Looking for examples of Biomass conversion techniques through thermochemistry</i>	SCL (Kuliah dan diskusi) [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	- Mencari contoh teknik konversi Biomassa melalui thermokimia <i>Looking for examples of Biomass conversion techniques through thermochemistry</i>	10%
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					20%
9-10	Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (Biogas dari Bioreaktor Anaerob) <i>Students are able to explain the technique of converting Biomass into energy through biochemistry (Biogas from Anaerobic Bioreactors)</i>	Dapat menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (Biogas dari Bioreaktor Anaerob) <i>Be able to explain the technique of converting Biomass into energy through biochemistry (Biogas from Anaerobic Bioreactors)</i>	Makalah + ppt <i>Paper + PPT</i> Tugas mandiri: Mencari contoh teknik konversi Biomassa melalui Biokimia <i>Independent Assignment:</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Konsep teknik Biokimia Bioreaktor anaerob <i>Biochemical engineering concepts anaerobic bioreactor</i> - Mencari contoh teknik konversi Biomassa melalui Biokimia	10%

	<i>biochemistry (Biogas from Anaerobic Bioreactors)</i> Tugas 4 <i>Assignment 4</i>	Dapat menghitung konversi energi melalui biokimia <i>Be able to calculate energy conversion through biochemistry</i>	<i>Looking for examples of Biomass conversion techniques through Biochemistry</i>		<i>Looking for examples of Biomass conversion techniques through Biochemistry</i>	
11-13	Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (pembuatan Bioethanol dari Molase / tetes pabrik gula) <i>Students are able to explain the technique of converting Biomass into energy through biochemistry (making Bioethanol from Molasses / sugar factory drops)</i> Tugas 5 <i>Assignment 5</i> Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (gasifikasi sampah municipal) <i>Students are able to explain the technique of converting Biomass into energy through</i>	Dapat menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (pembuatan Bioethanol dari Molase / tetes pabrik gula) <i>Be able to explain the technique of converting Biomass into energy through biochemistry (making Bioethanol from Molasses / sugar factory drops)</i> Dapat menghitung energi melalui biokimia <i>Be able calculate energy through biochemistry</i> Dapat menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (gasifikasi sampah municipal) <i>Be able explain the technique of converting Biomass into energy through biochemistry (municipal waste gasification)</i>	Makalah + ppt <i>Paper + PPT</i> Tugas mandiri : Menghitung bioethanol yang dihasilkan dari proses fermentasi tetes <i>Independent Assignment: Calculating bioethanol produced from the drip fermentation process</i>	SCL (Kuliah dan diskusi) [TM: 3x(2x50'')] [BT: 3x(2x60'')] [BM: 3x(2x60'')]	- Konsep teknik Biokimia - Proses pembuatan bioethanol - Menghitung bioethanol yang dihasilkan dari proses fermentasi tetes - Konsep gasifikasi sampah municipal - Teknik explorasi gas dari sampah - Biochemical engineering concepts - The process of making bioethanol - Calculating bioethanol produced from the drip fermentation process - City waste gasification concept - Gas exploration techniques from waste	10%

	<i>biochemistry (municipal waste gasification)</i>					
14-15	Tugas 6 <i>Assignment 6</i> Mahasiswa mampu melakukan <i>Life Cycle Analysis</i> dari Biomassa <i>Students are able to do Life Cycle Analysis of Biomass</i>	Dapat menghitung konversi Biomassa <i>Be able to calculate Biomass conversion</i> Dapat menjelaskan <i>Life Cycle Analysis</i> dari Biomassa <i>Be able to explain Life Cycle Analysis of Biomass</i>	Tugas mandiri : Menghitung bioethanol yang dihasilkan dari proses fermentasi sampah municipal <i>Independent Assignment : Calculating bioethanol produced from the municipal waste fermentation process</i> Makalah + ppt <i>Paper + PPT</i>	Kuliah, brainstorming, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	- Menghitung biomethane yang dihasilkan dari proses fermentasi sampah municipal - Konsep life cycle bomassa - <i>Calculating the biomethane produced from the municipal waste fermentation process</i> - <i>Bomassa life cycle concept</i>	10%
16	Evaluasi Akhir Semester <i>Final Examination</i>					20%

Catatan :

Note

10. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS ENERGI BIOMASSA Biomass Energy			RA&E
				Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185341	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Pilihan <i>Field of Specialization:</i> <i>Elective</i>	Smt: 3 <i>Semester: 3</i>	
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i>	Koordinator RMK <i>Field Coordinator</i> Dr. Ir. Totok Soehartanto, DEA	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)	Bobot (%) CP-MK5 (8)
1-2	Mahasiswa mengetahui sumber-sumber Biomassa, klasifikasi, ketersediaan, karakteristik, dan kandungan energinya <i>Students know the sources of Biomass Energy, its classification, availability, characteristics, and energy content</i> Tugas 1 <i>Assignment 1</i>	Tugas Mandiri : review materi dan latihan soal <i>Independent Assignment:</i> <i>Material Review and Exercises</i> Tugas mandiri: Mencari contoh Biomassa dan mengkarakteristikan <i>Independent Assignment:</i> <i>Looking for the examples of Biomass and characterize</i>	15%				

3-4	Mahasiswa memahami <i>Cyclus Carbon</i> <i>Students understand Cyclus Carbon</i> Mahasiswa mengetahui teknologi untuk mengkonversi fisik Biomassa agar lebih praktis sebagai bahan bakar <i>Students know the technology for converting physical Biomass into more practical fuel</i>	- Kuliah dan Diskusi + Latihan soal <i>SCL + excersices</i> - Makalah + ppt <i>Paper + PPT</i>					
5-6	Tugas 2 <i>Assignment 2</i> Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui thermokimia <i>tudents are able to explain the security instrumentation system (safety) in industr</i>	Tugas mandiri : - Mencari contoh briketisasi Biomassa - Menghitung kalor briket <i>Independent Assignment:</i> <i>- Looking for examples of Biomass briquettes</i> <i>- Calculating the heat of Biomass briquettes</i> Kuliah dan diskusi <i>SCL</i>		5%			
7	Tugas 3 <i>Assignment 3</i>	Tugas mandiri : Mencari contoh teknik konversi Biomassa melalui thermokimia <i>Independent Assignment:</i> <i>Looking for examples of Biomass conversion techniques through thermochemistry</i>		5%	5%		
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>		5%	10%	5%		
9-10	Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (Biogas dari Bioreaktor Anaerob)	Kuliah dan diskusi <i>SCL</i> Tugas mandiri: Mencari contoh teknik konversi Biomassa melalui Biokimia			10%		

	<i>Students are able to explain the technique of converting Biomass into energy through biochemistry (Biogas from Anaerobic Bioreactors)</i> Tugas 4 <i>Assignment 4</i>	<i>Independent Assignment: Looking for examples of Biomass conversion techniques through Biochemistry</i>					
11-13	Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (pembuatan Bioethanol dari Molase / tetes pabrik gula) <i>Students are able to explain the technique of converting Biomass into energy through biochemistry (making Bioethanol from Molasses / sugar factory drops)</i> Tugas 5 <i>Assignment 5</i> Mahasiswa mampu menjelaskan teknik konversi Biomassa menjadi energi melalui biokimia (gasifikasi sampah municipal) <i>Students are able to explain the technique of converting Biomass into energy through biochemistry (municipal waste gasification)</i>	Kuliah dan diskusi <i>SCL</i> Tugas mandiri : Menghitung bioethanol yang dihasilkan dari proses fermentasi tetes <i>Independent Assignment: Calculating bioethanol produced from the drip fermentation process</i>				10%	
14-15	Tugas 6 <i>Assignment 6</i> Mahasiswa mampu melakukan <i>Life Cycle Analysis</i> dari Biomassa	Tugas mandiri : Menghitung bioethanol yang dihasilkan dari proses fermentasi sampah municipal <i>Independent Assignment : Calculating bioethanol produced from the municipal waste fermentation process</i>					10%

	Students are able to do Life Cycle Analysis of Biomass	Kuliah dan diskusi SCL					
16	Evaluasi Akhir Semester (Final Examination)					10%	10%
Total Bobot Penilaian (%) Total Point (%)			20%	20%	20%	20%	20%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
	Energi Air <i>Hydro Energy</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (<i>Code</i>): TF185342	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)</i>	Rumpun MK: Pilihan <i>Field of Specialization: Elective</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI (<i>Authorization</i>)	Pengembang RP <i>Contact Person – Learning Plan</i>	Koordinator RMK <i>Field Coordinator</i>	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengidentifikasi, merancang, melaksanakan, dan mengembangkan metodologi yang sesuai serta menganalisis dan menginterpretasi data dengan tepat. (25%) <i>Are able to identify, design, implement, and develop appropriate methodologies as well as analyze and interpret data appropriately.</i> CP-3 Mampu merancang komponen, sistem, atau proses dalam bidang rekayasa teknik fisika sesuai kebutuhan dan batasan operasional yang realistis. (25%) <i>Are able to design components, systems, or processes in the field of engineering physics according to needs and realistic operational constraints.</i> CP-4 Mampu berpikir kritis, kreatif dan inovatif dalam mengidentifikasi, memformulasi, mengevaluasi dan menyelesaikan masalah kerekayasaan yang berkembang di bidang teknik fisika. (25%) <i>Are able to think critically, creatively, and innovatively in identifying, formulating, evaluating, and solving engineering problems that develop in the field of engineering physics.</i>	

	CP-5 Mampu menggunakan teknik, keterampilan, dan peralatan rekayasa yang tersedia dan diperlukan dalam bidang teknik fisika. (25%) <i>Are able to use engineering techniques, skills, and engineering tools that are available and needed in the field of engineering physics.</i> CP-MK Course Learning Outcome (CLO) 1. Mahasiswa mampu menghitung dan menganalisa potensi dan analisis data air. <i>Students are able to calculate and analyze the potential and analysis of water data are able to explain about the instrumentation system for monitoring, security, and control.</i> 2. Mahasiswa mampu memahami, menghitung, dan menganalisa Hidrodinamika dan jenis-jenis turbin air. <i>Students are able to understand, calculate, and analyze hydrodynamics and types of hydro turbines.</i> 3. Mahasiswa mampu mengembangkan metodologi dan mendisain konversi energi air (jatuhan dan arus). <i>Students are able to develop methodology and design water energy conversion (fall and flow).</i> 4. Mahasiswa mampu mengetahui aspek-aspek dan urutan pelaksanaan studi kelayakan energi air serta implementasi komersialnya. <i>Students are able to know the aspects and sequence of conducting a feasibility study on water energy and its commercial implementation are able to explain about the instrumentation system for monitoring, security, and control.</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini memiliki tujuan mempelajari dan menerapkan prinsip-prinsip dasar termodinamika, mekanika fluida dan sistem mekanik untuk rekayasa turbin air. Dasar-dasar turbin air akan dijelaskan. Hidrodinamika turbin air; kinerja; desain komponen turbin air. Ikhtisar sumber daya air dan sejarah perkembangan turbin air serta pengenalan instalasi turbin air juga akan dibahas. Proyek berbasis tim merupakan bagian integral dari program ini. <i>This lecture aims to study and apply the basic principles of thermodynamics, fluid mechanics and mechanical systems for water turbine engineering. The basics of water turbines will be explained. Hydrodynamic water turbine; performance; water turbine component design. An overview of water resources and the history of water turbine development as well as an introduction to water turbine installations will also be discussed. Team-based projects are an integral part of the programme.</i>
Pokok Bahasan / Bahan Kajian Module content	1. Persamaan kontinuitas, persamaan momentum, Kinematika aliran, aliran Laminar dan turbulen melalui pipa. 2. Persamaan Navier- Stokes, model turbulen, parameter lapisan batas dan estimasi mereka, pemisahan lapisan batas. 3. Gaya hambat dan angkat pada badan yang terendam. 4. Aliran dalam saluran terbuka. 5. Jenis dan skema pembangkit tenaga air, hidrologi: studi limpasan, perkiraan estimasi banjir, penilaian potensi pembangkit tenaga air di cekungan, penyimpanan dan pondasi, studi beban, elemen pembangkit tenaga air dan desain hidroliknya: bendungan, intake. 6. Efek skala dan kemiripan hidraulik, non-dimensional number dan model, hukum afinitas untuk mesin hidrolis, pengujian model dan karakteristik kinerja. 7. Aliran dalam pipa, aliran laminar dan turbulen, alat kelengkapan pipa, kerugian pada pipa dan fitting, pipa secara seri dan paralel, karakteristik kehilangan tekanan, kapasitas pompa, pemilihan diameter optimal, analisis Jaringan pipa.

	8. Pendahuluan dan ikhtisar CFD, Akurasi dan kesalahan, konsistensi, stabilitas dan konvergensi, area aplikasi, persamaan alir diferensial, kondisi awal dan batas, metode beda hingga, metode elemen hingga, metode volume hingga, model turbulensi, jenis grid, metode pembuatan grid , Aplikasi CFD. 19. <i>Equation of continuity, equation of momentum, Kinematics of flow, Laminar and turbulent flow through pipes.</i> 20. <i>Navier-Stokes equation, turbulent model, boundary layer parameters and their estimation, boundary layer separation.</i> 21. <i>The drag and lift on a submerged body.</i> 22. <i>Flow in open channel.</i> 23. <i>Types and schemes of hydropower generation, hydrology: runoff studies, flood estimation estimates, hydroelectric potential assessment in basins, storage and foundations, load studies, hydroelectric elements and their hydraulic design: dams, intakes.</i> 24. <i>Hydraulic similarity and scale effects, non-dimensional number and model, affinity laws for hydraulic machines, model testing and performance characteristics.</i> 25. <i>Flow in pipes, laminar and turbulent flow, pipe fittings, losses in pipes and fittings, pipes in series and parallel, pressure loss characteristics, pump capacity, optimal diameter selection, Pipeline analysis.</i> 26. <i>Introduction and overview of CFD, Accuracy and error, consistency, stability and convergence, application areas, differential flow equations, initial and boundary conditions, finite difference method, finite element method, finite volume method, turbulence model, grid types, grid generation method , CFD application.</i>		
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>		
	1. Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Wade W. Huebsch, Fundamentals of Fluid Mechanics, Wiley 2. Mechanics of Fluids- Frank. M. White, McGraw-Hill 3. Fundamentals Of Hydrology, Tim Davie, Routledge Fundamentals Of Physical Geography Hydrology Handbook, SCE Manuals and Reports on Engineering Practice.		
	Pendukung: <i>Supporting</i>		
Media Pembelajaran <i>Learning Media</i>	Perangkat lunak: <i>Software</i>	Perangkat keras: <i>Hardware</i>	
	OS:Windows; Office, Video demo	PC & LCD Projector	
Tim Pengajar <i>Team Teaching</i>	Dr.Ridho Hantoro, ST,MT. ,Gunawan Nugroho, ST,MT,PhD.		
Matakuliah syarat <i>Entry requirement</i>	-	Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>

Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessm ent point (%) (7)
1-2	1. Mahasiswa memahami perkembangan teknologi turbin air. 2. Mahasiswa memahami potensi kinetik energi air 1. <i>Students understand the development of water turbine technology.</i> 2. <i>Students understand the kinetic potential of water energy</i>	- Ketepatan memahami perkembangan teknologi turbin air - Ketepatan memahami dan menghitung potensi kinetik energi air <i>Accuracy in understanding the development of water turbine technology</i> <i>Accuracy in understanding and calculating the kinetic energy potential of water</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah Diskusi Presentasi tugas <i>Lectures</i> <i>Discussions</i> <i>Task presentation</i>	- Kebijakan Energi Nasional - Potensi Energi Nasional - Bauran Energi Nasional - Peraturan Feed In Tarif <i>- National Energy Policy</i> <i>- National Energy Potential</i> <i>- National Energy Mix</i> <i>- Feed In Tariff Regulation</i>	10%
3-4	1. Mahasiswa mampu mengidentifikasi sumber energi air. 2. Mahasiswa memahami karakteristik energi air. 1. <i>Students are able to identify water energy sources.</i> 2. <i>Students understand the characteristics of water energy.</i>	- Ketepatan mengidentifikasi sumber energi air. - Pemahaman karakteristik energi air <i>Accuracy in identifying water energy sources.</i> <i>Understanding the characteristics of water energy</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah Diskusi Presentasi tugas <i>Lectures</i> <i>Discussions</i> <i>Task presentation</i>	- pola peredaran bumi terhadap Surya dan efeknya terhadap intensitas radiasi. - Mekanisme radiasi (direct, beam, difuse) - Perpindahan panas oleh radiasi matahari. - Teknologi konversi energi Surya (PV dan Thermal) <i>- the pattern of the earth's rotation about the sun and its effect on the intensity of radiation.</i>	10%

					- Radiation mechanism (direct, beam, diffuse) - Heat transfer by solar radiation. - Solar energy conversion technology (PV and Thermal) Monitoring	
5-6	1. Mahasiswa mampu memahami dan menghitung konsep actuator disk 2. Mahasiswa memahami momentum theory. <i>1. Students are able to understand and calculate the concept of actuator disk</i> <i>2. Students understand momentum theory.</i>	Kemampuan memahami dan menghitung konsep actuator disk dan momentum theory <i>Ability to understand and calculate actuator disk concepts and momentum theory</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah Diskusi Presentasi Tugas <i>Lectures Discussions Task presentation</i>	- Tipe dan ketersediaan biomassa - Nilai kalor biomassa - Teknologi konversi energi biomassa - Type and availability of biomass - Calorific value of biomass - Biomass energy conversion technology	10%
7-9	1. Mahasiswa mampu menghitung dan menganalisa performansi turbin air. <i>1. Students are able to calculate and analyze the performance of water turbines.</i>	• Kemampuan menghitung dan menganalisa performansi turbin air • <i>Ability to calculate and analyze water turbine performance</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah Diskusi Presentasi Tugas <i>Lectures Discussions Task presentation</i>	- pola peredaran bumi terhadap Surya dan efeknya terhadap peredaran angin - Mekanisme ekstraksi energi air - the pattern of the earth's circulation to the sun and its effect on the circulation of the wind - Water energy extraction mechanism	10%
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					15%

9	Lihat minggu ke-7 <i>Look at week 7</i>					
10-11	1. Mahasiswa mampu memahami dan menyusun konseptual disain turbin air. <i>1. Students are able to understand and develop conceptual design of water turbines.</i>	- Kemampuan menyusun konseptual disain turbin air <i>• Ability to conceptualize water turbine design</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah Diskusi Presentasi Tugas <i>Lectures Discussions Task presentation</i>	Prinsip fisika dari proses sensing: • elektrik • mekanik • akustik • Thermal • optik <i>The physical principle of the sensing process:</i> • <i>electric</i> • <i>mechanic</i> • <i>acoustic</i> • <i>Thermal</i> • <i>optics</i>	10%
12-13	1. Mahasiswa mampu memahami aspek-aspek implementasi pemasangan turbin air <i>1. Students are able to understand the implementation aspects of water turbine installation</i>	- Kemampuan memahami aspek-aspek implementasi pemasangan turbin air <i>• Ability to understand the implementation aspects of water turbine installation</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah Diskusi Presentasi Tugas <i>Lectures Discussions Task presentation</i>	• Konsep radiometri & fotometri • Komponen optik dalam sensor • Komponen elektronik untuk sistem akuisisi data elektronik suatu sensor / sistem sensor <i>• Concepts of radiometry and photometry</i> <i>• Optical components in the sensor</i> <i>• Electronic components for the electronic data acquisition system of a sensor / sensor system</i>	10%

14-15	1. Mahasiswa mampu membuat studi kasus perancangan penyediaan turbin air. <i>1. Students are able to make a case study of the design of the water turbine supply.</i>	- Kemampuan membuat studi kasus perancangan penyediaan turbin air. <i>Ability to make case studies of water turbine supply design.</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah Diskusi Presentasi Tugas <i>Lectures Discussions Task presentation</i>	<i>Band-band recombination</i> <i>Donor-Acceptor Pair Transitions system</i> <i>Band-impurity Recombination</i>	10%
16	Evaluasi Akhir Semester <i>Final Examination</i>					15%

Catatan :

Note

11. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Energi Air Hydro Energy			RA&E
				Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185342	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Pilihan <i>Field of Specialization: Elective</i>	Smt: 3 <i>Semester: 3</i>	
OTORISASI <i>(Authorization)</i>	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i>	Koordinator RMK <i>Field Coordinator</i>	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1-2	1. Mahasiswa memahami perkembangan teknologi turbin air. 2. Mahasiswa memahami potensi kinetik energi air <i>1. Students understand the development of water turbine technology.</i> <i>2. Students understand the kinetic potential of water energy</i>	- Ketepatan memahami perkembangan teknologi turbin air - Ketepatan memahami dan menghitung potensi kinetik energi air <i>Accuracy in understanding the development of water turbine technology</i> <i>Accuracy in understanding and calculating the kinetic energy potential of water</i>	10%			
3-4	1. Mahasiswa mampu mengidentifikasi sumber energi air.	- Ketepatan mengidentifikasi sumber energi air. - Pemahaman karakteristik energi air	10%			

	2. Mahasiswa memahami karakteristik energi air. 1. <i>Students are able to identify water energy sources.</i> 2. <i>Students understand the characteristics of water energy.</i>	• <i>Accuracy in identifying water energy sources.</i> • <i>Understanding the characteristics of water energy</i>				
5-6	1. Mahasiswa mampu memahami dan menghitung konsep actuator disk 2. Mahasiswa memahami momentum theory. 1. <i>Students are able to understand and calculate the concept of actuator disk</i> 2. <i>Students understand momentum theory.</i>	• Kemampuan memahami dan menghitung konsep actuator disk dan momentum theory <i>Ability to understand and calculate actuator disk concepts and momentum theory</i>		10%		
7-9	1. Mahasiswa mampu menghitung dan menganalisa performansi turbin air. 1. <i>Students are able to calculate and analyze the performance of water turbines.</i>	• Kemampuan menghitung dan menganalisa performansi turbin air <i>Ability to calculate and analyze water turbine performance</i>		10%		
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>		7,5%	7,5%		
9	Lihat minggu ke-7 <i>Look at week 7</i>					
10-11	1. Mahasiswa mampu memahami dan menyusun konseptual disain turbin air. 1. <i>Students are able to understand and develop conceptual design of water turbines.</i>	• Kemampuan menyusun konseptual disain turbin air <i>Ability to conceptualize water turbine design</i>			10%	
12-13	1. Mahasiswa mampu memahami aspek-aspek implementasi pemasangan turbin air 1. <i>Students are able to understand the implementation aspects of water turbine installation</i>	• Kemampuan memahami aspek-aspek implementasi pemasangan turbin air <i>Ability to understand the implementation aspects of water turbine installation</i>			5%	5%

14-15	1. Mahasiswa mampu membuat studi kasus perancangan penyediaan turbin air. <i>1. Students are able to make a case study of the design of the water turbine supply.</i>	Kemampuan membuat studi kasus perancangan penyediaan turbin air. <i>Ability to make case studies of water turbine supply design.</i>				10%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)				7,5%	7,5%
Total Bobot Penilaian (%) <i>Total Point</i> (%)			27,5%	27,5%	22,5%	22,5%

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i>		RP
			Edisi: Agt 2018 <i>Edition: Aug 2018</i>
	Energi Surya <i>Solar Energy</i>		
Kode (<i>Code</i>): TF185343	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Pilihan <i>Field of Specialization: Elective</i>	Smt: 3 <i>Semester: 3</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i>	Koordinator RMK <i>Field Coordinator</i> Ir. Harsono Hadi M T., Ph.D	Ka PRODI <i>Head of Master Program</i> Aulia M T Nasution

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 Mampu mengidentifikasi, merancang, melaksanakan, dan mengembangkan metodologi yang sesuai serta menganalisis dan menginterpretasi data dengan tepat. (25%) <i>Are able to identify, design, implement, and develop appropriate methodologies as well as analyze and interpret data appropriately.</i> CP-3 Mampu merancang komponen, sistem, atau proses dalam bidang rekayasa teknik fisika sesuai kebutuhan dan batasan operasional yang realistis. (25%) <i>Are able to design components, systems, or processes in the field of engineering physics according to needs and realistic operational constraints.</i> CP-4 Mampu berpikir kritis, kreatif dan inovatif dalam mengidentifikasi, memformulasi, mengevaluasi dan menyelesaikan masalah kereakayaan yang berkembang di bidang teknik fisika. (25%) <i>Are able to think critically, creatively, and innovatively in identifying, formulating, evaluating, and solving engineering problems that develop in the field of engineering physics.</i>	

	CP-5 Mampu menggunakan teknik, keterampilan, dan peralatan rekayasa yang tersedia dan diperlukan dalam bidang teknik fisika. (25%) <i>Are able to use engineering techniques, skills, and engineering tools that are available and needed in the field of engineering physics.</i>	
	CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu menghitung dan menganalisa potensi dan analisis data energi surya. (CP-) (%) <i>Students are able to calculate and analyze the potential and analyze solar energy data.</i> 2. Mahasiswa mampu memahami, menghitung dan menganalisa radiasi surya dan jenis-jenis konversinya. (CP-) (%) <i>Students are able to understand, calculate and analyze solar radiation and its types of conversion</i> 3. Mahasiswa mampu mengembangkan metodologi dan mendesain konversi energi surya (PV dan solar thermal). (CP-) (%) <i>Students are able to develop methodologies and design solar energy conversion (PV and solar thermal)</i> 4. Mahasiswa mampu mengetahui aspek-aspek dan urutan pelaksanaan studi kelayakan energi surya serta implementasi komersialnya. (CP-)(%) <i>Students are able to know the aspects and sequence of conducting a feasibility study on solar energy and its commercial implementation</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini memiliki tujuan mempelajari konversi energi Surya dan menerapkan prinsip-prinsip dasar termodinamika, mekanika fluida dan perpindahan panas. Dasar-dasar photovoltaic dan solar thermal akan dijelaskan. Proyek berbasis tim merupakan bagian integral dari program ini. <i>This lecture aims to study the conversion of solar energy and apply the basic principles of thermodynamics, fluid mechanics and heat transfer. The basics of photovoltaic and solar thermal will be explained. Team-based projects are an integral part of the programme.</i>	
Pokok Bahasan / Bahan Kajian Module content	• Sistem matahari, peredaran, perubahan musim, karakteristik radiasi matahari, perhitungan potensi energi • Sistem PV surya mencakup prinsip kerja dan perhitungan efisiensi, bahan dan jenis sel, karakteristik I-V, desain modul, pelacakan titik daya maksimum (MPPT), prinsip kerja dan pemodelan baterai dan inverter, konfigurasi sistem PV, desain sistem on-grid dan sistem off-grid, dan evaluasi kinerja sistem • Sistem termal surya mencakup mekanisme dan potensi perpindahan panas radiasi matahari, hasil pemanasan, disain dan perhitungan kolektor pelat datar, kolektor konsentrat, pemanas air matahari, pemanas dan pendinginan ruang matahari, dan sistem tenaga panas matahari. • <i>Solar system, circulation, seasonal changes, characteristics of solar radiation, calculation of energy potential</i> • <i>Solar PV systems cover working principles and efficiency calculations, cell materials and types, I-V characteristics, module design, maximum power point tracking (MPPT), battery and inverter working principles and modeling, PV system configuration, on-grid system design and off system -grid, and system performance evaluation</i> • <i>The solar thermal system includes the mechanism and potential of solar radiation heat transfer, heating yield, design and calculation of flat plate collectors, concentrate collectors, solar water heaters, solar space heating and cooling, and solar thermal power systems.</i>	
Pustaka Reading Materials	Utama: Main	

Solar Energy Engineering, Soteris A. Kalogirou, Academic Press Solar Energy Engineering, A.M. Sayigh, Academic Press Pendukung: Supporting						
Media Pembelajaran Learning Media		Perangkat lunak: Software			Perangkat keras: Hardware	
		OS:Windows; Office, Video demo			PC & LCD Projector	
Tim Pengajar Team Teaching		Ir. Harsono Hadi M T., Ph.D				
Matakuliah syarat Entry requirement		Fisika Teknik Lanjut (Advanced Engineering Physics) Matematika Teknik Lanjut (Advanced Engineering Mathematics)			Bahasa pengantar: Languages	Bahasa Indonesia Indonesian
Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessment point (%) (7)
1-2	Mampu menghitung potensi energi surya Be able to calculate the potential of solar energy Mampu menganalisa potensi energi surya Be able to analyze the potential of solar energy	Dapat menghitung potensi energi surya Can calculate the potential of solar energy Dapat menganalisa potensi energi surya Can analyze the potential of solar energy	Makalah + ppt Paper + PPT	Kuliah dan diskusi 2x50 min + (Latihan soal) Lectures and discussions 2x50 min + (Exercises)	Sistem Matahari Solar System Sistem peredaran matahari solar circulation system	10%
3-4	Mampu analisis data energi surya	Dapat menganalisis data energi surya	Makalah + ppt Paper + PPT	Kuliah dan diskusi 2x50 min + (Latihan soal)	Perubahan musim Seasonal change	10%

	<i>Be able to analyze solar energy data</i> Mampu memahami radiasi surya <i>Be able to understand solar radiation</i>	<i>Can analyze solar energy data</i> Dapat memahami radiasi surya <i>Can understand solar radiation</i>		<i>Lectures and discussions 2x50 min + (Exercises)</i>	Karakteristik radiasi matahari <i>Characteristics of solar radiation</i>	
5-6	Mampu menghitung radiasi surya <i>Be able to calculate solar radiation</i> Mampu menganalisa radiasi surya <i>Be able to analyze solar radiation</i>	Dapat menghitung radiasi surya <i>Can calculate solar radiation</i> Dapat menganalisa radiasi surya <i>Can analyze solar radiation</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah dan diskusi 2x50 min + (Latihan soal) <i>Lectures and discussions 2x50 min + (Exercises)</i>	Perhitungan Potensi Surya <i>Calculation of Solar Potential</i> Sistem PV surya (prinsip kerja dan perhitungan efisiensi) <i>Solar PV system (working principle and efficiency calculation)</i>	17,5%
7	Mampu mengetahui jenis jenis konversi energi surya <i>Be able to know the types of solar energy conversion</i>	Dapat mengetahui jenis jenis konversi energi surya. <i>Can know the types of solar energy conversion</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah dan diskusi 2x50 min + (Latihan soal) <i>Lectures and discussions 2x50 min + (Exercises)</i>	Bahan dan jenis sel karakteristik I-V desain modul <i>Material and cell type characteristics I-V module design</i>	12,5%
8	Evaluasi Tengah Semester (ETS) Mid Term Examination					
9-10	Mampu mengembangkan metodologi konversi energi surya	Dapat mengembangkan metodologi konversi energi surya <i>Can develop solar energy conversion methodology</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah dan diskusi 2x50 min + (Latihan soal) <i>Lectures and discussions 2x50 min + (Exercises)</i>	Pelacakan titik daya maksimum (MPPT) <i>Maximum power point tracking (MPPT)</i>	10%

	<i>Be able to develop solar energy conversion methodology</i>					
11-13	Mampu mendesain konversi energi surya solar thermal <i>Be able to design solar thermal energy conversion</i> Mampu mengetahui aspek kelayakan surya <i>Be able to know aspects of solar feasibility</i> Mampu memahami peluang komersial energi surya <i>Be able to understand the commercial opportunities of solar energy</i>	Dapat mendesain konversi energi surya solar thermal <i>Can design solar thermal energy conversion</i> Mampu mengetahui aspek kelayakan surya <i>Be able to know aspects of solar feasibility</i> Dapat memahami peluang komersial energi surya <i>Can understand the commercial opportunities of solar energy</i>	Makalah + ppt <i>Paper + PPT</i>	Kuliah dan diskusi 2x50 min + (Latihan soal) <i>Lectures and discussions 2x50 min + (Exercises)</i>	Desain sistem on-grid dan off-grid <i>On-grid and off-grid system design</i> Sistem termal surya (mekanisme dan potensi perpindahan panas radiasi matahari, hasil pemanasan) Bentuk alloy & karakteristiknya <i>Solar thermal system (mechanism and heat transfer potential of solar radiation, heating product) Form of alloys & their characteristics</i> Desain dan perhitungan kolektor pelat datar, kolektor konsentrat, pemanas air matahari. <i>Design and calculation of flat plate collector, concentrate collector, solar water heater.</i>	15%
14-15	Mampu memahami urutan studi kelayakan energi surya	Dapat memahami urutan studi kelayakan energi surya	Makalah + ppt <i>Paper + PPT</i>	Kuliah dan diskusi 2x50 min + (Latihan soal) <i>Lectures and discussions</i>	Pemanas dan pendingin ruangan matahari	25%

	<i>Be able to understand the sequence of solar energy feasibility studies</i> Mampu memahami urutan studi implementasi komersial energi surya <i>Be able to understand the sequence of studies on the commercial implementation of solar energy</i>	<i>Can understand the sequence of solar energy feasibility studies</i> Dapat memahami urutan studi implementasi komersial energi surya <i>Can understand the sequence of studies on the commercial implementation of solar energy</i>		2x50 min + (Exercises)	<i>Solar heating and air conditioning</i> Sistem tenaga panas matahari <i>Solar thermal power system</i>	
16	Evaluasi Akhir Semester <i>Final Examination</i>					

Catatan :

Note

12. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTI IST MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS Energi Surya Solar Energy			RA&E
				Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185343	Bobot sks(T/P) / ECTS: (2/0) / 3.2 Credits(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Pilihan Field of Specialization: <i>Elective</i>	Smt: <i>Semester:</i>	
OTORISASI (<i>Authorization</i>)	Penyusun RA & E PIC – Assessment & Evaluation Plan	Koordinator RMK Field Coordinator Ir. Harsono Hadi MT. Ph.D	Ka PRODI Head of Master Program Aulia M T Nasution	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot (%) CP-MK4 (7)
1-2	Mampu menghitung potensi energi surya <i>Be able to calculate the potential of solar energy</i> Mampu menganalisa potensi energi surya <i>Be able to analyze the potential of solar energy</i>	Kuliah dan diskusi 2 x 50 " <i>Lectures and discussions</i> 2x50 "	10%			
3-4	Mampu analisis data energi surya <i>Be able to analyze solar energy data</i>	Kuliah dan diskusi 2 x 50 "		10%		

	Mampu memahami radiasi surya <i>Be able to understand solar radiation</i>	<i>Lectures and discussions</i> 2x50 "				
5-6	Mampu menghitung radiasi surya <i>Be able to calculate solar radiation</i> Mampu menganalisa radiasi surya <i>Be able to analyze solar radiation</i>	Kuliah dan diskusi 2 x 50 " <i>Lectures and discussions</i> 2x50 "		17,5%		
7	Mampu mengetahui jenis jenis konversi energi surya <i>Be able to know the types of solar energy conversion</i>	Kuliah dan diskusi 2 x 50 " <i>Lectures and discussions</i> 2x50 "			12,5%	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					
9-10	Mampu mengembangkan metodologi konversi energi surya <i>Be able to develop solar energy conversion methodology</i>	Kuliah dan diskusi 2 x 50 " <i>Lectures and discussions</i> 2x50 "			5%	5%
11-13	Mampu mendesain konversi energi surya solar thermal <i>Be able to design solar thermal energy conversion</i> Mampu mengetahui aspek kelayakan surya <i>Be able to know aspects of solar feasibility</i> Mampu memahami peluang komersial energi surya	Kuliah dan diskusi 2 x 50 " <i>Lectures and discussions</i> 2x50 "			5%	10%

	<i>Be able to understand the commercial opportunities of solar energy</i>					
14-15	Mampu memahami urutan studi kelayakan energi surya <i>Be able to understand the sequence of solar energy feasibility studies</i> Mampu memahami urutan studi implementasi komersial energi surya <i>Be able to understand the sequence of studies on the commercial implementation of solar energy</i>	Kuliah dan diskusi 2 x 50 " <i>Lectures and discussions 2x50 "</i>				25%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)					
Total Bobot Penilaian (%) <i>Total Point</i> (%)			10%	27,5%	22,5%	40%

TF185344 RPS RAE Energi Angin (*Wind Energy*)

TF185441 RPS RAE Energi Panas Bumi (*Geothermal Energy*)

TF185443 RPS RAE Reduksi Emisi (*Emission Reduction*)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i>	RP
--	---	-----------

	PRODI MAGISTER TEKNIK FISIKA FTI ITS <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS – ITS</i> Reduksi Emisi <i>Emission Reduction</i>		Edisi: Agt 2018 <i>Edition: Aug 2018</i>
Kode (Code): TF185443	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits(T/P) / ECTS:</i> (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization: Energy Engineering and Environmental Conditioning</i>	Smt: 4 <i>Semester: 4</i>
OTORISASI <i>(Authorization)</i>	Pengembang RP <i>Contact Person – Learning Plan</i> Dr. Ridho Hantoro, ST., MT.	Koordinator RMK <i>Field Coordinator</i> Gunawan Nugroho, PhD	Ka PRODI <i>Head of Master Program</i> Dr. Ridho Hantoro

Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CP-PRODI <i>Program Learning Outcome (PLO)</i>	
	CP-2 CP-3 CP-5	Lulusan mampu mengembangkan pemikiran kritis, dan kreatif dalam mengidentifikasi, merumuskan, memecahkan, dan mengevaluasi masalah ilmiah dan rekayasa yang muncul di bidang fisika teknik secara intra atau multidisiplin. (18,75%) <i>Graduates are able to develop a critical, and creative thinking in identifying, formulating, solving, and evaluating the scientific and engineering problems that emerge in the field of engineering physics on an intra-or multidisciplinary basis.</i> Lulusan mampu mengidentifikasi dan mengembangkan metodologi yang tepat serta menganalisis dan mengevaluasi data penelitian dan rekayasa. (18,75%) <i>Graduates are able to identify and to develop the appropriate methodologies as well as to analyze and to evaluate research and engineering data</i> Lulusan mampu berkomunikasi secara efektif dalam format lisan dan tulisan. (25%) <i>Graduates are able to effectively communicate in both oral and written format</i>

	CP-6 Lulusan mampu secara mandiri mengembangkan metode, keterampilan, dan alat inovatif yang diperlukan dalam merancang dan mengoptimalkan sistem energi terbarukan dan berkelanjutan di bawah berbagai kondisi parameter. (37,5%) <i>Graduates are able to independently develop innovative methods, skills and tools required in designing and optimizing renewable and sustainable energy system under various parameter condition</i> CP-MK Course Learning Outcome (CLO) 1. Mahasiswa mampu mengaplikasikan prinsip-prinsip manajemen dan sistem pengurangan emisi <i>Students are able to apply management principles and emission reduction systems.</i> 2. Mahasiswa mampu memahami dan mengontrol teknik-teknik pengurangan emisi <i>Students are able to understand and control emission reduction techniques..</i> 3. Mahasiswa mampu menganalisis hasil asesmen kajian emisi dan mampu mengontrol dan mengurangi emisi. <i>Students are able to analyze the results of the assessment of emissions studies and are able to control and reduce emissions.</i> 4. Mahasiswa mampu menganalisis dinamika atmosfer secara umum. <i>Students are able to analyze the dynamics of the atmosphere in general.</i> 5. Mahasiswa mampu menganalisis siklus karbon dan sulfur secara global. <i>Students are able to analyze the global carbon and sulfur cycle.</i> 6. Mahasiswa mampu menganalisis pembentukan aerosol organik di atmosfer. <i>Students are able to analyze the formation of organic aerosols in the atmosphere.</i> 7. Mahasiswa mampu menerapkan teknologi pengurangan emisi. <i>Students are able to apply emission reduction technology.</i>
Diskripsi Singkat MK Course Description	Mata kuliah ini mempelajari tentang pengembangan keilmuan yakni Dinamika atmosfer global, Sirkulasi global dari karbon dan sulfur, Pembentukan aerosol organik di atmosfer, dan Penerapan teknologi pengurangan emisi Penerapan dalam ekonomi energi. <i>This course studies scientific developments, namely dynamics of the global atmosphere, global circulation of carbon and sulfur, formation of organic aerosols in the atmosphere, and the application of emission reduction technologies. Applications in the energy economy.</i>
Pokok Bahasan / Bahan Kajian Module content	1. Dinamika atmosfer global 2. Sirkulasi global dari karbon dan sulfur 3. Pembentukan aerosol organik di atmosfer 4. Penerapan teknologi pengurangan emisi Penerapan dalam ekonomi energi. <i>27. Global atmospheric dynamics</i> <i>28. Global circulation of carbon and sulfur</i> <i>29. Formation of organic aerosols in the atmosphere</i> <i>30. Application of emission reduction technology Application in energy economy</i>

Pustaka <i>Reading Materials</i>		Utama: <i>Main</i> 3. Seinfeld J.H., Atmospheric Chemistry and Physics 2nd Edition, John Wiley & Sons, Inc., New Jersey, 2006 4. Emission Reduction Techniques for Oil and Gas Activities , U.S. Forest Service 2011 5. (http://www.oilandgasbmps.org/ browse.php?cat=1) 6. http://www.epa.gov/gasstar/tools/recommended.html 7. http://www.blm.gov/wo/st/en/prog/energy/oil_and_gas/best_management_Practice/technical Pendukung: <i>Supporting</i> 9. Moreira D. & Vilhena M. (Ed.), Air Pollution and Turbulence: Modeling and Applications, Taylor and Francis Group, Boca Raton, 2010 10. International journal emission reduction 11. International Journal of Greenhouse Gas Control 12. Approaches to reducing carbon dioxide emissions				
Media Pembelajaran <i>Learning Media</i>		Perangkat lunak: <i>Software</i> Microsoft office			Perangkat keras: <i>Hardware</i> Private Computer	
Tim Pengajar <i>Team Teaching</i>		Dr. Ridho Hantoro, ST., MT.				
Matakuliah syarat <i>Entry requirement</i>			-		Bahasa pengantar: <i>Languages</i>	Bahasa Indonesia <i>Indonesian</i>
Mg Ke- <i>Week</i> (1)	Sub-CP-MK <i>Sub-CLO</i> (2)	Indikator Penilaian <i>Assessment Indicator</i> (3)	Kriteria & Bentuk Penilaian <i>Criteria & Assessment Form</i> (4)	Metode Pembelajaran [Estimasi Waktu] <i>Learning Method</i> [Work load] (5)	Materi Pembelajaran <i>Course/learning Content</i> (6)	Bobot Penilaian (%) <i>Assessm ent point (%)</i> (7)
1-2	Mahasiswa mampu menjelaskan tentang History of Earth’s Climate.Greenhouse Effect, Earth’s Atmospheric Gases.	Ketepatan mengidentifikasi History of Earth’s Climate.Greenhouse Effect, Earth’s Atmospheric Gases.	Tugas 1: Review literatur Presentasi tentang History of Earth’s Climate.Greenhouse	SCL (Kuliah dan diskusi) [TM: 2x(2x50’’)] [BT: 2x(2x60’’)] [BM: 2x(2x60’’)]	- Apakah dunia semakin panas? - Jika demikian, apakah tindakan manusia yang harus disalahkan atas kenaikan suhu bumi?	10%

	<i>Students are able to explain the History of Earth's Climate. Greenhouse Effect, Earth's Atmospheric Gases</i>	<i>Accuracy of identifying History of Earth's Climate. Greenhouse Effect, Earth's Atmospheric Gases</i>	Effect, Earth's Atmospheric Gases <i>Assignment 1:</i> • Literature review • Presentation on History of Earth's Climate. Greenhouse Effect, Earth's Atmospheric Gases		• Is the world getting warmer? • If so, are the actions of mankind to blame for earth's temperature increases	
3-4	Mahasiswa mampu menjelaskan peningkatan konsentrasi CO ₂ di atmosfer kontribusi Power Plant dan Rumah Tangga. <i>Students are able to explain the increase in CO₂ concentration in the atmosphere contributed by Power Generation and Households.</i>	• Ketepatan menghitung dan menjelaskan peningkatan konsentrasi CO₂ di atmosfer kontribusi Power Plant dan Rumah Tangga • The accuracy of calculating and explaining the increase in the concentration of CO₂ in the atmosphere contributed by Power Plants and Households	Tugas 2: Tugas mandiri menghitung dan menjelaskan peningkatan konsentrasi CO ₂ di atmosfer kontribusi Power Plant dan Rumah Tangga <i>Assignment 2:</i> • Independent task of calculating and explaining the increase in the concentration of CO₂ in the atmosphere contributed by Power Plants and Households	Kuliah, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')] [BM: 2x(2x60'')]	• Menyelesaikan masalah pengurangan GHG secara internasional <i>Solving the problem of reducing GHG internationally</i>	10%
5-7	Mahasiswa mampu memahami peningkatan Protection of Air Resources	• Ketepatan mengidentifikasi dan memahami peningkatan Protection of Air Resources.	Tugas 3: Menyusun makalah tentang peningkatan	Kuliah, presentasi dan diskusi [TM: 2x(2x50'')] [BT: 2x(2x60'')]	Kontrol Administratif di Jalan; • Emisi berkurang • Manfaat	15%

	<i>Students are able to understand the improvement of Protection of Air Resources</i>	<i>Accurately identify and understand the improvement of Protection of Air Resources.</i>	Protection of Air Resources <i>Assignment 3:</i> <i>Prepare a paper on improving the Protection of Air Resources</i>	[BM: 2x(2x60'')]	• Dimana hal ini dapat diterapkan, • Keterbatasan Dokumen Perencanaan; Gagasan untuk dokumen perencanaan: fase transportasi <i>1 Administrative Controls on Roadways;</i> • <i>Emissions reduced</i> • <i>Benefits</i> • <i>Where this can be applied,</i> • <i>Limitations</i> <i>Planning Documents; Ideas for planning documents: transport phase</i>	
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					10%
9-11	Mahasiswa mampu menganalisis Air Resource Emission Reduction Techniques Drilling Phase <i>Students are able to analyze the Drilling Stage Air Resources Emission Reduction Technique.</i>	Ketepatan menghitung dan menganalisis Air Resource Emission Reduction Techniques Drilling Phase. <i>Accuracy in calculating and analyzing Air Resource Emission Reduction Techniques Drilling Phase.</i>	<u>Tugas 6:</u> • Tugas Mandiri menghitung dan menganalisis Air Resource Emission Reduction Techniques Drilling Phase. <i>Assignment 6:</i> <i>Independent Tasks to calculate and analyze Air Resource Emission Reduction Techniques Drilling Phase.</i>	Kuliah, presentasi dan diskusi [TM: 1x(2x50'')] [BT: 1x(2x60'')] [BM: 1x(2x60'')]	Analisis Teknik pengurangan emisi: • Melakukan pertemuan lapangan pra-konstruksi sebelum memulai pekerjaan tanah. • Gunakan peredam debu untuk meminimalkan dampak • tindakan pencegahan yang diperlukan untuk meminimalkan bahaya kebakaran <i>Emission reduction engineering analysis:</i>	20%

					• <i>Conduct a pre-construction field meeting prior to beginning any dirt work.</i> • <i>Employ dust suppression to minimize impacts.</i> • <i>necessary precautions to minimize fire hazards</i>	
12-13	Mahasiswa mampu menjalankan Air Resource Emission Reduction Techniques Production Phase. <i>Students are able to carry out the Production Stage of Air Resources Emission Reduction Engineering.</i>	Ketepatan menghitung dan menjalankan Air Resource Emission Reduction Techniques Production Phase. <i>Accuracy in calculating and executing Air Resource Emission Reduction Techniques Production Phase</i>	Tugas 7: Tugas Mandiri menghitung dan menjalankan Air Resource Emission Reduction Techniques Production Phase. <i>Assignment 7:</i> <i>Independent Tasks to calculate and execute Air Resource Emission Reduction Techniques Production Phase</i>	Kuliah, presentasi dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	• Reduksi sistem pneumatik • Lift System and Automation system • Planing Document • <i>Pneumatic system reduction</i> • <i>Lift System and Automation system</i> • <i>Planning Documents</i>	5%
14-15	Mahasiswa mampu merancang Air Resource Emission Reduction Techniques. <i>Students are able to design Air Resource Emission Reduction Techniques.</i>	Ketepatan merancang Air Resource Emission Reduction Techniques. <i>Accuracy in designing Air Resource Emission Reduction Techniques</i>	Tugas 8: Menyusun makalah dan presentasi merancang Air Resource Emission Reduction Techniques. <i>Assignment 8:</i> <i>Prepare papers and presentations on designing</i>	Kuliah, presentasi, dan diskusi [TM: 2x(2x50")] [BT: 2x(2x60")] [BM: 2x(2x60")]	• Reduksi sistem pneumatik • Lift System and Automation system • Planing Document • <i>Pneumatic system reduction</i> • <i>Lift System and Automation system</i> • <i>Planning Document</i>	20%

			<i>Air Resource Emission Reduction Techniques</i>			
16	Evaluasi Akhir Semester <i>Final Examination</i>					10%

Catatan :

Note

1. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.
Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) <i>ASSESSMENT & EVALUATION PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTI IST <i>MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS</i> Reduksi Emisi <i>Emission Reduction</i>			RA&E
				Edisi (<i>Edition</i>): Agt 2018 <i>Aug 2018</i>
Kode (<i>Code</i>): TF185443	Bobot sks(T/P) / ECTS: (2/0) / 3.2 <i>Credits</i>(T/P) / ECTS: (2/0) / 3.2 (544 hours)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan <i>Field of Specialization:</i> <i>Energy Engineering and Environmental Conditioning</i>	Smt: 4 <i>Semester: 4</i>	
OTORISASI (<i>Authorization</i>)	Penyusun RA & E <i>PIC – Assessment & Evaluation Plan</i>	Koordinator RMK <i>Field Coordinator</i>	Ka PRODI	

	Dr. Ridho Hantoro, ST., MT.	Gunawan Nugroho, PhD	Head of Master Program Dr. Ridho Hantoro
--	-----------------------------	----------------------	--

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP- MK1 (4)	Bobot CP- MK2 (5)	Bobot CP- MK3 (6)	Bobot CP- MK4 (7)	Bobot CP- MK5 (8)	Bobot CP- MK6 (9)	Bobot CP- MK7 (10)
1-2	Mahasiswa mampu menjelaskan tentang History of Earth's Climate.Greenhouse Effect, Earth's Atmospheric Gases. <i>Students are able to explain the History of Earth's Climate. Greenhouse Effect, Earth's Atmospheric Gases</i>	Tugas 1: - Review literatur Presentasi tentang History of Earth's Climate.Greenhouse Effect, Earth's Atmospheric Gases Assignment 1: - Literature review - Presentation on History of Earth's Climate. Greenhouse Effect, Earth's Atmospheric Gases	7,5%	2,5%					
3-4	Mahasiswa mampu menjelaskan peningkatan konsentrasi CO2 di atmosfer kontribusi Power Plant dan Rumah Tangga. <i>Students are able to explain the increase in CO2 concentration in the atmosphere contributed by Power Generation and Households.</i>	Tugas 2: Tugas mandiri menghitung dan menjelaskan peningkatan konsentrasi CO2 di atmosfer kontribusi Power Plant dan Rumah Tangga Assignment 2: Independent task of calculating and explaining the increase in the concentration of CO2 in the atmosphere contributed by Power Plants and Households		5%	2,5%	2,5%			
5-7	Mahasiswa mampu memahami peningkatan Protection of Air Resources <i>Students are able to understand the improvement of Protection of Air Resources</i>	Tugas 3: Menyusun makalah tentang peningkatan Protection of Air Resources Assignment 3: Prepare a paper on improving the Protection of Air Resources		2,5%	7,5%	5%			

8	Evaluasi Tengah Semester (ETS) <i>Mid-Term Exam</i>		2,5%	2,5%	2,5%	2,5%			
9-11	Mahasiswa mampu menganalisis Air Resource Emission Reduction Techniques Drilling Phase <i>Students are able to analyze the Drilling Stage Air Resources Emission Reduction Technique.</i>	Tugas 6: • Tugas Mandiri menghitung dan menganalisis Air Resource Emission Reduction Techniques Drilling Phase. <i>Assignment 6:</i> <i>Independent Tasks to calculate and analyze Air Resource Emission Reduction Techniques Drilling Phase.</i>				5%	12,5%	2,5%	
12-13	Mahasiswa mampu menjalankan Air Resource Emission Reduction Techniques Production Phase. <i>Students are able to carry out the Production Stage of Air Resources Emission Reduction Engineering.</i>	Tugas 7: Tugas Mandiri menghitung dan menjalankan Air Resource Emission Reduction Techniques Production Phase. <i>Assignment 7:</i> • <i>Independent Tasks to calculate and execute Air Resource Emission Reduction Techniques Production Phase</i>					2,5%	2,5%	
14-15	Mahasiswa mampu merancang Air Resource Emission Reduction Techniques. <i>Students are able to design Air Resource Emission Reduction Techniques.</i>	Tugas 8: Menyusun makalah dan presentasi merancang Air Resource Emission Reduction Techniques. <i>Assignment 8:</i> • <i>Prepare papers and presentations on designing Air Resource Emission Reduction Techniques</i>						10%	10%
16	Evaluasi Akhir Semester <i>Final Exam</i>								10%
Total Bobot Penilaian (%) <i>Total Point (%)</i>			10%	12,5%	12,5%	15%	15%	15%	20%

TF185444 RPS RAE Konservasi Energi (Energy Conservation)

	RENCANA PEMBELAJARAN (RP) - <i>LEARNING PLAN</i> PRODI MAGISTER TEKNIK FISIKA FTIRS ITS	RP
--	--	-----------

	MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS			Edisi: Agt 2018 Edition: Aug 2018
	Konservasi Energi Energy Conservation			
Kode (Code): TF185444	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi dan Pengkondisian Lingkungan Field of Specialization: Energy Engineering and Environmental Conditioning	Smt: 3/4 Semester: 3/4	
OTORISASI (Authorization)	Pengembang RP Contact Person – Learning Plan Dr. Ridho Hantoro	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Aulia M T Nasution	
Capaian Pembelajaran (CP) Learning Outcome (LO)	CP-PRODI Program Learning Outcome (PLO)	CP-2 Mampu mengembangkan dan menerapkan berpikir kritis, kreatif, dan inovatif dalam mengidentifikasi, memformulasikan, mengevaluasi dan menyelesaikan permasalahan rekayasa dan saintifik yang mutakhir dalam bidang keahlian Teknik Fisika baik dalam konteks intra- maupun multidisiplin ilmu. (37.5%) <i>Are able to develop a critical, creative, and innovative thinking in identifying, formulating, evaluating, and solving the scientific and engineering problems that emerge in the field of engineering physics on an intra- or multidisciplinary basis.</i> CP-5 Mampu berkomunikasi secara efektif baik lisan maupun tulisan. (25%) <i>Are able to effectively communicate in both oral and written format.</i> CP-6 Mampu secara independen (mandiri) mengembangkan metode inovatif dan menguasai kompetensi yang dibutuhkan untuk merancang dan mengoptimasi sistem pengendalian dan instrumentasi di industri dengan batasan operasional tertentu atau sistem energi berkelanjutan dan terbarukan dengan berbagai kondisi parameter. (37.5%) <i>Are able to independently develop innovative methods, skills and tools required in designing and optimizing an instrumentation and control system in industry under certain operational limitations or renewable and sustainable energy system under various parameter conditions..</i>		
	CP-MK Course Learning Outcome (CLO)	1. Mahasiswa mampu mengidentifikasi kesenjangan pasokan permintaan energi (CP-2) (7.5%) <i>Students are able to identify the supply gap on energy demand</i>		

	2. Mahasiswa mampu melakukan audit energi suatu industri / organisasi (CP-2, CP-6) (15%) <i>Students are able to perform energy audit in industry/oranization</i> 3. Mahasiswa mampu menggambarkan diagram alir energi suatu industri dan mengidentifikasi energi yang terbuang (CP-2, CP-5, CP-6) (22.5%) <i>Students are able to draw energy flow diagram in industry and identify the energy waste</i> 4. Mahasiswa mampu memilih metode konservasi energi yang tepat untuk mengurangi pemborosan energi (CP-2, CP-5, CP-6) (27.5%) <i>Students are able to utilize appropriate energy conservation method to reduce energy loss</i> 5. Mahasiswa mampu mengevaluasi kelayakan teknoekonomi teknik konservasi energi yang diadopsi (CP-2, CP-5, CP-6) (27.5%) <i>Students are able to evaluate the techno-economic feasibility of the adopted energy conservation technique</i>	
Diskripsi Singkat MK <i>Course Description</i>	Mata kuliah ini mempelajari tentang pengembangan keilmuan yakni keberlanjutan energi, kriteria keberlanjutan energi, skema pemenuhan keberlanjutan energi, MCDM (multi criteria decision making) dan AHP (analytical hierarchy process). Pengembangan keilmuan ini merupakan kewajiban bagi semua mahasiswa Magister untuk mengembangkan keberlanjutan energi dalam meningkatkan kompetensi pemenuhan energi baik dengan cara MCDM dan AHP. <i>This course will discuss the recent development of energy sustainability, sustainable energy criteria, sustainable energy scenario/scheme, MCDM (Multi criteria decision method) and AHP (Analytical Hierarchy Process). The elective course is almost considered mandatory for all master students to be a competent sustainable energy supply that is capable of using MCDM and AHP method.</i>	
Pokok Bahasan / Bahan Kajian <i>Module content</i>	a. Energy dan lingkungan. b. Utilitas pada industry dan bangunan komersial c. Energi dan transportasi d. Teknik analisis energi e. Audit energi dan survey energi f. Penilaian investasi project konservasi energi g. Pengawasan dan target energi, serta pengurangan losses energi <i>a. Energy and environment. b. Utility in industry and commercial building c. Energy and transportation d. Energy analysis technique e. Energy audit and energy survey f. Investment appraisal of energy conservation project g. Monitoring and energy targets, and energy losses reduction</i>	
Pustaka <i>Reading Materials</i>	Utama: <i>Main</i>	- Beggs C. Energy Management, Supply, and Conservation, Published by Elsevier Ltd. All rights reserved, 2009

		- Thumann, Albert, Plant engineers and managers guide to energy conservation/ Albert Thumann--8th ed. 2001				
		Pendukung: Supporting				
Media Pembelajaran Learning Media		Perangkat lunak: Software		Perangkat keras: Hardware		
		Ms. Office (Powerpoint and Excel),		Private Computer		
Tim Pengajar Team Teaching		Dr. Ridho Hantoro				
Matakuliah syarat Entry requirement		-				
Mg Ke- Week (1)	Sub-CP-MK Sub-CLO (2)	Indikator Penilaian Assessment Indicator (3)	Kriteria & Bentuk Penilaian Criteria & Assessment Form (4)	Metode Pembelajaran [Estimasi Waktu] Learning Method [Work load] (5)	Materi Pembelajaran Course/learning Content (6)	Bobot Penilaian (%) Assessm ent point (%) (7)
1-3	- Mampu mengidentifikasi kesenjangan pasokan permintaan energi - Mampu menganalisa peluang permintaan energi - Mampu menganalisa prinsip kerja konversi energi - Students are able to identify the supply gap in energy demand - Students are able to analyze the opportunity in energy demand	- Ketepatan identifikasi kesenjangan pasokan permintaan energi - Ketepatan analisis peluang permintaan energi - Appropriate identification of the supply gap in energy demand - Accurate analysis the opportunity in energy demand	TUGAS 1: - Review literatur - Presentasi tentang mengidentifikasi kesenjangan pasokan permintaan energi dan menganalisa peluang permintaan energi, serta prinsip kerja konversi energi COGNITIVE ASSIGNMENT 1: - Literature review - Presentation and discussion of the supply gap of energy demand, opportunity analyses of	SCL (Kuliah dan diskusi) [TM: 3x(2x100")] [BT: 3x(2x120")] [BM: 3x(2x120")] SCL (Course/seminar and discussion) [CS: 3x(2x100")] [EX: 3x(2x120")] [SL: 3x(2x120")] TM (CS): Tatap Muka (Course/Seminar) BT (EX): Belajar Terstruktur (Exercise) BM (SL): Belajar Mandiri (Self Learning)	a. Energy dan lingkungan. b. Utilitas pada industry dan bangunan komersial 9. Energy and Environment 10. Utility in industry and commercial building	7.5% (CP-MK1) 2.5% (CP-MK2)

	<i>Students are able to analyze the energy conversion principle</i>		<i>energy demand, and principles of energy conversion.</i>			
4-7	- Mampu mendeskripsikan alur kerja suatu industri - Mampu melakukan skema audit energi industri - Mampu menggambarkan diagram alir energi suatu industri - Mampu mengidentifikasi energi yang terbuang <i>Students are able to explain and describe the workflow in industry</i> <i>Students are able to perform industrial energy audit</i> <i>Students are able to draw energy flow diagram in industry</i> <i>Students are able to identify the energy waste</i>	- Ketepatan mendeskripsikan alur kerja dan diagram alir energi di industri - Ketepatan identifikasi energi yang terbuang dan audit energi <i>Accurate description of the workflow and energy flow diagram in industry</i> <i>Accurate identification of energy waste and energy audit</i>	TUGAS 2: - Review literatur - Presentasi tentang alur kerja suatu industri, audit energi industri, diagram alir energi suatu industri, dan energi yang terbuang <i>COGNITIVE ASSIGNMENT 2:</i> <i>Literature review</i> <i>Presentation and discussion of the workflow in industry; energy audit in industry, energy flow diagram in industry, and the energy waste</i>	SCL (Kuliah dan diskusi) [TM: 4x(2x100")] [BT: 4x(2x120")] [BM: 4x(2x120")] <i>SCL (Course/seminar and discussion)</i> [CS: 4x(2x100")] [EX: 4x(2x120")] [SL: 4x(2x120")]	17. Energi dan transportasi. 18. Teknik analisis energi 9. <i>Energy and transportation</i> 10. <i>Energy analysis technique</i>	7.5% (CP-MK2) 12.5% (CP-MK3)
8	Evaluasi Tengah Semester (ETS) <i>Mid Term Examination</i>					5% (CP-MK) 10% (CP-MK3) 5% (CP-MK4)
9-13	- Mampu memilih metode konservasi energi - Mampu menganalisa tentang pemborosan energi	- Ketepatan memilih metode konservasi energi. - Ketepatan analisis dan rekomendasi pengurangan pemborosan energi	TUGAS 3: - Review literatur - Presentasi tentang metode konservasi energi, pemborosan	SCL (Kuliah dan diskusi) [TM: 5x(2x100")] [BT: 5x(2x120")] [BM: 5x(2x120")]	6. Audit energi 7. Survei energi 6. <i>Energy audit</i> 7. <i>Energy survey</i>	5% (CP-MK4) 7.5% (CP-MK5)

	• Mampu memberikan solusi untuk mengurangi pemborosan energi • Mampu mengevaluasi kelayakan tekno ekonomi • Mampu mengevaluasi teknik konversi energi • <i>Students are able to utilize proper method for energy conservation</i> • <i>Students are able to analyze the energy waste</i> • <i>Students are able to propose solutions to reduce energy waste</i> • <i>Students are capable of evaluating the technoeconomic feasibility</i> • <i>Students can evaluate the energy conversion technique</i>	• Ketepatan evaluasi kelayakan tekno ekonomi • <i>Accurate selection of energy conservation method</i> • <i>Accurate analysis and recommendation on the energy waste reduction</i> • <i>Appropriate evaluation of technoeconomic feasibility</i>	energi, solusi untuk mengurangi pemborosan energi, kelayakan tekno ekonomi, dan teknik konversi energi <i>CASE-BASED ASSIGNMENT 3:</i> • <i>Literature review</i> • <i>Presentation and discussion of the energy conservation method, the energy waste and its solution to reduce energy waste, technoeconomic feasibility energy conversion techniques.</i>	<i>SCL (Course/seminar and discussion)</i> <i>[CS: 5x(2x100")]</i> <i>[EX: 5x(2x120")]</i> <i>[SL: 5x(2x120")]</i>		
14,15	• Mampu mengevaluasi teknik konservasi energi yang diadopsi • Mampu melakukan pengawasan target energi, serta pengurangan losses energi • <i>Students are able to evaluate the adopted energy conservation technique</i> • <i>Students are capable of performing the energy</i>	• Ketepatan evaluasi teknik konversi energi yang diadopsi pada sebuah kasus • Ketepatan dalam pengawasan target energi dan pengurangan losses energi • <i>Accurate evaluation of case-based adopted energy conservation technique</i> • <i>Accurate monitoring of energy target and reduction of energy losses</i>	<u>TUGAS 4:</u> • Review literatur • Presentasi teknik konservasi energi yang diadopsi, dan pengawasan target energi, serta pengurangan losses energi <i>CASE-BASED ASSIGNMENT 4:</i> • <i>Literature review</i>	SCL (Kuliah dan diskusi) [TM: 2x(2x100")] [BT: 2x(2x120")] [BM: 2x(2x120")] <i>SCL (Course/seminar and discussion)</i> <i>[CS: 2x(2x100")]</i> <i>[EX: 2x(2x120")]</i> <i>[SL: 2x(2x120")]</i>	1. Penilaian investasi project konservasi energi 2. Pengawasan target energi serta pengurangan losses energi <i>1. Investment appraisal of energy conversion project</i> <i>2. Target monitoring of energy and reduction of energy losses</i>	7.5% (CP-MK4) 10% (CP-MK5)

	<i>target monitoring and reducing the energy losses</i>		<i>Presentation and discussion of the adopted energy conservation technique, the energy target monitoring, and reducing the energy losses.</i>			
16	Evaluasi Akhir Semester <i>Final Examination</i>					10% (CP-MK4) 10% (CP-MK5)

Catatan :

Note

13. Sub-CP Mata kuliah (Sub-CP-MK) adalah kemampuan yang dijabarkan secara spesifik dari CP mata kuliah (CP-MK) yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran.

Sub-CLO is the competencies derived from certain CLO which can be measured/observed and the expected final competency in the end of each learning step.

	RENCANA ASSESSMENT & EVALUASI (RA&E) ASSESSMENT & EVALUATION PLAN PRODI MAGISTER TEKNIK FISIKA FTIRS ITS MASTER PROGRAM ENGINEERING PHYSICS, INDSYS - ITS KONSERVASI ENERGI ENERGY CONSERVATION			RA&E
				Edisi (<i>Edition</i>): Agt 2018 Aug 2018
Kode (<i>Code</i>): TF185444	Bobot sks (T/P): (2/0) Credits (T/P): (2/0)	Rumpun MK: Rekayasa Energi Field of Specialization: <i>Energy Engineering and Environmental Conditioning</i>	Smt: 3/4 <i>Semester: 3/4</i>	
OTORISASI (<i>Authorization</i>)	Penyusun RA & E Contact Person – Assessment & Evaluation Plan Dr. Ridho Hantoro	Koordinator RMK Field Coordinator Gunawan Nugroho, PhD	Ka PRODI Head of Master Program Aulia M T Nasution	

Mg ke (1)	Sub CP-MK (2)	Bentuk Asesmen (Penilaian) (3)	Bobot CP-MK1 (4)	Bobot CP-MK2 (5)	Bobot (%) CP-MK3 (6)	Bobot CP-MK4 (4)	Bobot CP-MK5 (5)
1-3	- Mampu mengidentifikasi kesenjangan pasokan permintaan energi - Mampu menganalisa peluang permintaan energi - Mampu menganalisa prinsip kerja konversi energi <i>Students are able to identify the supply gap in energy demand</i> <i>Students are able to analyze the opportunity in energy demand</i>	TUGAS 1: - Review literatur - Presentasi tentang mengidentifikasi kesenjangan pasokan permintaan energi dan menganalisa peluang permintaan energi, serta prinsip kerja konversi energi COGNITIVE ASSIGNMENT 1: <i>Literature review</i> <i>Presentation and discussion of the supply gap of energy demand, opportunity analyses of energy demand, and principles of energy conversion.</i>	7.5%	2.5%			

	<i>Students are able to analyze the energy conversion principle</i>						
4-7	• Mampu mendeskripsikan alur kerja suatu industri • Mampu melakukan skema audit energi industri • Mampu menggambarkan diagram alir energi suatu industri • Mampu mengidentifikasi energi yang terbuang • <i>Students are able to explain and describe the workflow in industry</i> • <i>Students are able to perform industrial energy audit</i> • <i>Students are able to draw energy flow diagram in industry</i> • <i>Students are able to identify the energy waste</i>	TUGAS 2: • Review literatur • Presentasi tentang alur kerja suatu industri, audit energi industri, diagram alir energi suatu industri, dan energi yang terbuang COGNITIVE ASSIGNMENT 2: • <i>Literature review</i> • <i>Presentation and discussion of the workflow in industry; energy audit in industry, energy flow diagram in industry, and the energy waste</i>		7.5%	12.5%		
8	Evaluasi Tengah Semester (<i>Mid Term Examination</i>)			5%	10%	5%	
9-13	• Mampu memilih metode konservasi energi • Mampu menganalisa tentang pemborosan energi • Mampu memberikan solusi untuk mengurangi pemborosan energi • Mampu mengevaluasi kelayakan tekno ekonomi • Mampu mengevaluasi teknik konversi energi • <i>Students are able to utilize proper method for energy conservation</i> • <i>Students are able to analyze the energy waste</i> • <i>Students are able to propose solutions to reduce energy waste</i>	TUGAS 3: • Review literatur • Presentasi tentang metode konservasi energi, pemborosan energi, solusi untuk mengurangi pemborosan energi, kelayakan tekno ekonomi, dan teknik konversi energi CASE-BASED ASSIGNMENT 3: • <i>Literature review</i> • <i>Presentation and discussion of the energy conservation method, the energy waste and its solution to reduce energy waste, technoeconomic feasibility energy conversion techniques.</i>				5%	7.5%

	• <i>Students are capable of evaluating the technoeconomic feasibility</i> • <i>Students can evaluate the energy conversion technique</i>						
14,15	• Mampu mengevaluasi teknik konservasi energi yang diadopsi • Mampu melakukan pengawasan target energi, serta pengurangan losses energi • <i>Students are able to evaluate the adopted energy conservation technique</i> • <i>Students are capable of performing the energy target monitoring and reducing the energy losses</i>	TUGAS 4: • Review literatur • Presentasi teknik konservasi energi yang diadopsi, dan pengawasan target energi, serta pengurangan losses energi <i>CASE-BASED ASSIGNMENT 4:</i> • <i>Literature review</i> • <i>Presentation and discussion of the adopted energy conservation technique, the energy target monitoring, and reducing the energy losses.</i>				7.5%	10%
16	Evaluasi Akhir Semester (<i>Final Examination</i>)					10%	10%
Total Bobot Penilaian (%)			7.5%	15%	22.5%	27.5%	27.5%
<i>Total Point</i> (%)							