SILABUS KURIKULUM ITS 2018-2023
FAKULTAS TEKNOLOGI INDUSTRI

Program Studi	**TEKNIK MATERIAL**
Jenjang Pendidikan	**PROGRAM SARJANA**

MATA KULIAH	**Nama Mata Kuliah : Bahasa Indonesia**
	Kode Mata Kuliah : UG184912
	Kredit : 2 sks
	Semester : 1

DESKRIPSI MATA KULIAH

Mata kuliah Bahasa Indonesia digunakan untuk menentukan penggunaan Bahasa Indonesia. Bahasa Indonesia mempelajari ilmu tentang Bahasa Indonesia yang disempurnakan, pembacaan, percakapan dan penulisan. Bahasa Indonesia digunakan untuk penulisan ilmiah ilmu dan teknologi material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Ketrampilan Umum
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami struktur kalimat.
2. Mahasiswa mampu memahami kalimat efektif.
3. Mahasiswa mampu menjelaskan kerangka karangan / kerangka berpikir.
4. Mahasiswa mampu menjelaskan pilihan kata (diksi).
5. Mahasiswa mampu menerapkan penulisan karya ilmiah.
6. Mahasiswa mampu mengaplikasikan kaidah ejaan bahasa Indonesia.
7. Mahasiswa mampu menganalisis daftar pustaka.

POKOK BAHASAN

1. Struktur Kalimat
2. Kalimat Efektif
3. Kerangka Karangan / Kerangka Berpikir
4. Pilihan Kata (Diksi)
5. Penulisan Karya Ilmiah
6. Kaidah Ejaan Bahasa Indonesia
7. Daftar Pustaka

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Rahardi, R. Kunjana. 2012. *Bahasa Indonesia untuk Perguruan Tinggi.* Jakarta : Erlangga

PUSTAKA PENDUKUNG

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MATA KULIAH	**Nama Mata Kuliah : Kewarganegaraan**
	Kode Mata Kuliah : UG184913
	Kredit : 2 sks
	Semester : 1

DESKRIPSI MATA KULIAH

Mata kuliah Kewarganegaraan digunakan untuk menentukan sikap warga negara. Kewarganegaraan mempelajari ilmu tentang negara, identitas nasional, hak warga negara, kewajiban warga negara, konstitusi, hukum pemerintah dan globalisasi. Kewarganegaraan digunakan untuk merekayasa dan mengembangkan material dan metalurgi di negara.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.4 berperan sebagai warga negara yang bangga dan cinta tanah air, memiliki nasionalisme serta rasa tanggungjawab pada negara dan bangsa;
   - 1.7 taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami Pancasila dan implementasinya
2. Mahasiswa mampu memahami Indentitas nasional dan masyarakat madani
3. Mahasiswa mampu menjelaskan Demokrasi
4. Mahasiswa mampu menjelaskan Hak dan kewajiban warga negara
5. Mahasiswa mampu menerapkan Konstitusi dan *Rule of Law*
6. Mahasiswa mampu menerapkan Hak asasi manusia
7. Mahasiswa mampu mengaplikasikan Geopolitik
8. Mahasiswa mampu mengaplikasikan Geostrategi
9. Mahasiswa mampu menganalisis Otonomi daerah
10. Mahasiswa mampu menganalisis *Good governance* dan globalisasi

POKOK BAHASAN

1. Pancasila dan implementasinya
2. Indentitas nasional dan masyarakat madani
3. Demokrasi
4. Hak dan kewajiban warga negara
5. Konstitusi dan Rule of Law
6. Hak asasi manusia
7. Geopolitik
8. Geostrategi
9. Otonomi daerah
10. Good governance dan globalisasi

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Darmodihardjo, dkk. 1991. Santiaji Pancasila (Suatu Tinjauan Filosofis, Historis dan Yuridis Konstitusional). Usaha Nasional. Surabaya.
2. Mansur, Hamdan, dkk. 2002. Pendidikan Kewarganegaraan. Gramedia Pustaka Utama. Jakarta.

PUSTAKA PENDUKUNG

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MATA KULIAH	**Nama Mata Kuliah : Kimia 1**
	Kode Mata Kuliah : SK184101
	Kredit : 3 sks
	Semester : 1

DESKRIPSI MATA KULIAH

Mata kuliah Kimia digunakan untuk menentukan kondisi internal suatu zat. Kimia mempelajari ilmu tentang struktur internal zat, ikatan kimia dan transformasi. Kimia digunakan untuk merekayasa dan mengembangkan internal material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 1.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 1.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 1.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat Struktur Atom
2. Mahasiswa mampu memahami Periodik unsur
3. Mahasiswa mampu menjelaskan Ikatan Kimia
4. Mahasiswa mampu menjelaskan Stokiometri
5. Mahasiswa mampu menerapkan Wujud zat
6. Mahasiswa mampu mengaplikasikan Larutan dan sifat koligatif
7. Mahasiswa mampu menganalisis Transformasi fasa
8. Mahasiswa mampu menganalisis Termokimia
9. Mahasiswa mampu menganalisis Dasar-dasar aplikasi kimia di industri

POKOK BAHASAN

1. Struktur Atom
2. Periodik unsur
3. Ikatan Kimia
4. Stokiometri
5. Wujud zat
6. Larutan dan sifat koligatif
7. Transformasi fasa
8. Termokimia
9. Dasar-dasar aplikasi kimia di industri

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Kimia
2. Kimia Dasar
3. Chemistry
4. General Chemistry

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Fisika 1 +P**
	Kode Mata Kuliah : SF184101
	Kredit : 4 sks
	Semester : 1

DESKRIPSI MATA KULIAH

Mata kuliah Fisika 1 digunakan untuk menentukan gerakan suatu benda. Fisika 1 mempelajari ilmu tentang gerak. Fisika 1 digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat Besaran-besaran dasar gerak: kerangka acuan, posisi, perpindahan, jarak tempuh (panjang lintasan), kelajuan (rata-rata dan sesaat), kecepatan linear (rata-rata dan sesaat), percepatan linear (rata-rata dan sesaat), kecepatan sudut (rata-rata dan sesaat), dan percepatan sudut (rata-rata dan sesaat)
2. Mahasiswa mampu memahami Jenis-jenis gerak: gerak pada garis lurus, gerak pada bidang, gerak dalam ruang, gerak relatif (posisi dan kecepatan relatif)
3. Mahasiswa mampu menjelaskan Analisis gerak sebuah partikel dalam koordinat lengkung (polar, bola, silinder)
4. Mahasiswa mampu menjelaskan Hukum Newton tentang gerak
5. Mahasiswa mampu menerapkan Penerapan hukum Newton tentang gerak
6. Mahasiswa mampu mengaplikasikan Konsep kerja dan energi
7. Mahasiswa mampu menganalisis Hukum Newton tentang Gravitasi
8. Mahasiswa mampu menganalisis Getaran linear
9. Mahasiswa mampu menganalisis Gelombang

POKOK BAHASAN

1. Besaran-besaran dasar gerak: kerangka acuan, posisi, perpindahan, jarak tempuh (panjang lintasan), kelajuan (rata-rata dan sesaat), kecepatan linear (rata-rata dan sesaat), percepatan linear (rata-rata dan sesaat), kecepatan sudut (rata-rata dan sesaat), dan percepatan sudut (rata-rata dan sesaat)
2. Jenis-jenis gerak: gerak pada garis lurus, gerak pada bidang, gerak dalam ruang, gerak relatif (posisi dan kecepatan relatif)
3. Analisis gerak sebuah partikel dalam koordinat lengkung (polar, bola, silinder)
4. Hukum Newton tentang gerak
5. Penerapan hukum Newton tentang gerak
6. Konsep kerja dan energi
7. Hukum Newton tentang Gravitasi
8. Getaran linear
9. Gelombang

PRASYARAT

Tidak ada
PUSTAKA UTAMA
1. Fisika Universitas 2. Physics 3. University Physics
PUSTAKA PENDUKUNG
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MATA KULIAH	**Nama Mata Kuliah : Matematika 1**
	Kode Mata Kuliah : KM184101
	Kredit : 3 sks
	Semester : 1

DESKRIPSI MATA KULIAH

Mata kuliah Matematika 1 digunakan untuk menentukan bilangan. Matematika 1 mempelajari ilmu tentang bilangan, fungsi, turunan, integral, dan matriks. Matematika 1 digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat Konsep dasar sistim bilangan real: pengertian nilai mutlak, pertidaksamaan, garis, jarak dua titik, lingkaran, parabola
2. Mahasiswa mampu memahami Konsep-konsep fungsi, limit: Domain, range, fungsi linier, kuadratik dan trigonometri, grafik fungsi, limit fungsi dan kontinuitas
3. Mahasiswa mampu menjelaskan Diferensial/turunan : definisi turunan, Aturan-aturan diferensisasi, aturan rantai dan turunan fungsi implisit
4. Mahasiswa mampu menerapkan Aplikasi Turunan : Laju-laju berkaitan, interval naik turun, kecekungan, penggambaran grafik yang mempunyai asimtot dan puncak, aproksimasi, nilai ekstrema dan aplikasi lainnya
5. Mahasiswa mampu mengaplikasikan Integral tak-tentu dan integral tertentu: definisi integral, limit jumlah tak hingga, jumlahan Rieman, Luas bidang datar, teorema Fundamental Kalkulus
6. Mahasiswa mampu menganalisis Matriks dan determinan

POKOK BAHASAN

1. Konsep dasar sistim bilangan real: pengertian nilai mutlak, pertidaksamaan, garis, jarak dua titik, lingkaran, parabola
2. Konsep-konsep fungsi, limit: Domain, range, fungsi linier, kuadratik dan trigonometri, grafik fungsi, limit fungsi dan kontinuitas
3. Diferensial/turunan : definisi turunan, Aturan-aturan diferensisasi, aturan rantai dan turunan fungsi implisit
4. Aplikasi Turunan : Laju-laju berkaitan, interval naik turun, kecekungan, penggambaran grafik yang mempunyai asimtot dan puncak, aproksimasi, nilai ekstrema dan aplikasi lainnya
5. Integral tak-tentu dan integral tertentu: definisi integral, limit jumlah tak hingga, jumlahan Rieman, Luas bidang datar, teorema Fundamental Kalkulus
6. Matrik dan determinan

PRASYARAT

Tidak ada

PUSTAKA UTAMA
1. Matematika Universitas 2. Matematika 3. Matematika Dasar
PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Agama** **Agama Islam** **Agama Kristen** **Agama Katolik** **Agama Hindu** **Agama Buddha** **Agama Khonghucu**
	Kode Mata Kuliah : UG184 UG184901 UG184902 UG184903 UG184904 UG184905 UG184906
	Kredit : 2 sks
	Semester : 1

DESKRIPSI MATA KULIAH

Mata kuliah Agama digunakan untuk menentukan sikap seorang yang memiliki agama. Mata kuliah ini dirancang dengan maksud untuk memperkuat iman dan taqwa kepada Tuhan Yang Maha Esa sehingga terbentuk seorang manusia yang berbudi pekerti luhur, berpikir filosofis, bersikap rasional, dinamis, dan menjaga toleransi antar umat beragama.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami keragaman umat beragama.
2. Mahasiswa mampu memahami nilai - nilai toleransi.
3. Mahasiswa mampu menjelaskan sumber - sumber ajaran agama.
4. Mahasiswa mampu menerapkan faham fundamentalis dalam agama.
5. Mahasiswa mampu mengaplikasikan nilai agama dalam masyarakat madani.
6. Mahasiswa mampu menganalisis nilai - nilai agama dalam berbagai bidang.

POKOK BAHASAN

1. Keragaman Umat Beragama.
2. Nilai toleransi.
3. Sumber ajaran agama.
4. Fundamentalis dalam agama.
5. Nilai agama dalam masyarakat madani.
6. Nilai - nilai agama dalam berbagai bidang.

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Muthahari, M. 1993. *Manusia dan Agama*. Bandung : Mizan.
2. Hasbullah. 2005. *Dasar - Dasar Ilmu Pendidikan*. Jakarta : PT. Raja Grafindo Persada.
3. Shihab, M.Q. 1996. *Wawasan Al-Quran*. Bandung : Mizan.
4. Ilmu Agama Kristen

5. Ilmu Agama Katolik
6. Ilmu Agama Hindu
7. Ilmu Agama Buddha
8. Ilmu Agama Khonghucu

PUSTAKA PENDUKUNG

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MATA KULIAH	**Nama Mata Kuliah : Pengantar Teknik Material dan Metalurgi**
	Kode Mata Kuliah : TL184101
	Kredit : 2 sks
	Semester : 1

DESKRIPSI MATA KULIAH

Mata kuliah ini membahas secara komprehensif dasar – dasar bidang keilmuan Teknik Material dan Metalurgi yang didasarkan dari siklus hidup (*life cycle*) dari sebuah material baik logam, plastik atau keramik. Pembahasan dimulai dari proses permurnian material/ekstraksi, proses manufaktur, proses degradasi material dan daur ulang sebuah material. Didalam kuliah ini juga dipelajari tentang rekayasa material dan proses karakterisasi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.4 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.5 menginternalisasi nilai, norma, dan etika akademik;
   - 1.6 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.7 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.8 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.9 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 Mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 Mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri
   - 2.9 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.10 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.11 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus

4.1 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mengerti dan memahami konsep - konsep dasar material dan metalurgi baik logam maupun non – logam (keramik, plastik, komposit dll) serta siklus hidup material
2. Mahasiswa mengerti dan memahami proses pengolahan material dan mineral
3. Mahasiswa mengerti dan memahami teknologi manufaktur meliputi pengecoran, permesinan, pengelasan, pembentukan logam dll
4. Mahasiswa mengerti dan menganalisa proses degradasi material baik logam maupun non logam dan faktor – faktor yang mempengaruhinya serta usaha pengendaliannya
5. Mahasiswa mengerti dan memahami proses rekayasa material seperti perlakuan panas, rekayasa permukaan dll
6. Karakterisasi material
7. Mahasiswa mengerti dan memahami teknologi daur ulang

POKOK BAHASAN

1. Pengenalan material dan siklus hidup material
2. Teknologi pengolahan material dan mineral
3. Struktur kristal dan sistem paduan
4. Sifat – sifat material (mekanik, fisik, kimia dll) dan karakterisasinya its characterizations (Destructive Test (DT), Non-Destructive Test (NDT), XRD, SEM, FTIR, XRF, TGA, optical microscope, etc)
5. Diagram fase dan diagram transformasi
6. Proses rekayasa material seperti perlakuan panas, rekayasa permukaan serta proses manufaktur
7. Teknologi Manufaktur (pengecoran, permesinan, pengelasan dan lain-lain) dan Material polimer, keramik dan komposit
8. Korosi dan degradasi material baik logam maupun non logam, faktor – faktor dan usaha pengendaliannya
9. Teknologi daur ulang

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Callister, Materials Science and Engineering An Introduction, Us, 2009
2. Schlenker, B.R., Introduction to Material Science, SI edition,Australia pty Sidney: John Wiley & Sons,1974.
3. Avner, Sidney H, Introduction to Physical Metallurgy, Second edition, Tokyo: Mc Graw Hill International Book Company, 1987

PUSTAKA PENDUKUNG

1. Barret, Craig R, Nix, William D, Tetelman, Alan S, The Principles of Engineering Materials, New Jersey: Prentice Hall Inc, Englewood Cliffs,1973
2. Kalpakijan, Seroke, Manufacturing Engineering and Technology, First Edition, Addison Wesley Pub.Company, 1989
3. M. Ohring, The Materials Science of Thin Films The Materials Science of Thin Films, Academic Press, 1992
4. ___ASM Handbook 5: Surface Engineering, ASM International, 1994
5. Arthur A. Tracton, Coatings Materials And Surface Coatings, CRC Press, 2007
6. Zaki Ahmad, Principles of Corrosion Engineering and Corrosion Control, Elsevier, 2006
7. Vijay Kumar Thakur, Recycled Polymers: Chemistry and Processing, Smithers Rapra, 2016

SEMESTER II

MATA KULIAH	**Nama Mata Kuliah : Bahasa Inggris**
	Kode Mata Kuliah : UG184914
	Kredit : 2 sks
	Semester : 2

DESKRIPSI MATA KULIAH

Mata kuliah Bahasa Inggris digunakan untuk penggunaan Bahasa Inggris. Bahasa Inggris mempelajari ilmu tentang membaca, mendengar, menulis, dan berbicara menggunakan Bahasa Inggris. Bahasa Inggris digunakan untuk merekayasa dan mengembangkan ilmu material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   2.1 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan membaca Bahasa Inggris
2. Mahasiswa mampu menerapkan mendengar Bahasa Inggris
3. Mahasiswa mampu mengaplikasikan menulis Bahasa Inggris
4. Mahasiswa mampu menganalisis berbicara Bahasa Inggris

POKOK BAHASAN

1. Membaca Bahasa Inggris
2. Mendengar Bahasa Inggris
3. Menulis Bahasa Inggris
4. Berbicara Bahasa Inggris

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Bahasa Inggris
2. English

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Matematika 2**
	Kode Mata Kuliah : KM184201
	Kredit : 3 sks
	Semester : 2

DESKRIPSI MATA KULIAH

Mata kuliah Matematika 2 digunakan untuk menentukan bilangan. Matematika 2 mempelajari ilmu tentang integral, koordinat, dan barisan. Matematika 2 digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat Teknik Integrasi: integral partial, integral fungsi trigonometri, integral fungsi pecah rasional
2. Mahasiswa mampu memahami Integral Numerik dan Integral tak Wajar: integral numerik, aturan Simpson, integral tak wajar
3. Mahasiswa mampu menjelaskan Terapan Integral Tertentu: luas bidang datar, volume dan luas permukaan benda putar, titik berat dan aplikasi pada fisika
4. Mahasiswa mampu menjelaskan Koordinat Kutub: menggambar fungsi dalam koordinat kutub bentuk parametrik, dan dapat mengaplikasikan teknik integrasi dalam koordinat kutub, fungsi parametrik
5. Mahasiswa mampu menerapkan Barisan dan Deret Tak Hingga: barisan tak hingga, deret tak hingga, test konvergensi, deret Taylor, deret MacLaurin

POKOK BAHASAN

1. Teknik Integrasi: integral partial, integral fungsi trigonometri, integral fungsi pecah rasional
2. Integral Numerik dan Integral tak Wajar: integral numerik, aturan Simpson, integral tak wajar
3. Terapan Integral Tertentu: luas bidang datar, volume dan luas permukaan benda putar, titik berat dan aplikasi pada fisika
4. Koordinat Kutub: menggambar fungsi dalam koordinat kutub bentuk parametrik, dan dapat mengaplikasikan teknik integrasi dalam koordinat kutub, fungsi parametrik
5. Barisan dan Deret Tak Hingga: barisan tak hingga, deret tak hingga, test konvergensi, deret Taylor, deret MacLaurin

PRASYARAT

Tidak ada

PUSTAKA UTAMA
1. Matematika Universitas 2. Matematika 3. Matematika Dasar
PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Pancasila**
	Kode Mata Kuliah : UG184911
	Kredit : 2 sks
	Semester : 2

DESKRIPSI MATA KULIAH

Mata kuliah Pancasila digunakan untuk menentukan sikap dasar Bangsa Indonesia. Pancasila mempelajari ilmu tentang ideologi, dasar negara, budaya bangsa, pengertian Pancasila, fungsi Pancasila, dan penerapan Pancasila. Pancasila digunakan sebagai sikap untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.4 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.5 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan warga negara yang baik.
2. Mahasiswa mampu memahami filsafat yang terdapat di dalam pancasila.
3. Mahasiswa mampu menjelaskan peristiwa penting di Indonesia.
4. Mahasiswa mampu menjelaskan nilai - nilai budaya bangsa Indonesia.
5. Mahasiswa mampu membandingkan karakteristik periode sejarah Indonesia.
6. Mahasiswa mampu mengaplikasikan pancasila dalam persoalan sehari - hari.
7. Mahasiswa mampu menganalisis pancasila sebagai ideologi terbuka.

POKOK BAHASAN

1. Pancasila dan implementasinya
2. Filsafat Pancasila.
3. Peristiwa penting di Indonesia.
4. Nilai - nilai budaya bangsa Indonesia.
5. Karakteristik periode sejarah Indonesia.
6. Aplikasi Pancasila dalam kehidupan sehari - hari.
7. Pancasila sebagai ideologi terbuka.

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Magnis Suseno. 1997. Etika Politik, Jakarta : Gramedia.
2. Hamdan Mansoer, dkk. 2002. Kapita Selekta Pendidikan Pancasila (Untuk Mahasiswa), Jakarta : BPPTA - Ditjen Dikti, Depdiknas.

PUSTAKA PENDUKUNG

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MATA KULIAH	**Nama Mata Kuliah : Fisika 2**
	Kode Mata Kuliah : SF184202
	Kredit : 3 sks
	Semester : 2

DESKRIPSI MATA KULIAH

Mata kuliah Fisika 2 digunakan untuk menentukan perilaku listrik, fluida, cahaya dan energi. Fisika 2 mempelajari ilmu tentang listrk, gerakan fluida, gerakan cahaya dan energi panas. Fisika 2 digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 3.2 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat Hukum coulomb, Potensial dan Medan Listrik
2. Mahasiswa mampu memahami Arus Listrik
3. Mahasiswa mampu menjelaskan Medan magnet
4. Mahasiswa mampu menjelaskan Gaya gerak listrik induksi
5. Mahasiswa mampu menjelaskan Arus bolak-balik
6. Mahasiswa mampu menerapkan Mekanika fluida
7. Mahasiswa mampu mengaplikasikan Optik dan cahaya
8. Mahasiswa mampu menganalisis Kalor

POKOK BAHASAN

1. Hukum coulomb, Potensial dan Medan Listrik
2. Arus Listrik
3. Medan magnet
4. Gaya gerak listrik induksi
5. Arus bolak-balik
6. Mekanika fluida
7. Optik dan cahaya
8. Kalor

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Fisika Universitas

2. Physics
3. University Physics

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Mekanika Teknik**
	Kode Mata Kuliah : TL 184202
	Kredit : 2 sks
	Semester : 2

DESKRIPSI MATA KULIAH

Perilaku mekanik material seperti kekuatan dan regangan berkaitan dengan gaya-gaya eksternal yang bekerja pada sebuah benda yang merupakan dasar dari mekanika teknik. Gaya-gaya eksternal tersebut perlu di analisa dan dihitung untuk menentukan gaya resultannya. Seinggga mata kuliah ini akan membahas materi tentang sistem gaya pada partikel dan benda pejal, gaya ekuivalen (Momen), Analisa struktur, titik berat (center of gravity), Momen Inersia, Bidang Normal, Bidang geser dan bidang momen, Regangan dan defleksi pada balok, analisa tegangan kombinasi (lingkaran Mohr). Diharapakan di akhir kuliah mahasiswa mampu memahami konsep resultan gaya yang bekerja pada partikel dan benda pejal, menghitung kekuatan struktur, menentukan momen inersia untuk menghitung bidang geser dan bidang momen serta mengkombinasikan tegangan dengan metode lingkaran Mohr. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 2.4 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna;

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya;

2. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

4 Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami konsep dasar terkait kesetimbangan gaya pada partikel dan benda pejal
2. Mahasiswa mampu menghitung dan menyelesaikan persoalan kesetimbangan gaya, momen inersia, kekuatan struktur dan transformasi teegangan
3. Mahasiswa mampu mengungkapkan ide dan gagasan terkait konsep dasar fisika material baik secara lisan dan tertulis
4. Mahasiswa mampu memiliki moral dan dan tanggung jawab yang baik di dalam menyelesaikan tugasnya

POKOK BAHASAN

1. Gaya dan Kesetimbangan partikel,
2. Sistem gaya ekuivalen (Momen),
3. Kesetimbangan Benda Pejal,
4. Analisa struktur,
5. Titik berat (center of gravity),
6. Momen Inersia, Bidang Normal, Bidang geser dan bidang momen,
7. Regangan dan defleksi pada balok,
8. Tegangan akibat temperatur dan tegangan pada dinding tipis,
9. Analisa tegangan kombinasi (lingkaran Mohr)

PRASYARAT

Mata Kuliah Fisika 1 dengan minimal nilai D

PUSTAKA UTAMA

1. R.C. Hibbeler, “Engineering Mechanics: Statics”, 12th edition
2. Ferdinand P. Beer, E. Russell Johnston, Jr., Elliot R. Eisenberg,” Vector Mechanics for Engineers: Statics”, 8th edition, McGraw Hill, New York, USA

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Gambar Teknik dan Mesin +TB**
	Kode Mata Kuliah : TL184203
	Kredit : 3 sks
	Semester : 2

DESKRIPSI MATA KULIAH

Menggambar teknik adalah representasi ilmiah dari sebuah proyek, dimana proyek ini merupakan hasil imajinasi atau rekaan dari pembuatnya. Agar hasil imajinasi terekam dengan baik dan dapat ditindaklanjuti untuk dibuat bendanya, maka perlu dituangkan dalam sebuah gambar kerja. Menggambar teknik harus memenuhi kaidah / standar nasional maupun internasional agar dapat dipahami dan diterima secara universal. Menggambar teknik adalah media komunikasi antara pencipta dengan industry sebagai salah satu *tool* dalam proses pembuatannya. Menggambar teknik dan mesin mengajarkan dasar – dasar menggambar komponen dan sistem mekanik sederhana menurut standar teknik, penggunaan alat – alat gambar dan penggunaan perangkat lunak dalam menggambar teknik. Untuk mencapai tujuan tersebut maka strategi pembelajaran yang dilakukan adalah kuliah di kelas, pemberian tugas mandiri berupa tugas besar

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 Bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius.
   - 1.2 Menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika.
   - 1.3 Berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila.
   - 1.5 Menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain.
   - 1.6 Bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan.
   - 1.8 Menginternalisasi nilai, norma, dan etika akademik.
   - 1.9 Menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri.
   - 1.10 Menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan.
   - 1.11 Berusaha secara maksimal untuk mencapai hasil yang sempurna.
   - 1.12 Bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya.
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur.
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi.
   - 2.4 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data.Mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya.
   - 2.5 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya
   - 2.6 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri.
   - 2.7 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional.
   - 2.8 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan
   - 2.9 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.10 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi

3 Pengetahuan

3.1 Konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen.

3.2 Konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk.

3.3 Prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen.

3.5 Teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus

4.1 Mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen.

4.2 Mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa.

4.3 Mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen.

4.4 Mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan.

4.5 Mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6 Mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen.

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan pengertian dan aplikasi *Engineering Graphic and Design* di bidang Material dan Metalurgi
2. Mahasiswa mampu menjelaskan jenis-jenis garis dan media gambar.
3. Mahasiswa mampu menghubungkan teori proyeksi dan potongan.
4. Mahasiswa mampu mengaplikasikan aturan dasar untuk memberikan ukuran pada gambar teknik.
5. Mahasiswa mampu merumuskan cara penggambaran khusus dan gambar berulang (ulir dan pegas).
6. Mahasiswa mampu merumuskan cara penggambaran khusus dan gambar berulang (*Gears and Shafts*).
7. Mahasiswa mampu menghubungkan antara simbol pengelasan dan letak simbol las dalam media gambar.
8. Mahasiswa mampu menerangkan penggambaran suatu komponen material dengan autocad 2D.
9. Mahasiswa mampu membuat komponen mesin 3D menggunakan autocad.

POKOK BAHASAN

1. Pengenalan *Engineering Graphic and Design*
2. Konsep gambar dan klasifikasi gambar
3. Media gambar, jenis garis dan skala gambar
4. Teori pandangan / proyeksi dan contoh penggambaran pada bentuk sederhana
5. Teori potongan (*section*) dan contoh penggambaran pada bentuk sederhana, arsiran
6. Gambar susunan dan gambar rinci
7. Menggambar komponen mekanik (pegas, ulir, roda gigi, *bolt and nut*, simbol pengelasan)
8. Toleransi permukaan, suaian, kekasaran permukaan dan tanda pengerjaan
9. Teori penggunaan perangkat (*software*) untuk menggambar teknik

PRASYARAT

Tidak ada

PUSTAKA UTAMA

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2. K.L Narayana, P. Kannaiah, K. Venkata Reddy, “Machine Drawing 3rd ed”, New Age International Publishers.
3. J. La Heij, L.A. De Bruijn, “Mechanical Engineering Drawing”. Kemperman

PUSTAKA PENDUKUNG

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MATA KULIAH	**Nama Mata Kuliah : Kimia Material**
	Kode Mata Kuliah : TL184204
	Kredit : 3 sks
	Semester : 2

DESKRIPSI MATA KULIAH

Mata Kuliah Kimia Material mempelajari mengenai analisis dan pemisahan sampel dan proses elektrokimia. Analisis dapat bertujuan untuk menentukan jenis komponen apa saja yang terdapat dalam suatu sampel (kualitatif) dan juga menentukan berapa banyak komponen yang ada dalam suatu sampel (kuantitatif). Tidak semua unsur atau senyawa yang ada dalam sampel dapat dianalisis secara langsung, sebagian besar memerlukan proses pemisahan terlebih dulu dari unsur yang mengganggu. Karena itu cara-cara atau prosedur pemisahan merupakan hal yang penting untuk dipelajari. Elektrokimia sangat berperan dalam bidang material dan metalurgi, seperti proses elektrolisis untuk sintesis material dan proses galvanik seperti pada solar cell dan superkapasitor. Sehingga dalam mata kuliah ini akan mempelajari tentang Pengantar Kimia analitik, Kelarutan dan hasil kali kelarutan , Analisa Kation, Analisa Anion, Analisis Gravimetri, Volumetri,Titrasi asam basa, Titrasi Redoks, Titrasi pengendapan, Pengantar Elektrokimia, Konduksi Listrik, Larutan-larutan ionik, Sel Elektrokimia, Elektrode-elektrode, dan Reaksi-reaksi Elektrode Diharapkan di akhir mata kuliah mahasiswa mampu memahami teori dan menerapkan analisa kualitatif dan kuantitatif pada senyawa anorganik dan mampu menyelesaikan permasalahan yang berkaitan dengan korosi pada material dan proses elektrokimia di bidang teknik material dan metalurgi. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas, presentasi, pemberian tugas mandiri dan eksperimen berupa praktikum Kimia Material.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertaqwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan peradaban berdasarkan Pancasila;
   - 1.4 berperan sebagai warga negara yang bangga dan cinta tanah air, memiliki nasionalisme serta rasa tanggungjawab pada negara dan bangsa;
   - 1.5 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.7 taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri; dan
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni;
   - 2.4 mampu menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7 mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi serta evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggung jawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada di bawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3. Pengetahuan
   3.1 konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   3.3 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;

4. Ketrampilan Khusus
   4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem*) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu
   menjelaskan ruang lingkup kimia analitik dan menjelaskan peranan kimia analitik
2. Mahasiswa mampu :
   Menjelaskan prinsip analisis volumetri
   Menjelaskan metoda titrasi volumetric dan titrasi balik
3. Mahasiswa mampu:
   Menjelaskan titrasi asam-basa
   Menggambarkan kurva titrasi asam-basa
4. Mahasiswa mampu:
   Menjelaskan metoda analisis gravimetri
   Menjelaskan sifat-sifat endapan
   Menyelesaikan perhitungan-perhitungan gravimetri
5. Mahasiswa mampu:
   Menjelaskan reaksi pengendapan
   Menggambarkan kurva titrasi
   Menyelesaikan perhitungan titrasi pengendapan
6. Mahasiswa mampu:
   Menyebutkan sifat-sifat fisik kation dan anion yang berguna untuk identifikasi awal
   Menyebutkan kation dan anion yang umum dan cara analisisnya
   Memilih uji spesifik untuk menentukan anion tertentu
7. Mahasiswa mampu:
   Menjelaskan mengenai konsep elektrokimia dan ruang lingkup aplikasinya
   Menjelaskan mengenai konduksi listrik
8. Mahasiswa mampu:
   Menjelaskan mengenai larutan ionik
9. Mahasiswa mampu:
   Menjelaskan mengenai jenis-jenis dan prinsip reaksi pada sel elektrokimia
10. Mahasiswa mampu:
    Menjelaskan mengenai properties elektroda
    Menjelaskan mengenai reaksi-reaksi elektroda
11. Mahasiswa mampu:
    Menjelaskan mengenai aplikasi elektrokimia dibidang teknik material dan metalurgi

POKOK BAHASAN

1. Konsep Dasar Kimia Analitik
2. Analisis Volumetri
3. Keseimbangan asam basa
4. Kesetimbangan Larutan dan Titrasi Pengendapan
5. Analisis pemisahan kation dan kation
6. Konsep Elektrokimia
7. Konduksi Listrik

8. Larutan Ionik
9. Jenis dan prinsip sel elektrokimia
10. Properties elektroda
11. Reaksi Elektroda
12. Aplikasi Elektrokimia di bidang Material dan Metalurgi

PRASYARAT

Tidak ada

PUSTAKA UTAMA

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2. Day, R.A Jr and A.L Underwood, Quantitative Analysis 6th ed, Toronto: Prentice-Hall International, 1991
3. Kennedy JH, Analytical Chemistry Principles, 2nd ed, New York: Saunders College Publishing, 1990
4. Keith B. Oldham, Jan C. Myland, "Fundamentals of Electrochemical Science", Academic Press Inc, 1994.
5. Geoffrey Prentice, "Electrochemical Engineering Principles", prentice Hall International, Inc

PUSTAKA PENDUKUNG

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SEMESTER III

MATA KULIAH	**Nama Mata Kuliah : Termodinamika Material**
	Kode Mata Kuliah : TL184305
	Kredit : 3 sks
	Semester : 3

DESKRIPSI MATA KULIAH

Mata kuliah ini membahas perubahan-perubahan besaran thermodinamika yang menjadi bahasan hukum I Thermodinamika, hukum II Thermodinamika dan energi bebas GIbbs di dalam bidang material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan; 1.11
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya.

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses, atau manufaktur material dan metalurgi komponen;

3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini;

4 Ketrampilan Khusus

4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4 mampu merumuskan alternatif solusi untuk memyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen.

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menghitung dan menganalisis perubahan besaran-besaran Thermodinamika di dalam bidang material dan metalurgi

POKOK BAHASAN

1. Pendahuluan: Pengantar Thermodinamika Material
2. Hukum I Thermodinamika
3. Hukum II Thermodinamika
4. Thermodinamika pada Mesin Konversi Energi
5. Energi Bebas Gibbs
6. Thermodinamika Kesetimbangan Reaksi

PRASYARAT

Mata Kuliah Kimia, Kimia Material, Fisika 1, Fisika 2, Matematika 1 dan Matematika 2

PUSTAKA UTAMA

1. Gaskel, D.R,"Introduction to Metallurgical Thermodynamics", McGraw Hill, Kogakusha, Ltd, Tokyo.

PUSTAKA PENDUKUNG

2. Swalin, R.A., "Thermodynamics of Solid", John Wiley & Sons, New York.
3. Ragone, D.V., "Thermodynamics of Material", Vol. I and II, John Wiley & Sons, New York.
4. Yunus A. Cengel and Michael A. Boles " Thermodynamics An Engineering Approach" 2nd ed. Mc Graw Hill , 1994
5. J.M Smith, H.C Van Ness and M.M Abbot "Introduction to Chemical Engineering Thermodynamics" 5th ed., 1996
6. T.D Eastop and A. Mc Conkey, "Applied Thermodynamics for Engineering Technologist" 5th ed., 1993

MATA KULIAH	**Nama Mata Kuliah : Pemrograman Komputer**
	Kode Mata Kuliah : TL184306
	Kredit : 3 sks
	Semester : 3

DESKRIPSI MATA KULIAH

Perilaku mekanik dan rekayasa material tidak bisa dilepaskan dari perumusan matematika. Dasar-dasar pemrogaman computer diperlukan untuk mempermudah menggunakan perumusan matematika tersebut dalam memahami sifat dan perilaku mekanik dari material dengan analisa numerik. Sehingga diharapkan setelah akhir semester mahasiswa mampu memahami dasar-dasar logika pemgrogaman computer atau algoritma dalam membuat program computer. Untuk itu pada mata kuliah ini, mahasiswa akan belajar tentang mengenal dan memahami dasar pemrogaman komputer dengan menggunakan bahasa program Fortran 77 dan menggunakannya untuk aplikasi perhitungan sederhana terkait teknik material dan metalurgi. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas, presentasi, pemberian tugas mandiri dan eksperimen berupa praktikum komputer dasar.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 Bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius.
   - 1.2 Menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika.
   - 1.3 Berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila.
   - 1.4 Menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain.
   - 1.5 Bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan.
   - 1.6 Menginternalisasi nilai, norma, dan etika akademik.
   - 1.7 Menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri
   - 1.8 Menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan.
   - 1.9 Berusaha secara maksimal untuk mencapai hasil yang sempurna.
   - 1.10 Bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya.
   - 2.2 Mampu menunjukkan kinerja mandiri, bermutu, dan terukur.
   - 2.3 Mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi.
   - 2.4 Mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data.
   - 2.5 Mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya.
   - 2.6 Mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri.
   - 2.7 Mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional.
   - 2.8 Mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan.
   - 2.9 Mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.10 Mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1 Konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen.

3.2 Konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk.

4. Ketrampilan Khusus
   4.1 Mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen.
   4.2 Mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa.
   4.3 Mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen.
   4.4 Mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan.
   4.5 Mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6 Mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen.

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa Mampu menjelaskan pengertian dan aplikasi dasar pemrograman komputer.
2. Mahasiswa mampu menjelaskan tentang program turbo pascal beserta aplikasinya.
3. Mahasiswa mampu menghubungkan Unit Standar Turbo Pascal.
4. Mahasiswa mampu menerangkan tentang identifier dan variabel
5. Mahasiswa mampu menerangkan teori *reserved word* dan tipe data dalam pascal.
6. Mahasiswa mampu menguraikan tipe - tipe data dan bitwise operator.
7. Mahasiswa mampu mengaplikasikan teori *branching statement*.
8. Mahasiswa mampu menerangkan prioritas operator dan jenis deklarasi.
9. Mahasiswa mampu menjelaskan teori *looping* (perulangan).

POKOK BAHASAN

1. Definisi dan aplikasi Dasar Pemrograman Komputer
2. Instalasi program Turbo Pascal dan aplikasinya.
3. Definisi dan aplikasi Identifier dan Variabel.
4. Definisi dan aplikasi tipe - tipe data.
5. Teori *Branching Statement* dan aplikasinya.
6. Teori *Looping* (perulangan) beserta aplikasinya

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Abdul Kadir, 2004, “Pemrograman Pascal”.
2. Richard, S.F, 1982, “Pascal at Work and Play an Introduction to Computer Programming in Pascal”, London
3. “Introduction to Computer Programming”, Ozgur ZEYDAN BEU Dept. Of Enve. Eng.

PUSTAKA PENDUKUNG

-

MATA KULIAH	**Nama Mata Kuliah : Diagram Fasa dan Transformasi**
	Kode Mata Kuliah : TL184307
	Kredit : 3 sks
	Semester : 3

DESKRIPSI MATA KULIAH

Mata kuliah Transformasi dan Diagram Fasa memberikan pemahaman konsep dasar fasa dan prinsip kesetimbangan fasa menurut konsep termodinamika. Materi Transformasi dan Diagram Fasa meliputi penggunaan materi diagram fasa untuk menentukan fasa-fasa yang mungkin terjadi pada proses transformasi material serta melatih pemecahan permasalahan penentuan fasa dan perhitungan berat relatif pada suatu diagram fasa biner dan terner

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.4 taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;
   - 1.5 menginternalisasi nilai, norma, dan etika akademik;
   - 1.6 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.7 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.8 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

1 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus

4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja,

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menguasai konsep fasa dan diagram fasa berdasarkan konsep termodinamika
2. Mahasiswa mampu menguasai konsep tranformasi fasa
3. Mahasiswa mampu menghitung komposisi berat relative pada diagram fasa *unary*, *binary*, dan *ternary*
4. Mahasiswa mampu mengungkapkan ide dan gagasan terkait konsep diagram fasa pada material logam dan non logam
5. Mahasiswa mampu menggambar diagram fasa satu komponen dan dua komponen

POKOK BAHASAN

1. Konsep fasa dan diagram kesetimbangan fasa
2. Konsep diagram fasa: tinjauan termodinamika
3. Mekanisme tranformasi fasa
4. Diagram satu komponen *(unary)*
5. Diagram dua komponen *(binary)*
6. Diagram tiga komponen *(ternary)*
7. Case studi : diagram fasa logam dan non logam

PRASYARAT

Mata Kuliah Pengantar Teknik Material dan Metalurgi dengan i minimal nila C

PUSTAKA UTAMA

1. Raghavan, phase transformation, London, Prentice hall inc, 1987
2. Chadwick, metallography of phase transformation, London, Butter Worths& Co, 1972
3. Christian, The theory of tranfromation in metal and alloys, 2nd edition, Oxford, Pergamon Press, 1975
4. Porter, A. David and Eastering, E.Kenneth, Phase transformation in metal and alloys, Van Nostrand reinhold, UK. Co.ltd, 1980
5. Rhines, N.Frederick, Phase Diagram in Metallurgy, Their Development and application, McGraw-Hill, 1985
6. Callister, D.William, Material Science and Engineering, An introduction, John Wiley and son, Inc, 1994

PUSTAKA PENDUKUNG

Metal handbooks, vol 8 metallography, structure, dan phase diagram, ASM, 1973

MATA KULIAH	**Nama Mata Kuliah : Elemen Mesin**
	Kode Mata Kuliah : TL184308
	Kredit : 3 sks
	Semester : 3

DESKRIPSI MATA KULIAH

Elemen Mesin adalah mata kuliah yang membahas kerja pesawat/ elemen mekanik menurut prinsip gaya dan gerak terutama berkaitan dengan pemilihan material. Pesawat mekanik adalah salah satu alat bantu untuk memudahkan perkerjaan manusia. Pesawat mekanik didesain dan diproduksi berdasarkan kombinasi antara tujuan desain, ukuran, kapasitas dan pemilihan bahannya. Dalam perkuliahan ini, mahasiswa diberikan bekal dalam mendesain sebuah sistem mekanik sederhana dan juga mengevaluasi kinerja sebuah sistem mekanik sederhana yang telah ada. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANAN PADA MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.4 menginternalisasi nilai, norma, dan etika akademik;
   - 1.5 berusaha secara maksimal untuk mencapai hasil yang sempurna;

2 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.4 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.5 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya;

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

4 Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa memahami dan mampu menjelaskan konsep gaya dan tegangan pada elemen mekanik
2. Mahasiswa mampu menghitung dan menganalisa kekuatan sambungan permanen dan non permanen
3. Mahasiswa memahami dan mampu menjelaskan prinsip kerja pesawat mekanik
4. Mahasiswa mampu menghitung dan menganalisa kekuatan elemen-elemen sistem transmisi daya

POKOK BAHASAN

1. Beban dan tegangan pada elemen mekanik (teori kegagalan)
2. Sambungan permanen dan non permanen
3. Poros dan pasak
4. *Coupling, clutch* dan *brakes*
5. Belt-pulley, rantai-sprocket dan Roda Gigi
6. Journal dan Rolling contact Bearing (bantalan)
7. Pressure vessel

PRASYARAT

Mata Kuliah Mekanika Teknik dengan minimal nilai D

PUSTAKA UTAMA

1. R.S. Khurmi, J.K. Gupta, S. Chandran, "Textbook of Machine Design", 2005
2. Budynas, Nisbett, "Shigley's Mechanical Engineering Design, 8th edition" McGraw Hill-Primis
3. Joseph E. Shigley "Standard Handbook of Machine Design, 3rd ed"
4. Robert L Mott, "Machine elements in Mechanical Design 4th ed", Pearson Prentice Hall

PUSTAKA PENDUKUNG

Jurnal

MATA KULIAH	**Nama Mata Kuliah : Metalurgi I**
	Kode Mata Kuliah : TL184309
	Kredit : 3 sks
	Semester : 3

DESKRIPSI MATA KULIAH

Mahasiswa mampu mengerti struktur fisik material dan phenomena (gejala) yang berkaitan dengan struktur fisik

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.4 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.5 menginternalisasi nilai, norma, dan etika akademik;
   - 1.6 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.7 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan
   - 1.8 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.9 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.10 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.11 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.12 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.13 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan mekanisme deformasi plastik, rekristalisasi, patahan, susunan paduan dan struktur mikro
2. Mahasiswa mampu menerapkan berbagai mekanisme penguatan pada logam
3. Mahasiswa mampu menganalisis mekanisme berbagai perubahan fase

POKOK BAHASAN

1. Introduction
2. Struktur kristal, ikatan atom, kristal, cacat pada kristal, kristalografi
3. Diagram fasa dan kesetimbangan Besi-Karbida Besi
4. Diagram transformation, Phase transformation Processing, dekomposisi austenit
5. Penguatan logam, general heat treatment
6. Pengerasan dan penemperan
7. Pengerasan permukaan

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Avner, Sidney H, Introduction to Physical Metallurgy, Second Edition, Tokyo: Mc Graw Hill, International Book Company, 1987
2. Schlenker B.R, Introduction to Material Science, SI Edition, Sidney: John Wiley & Sons, 1974
3. Dieter, George E, Mechanical Metallurgy, Second Edition, Tokyo: McGraw Hill International Book Company, 1981
4. Baret, Craig R, Nix William D, Tetelman, Alan S, The Principles of Engineering Materials, New Jersey: Prentice Hall Incorporation, Englewood Cliffs, 1973

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Matematika Rekayasa**
	Kode Mata Kuliah : TL184310
	Kredit : 3 sks
	Semester : 3

DESKRIPSI MATA KULIAH

Konsep dan perhitungan di dunia teknik tidak lepas dari pemahaman persamaan differensial. Sehingga mata kuliah matematika rekayasa ini akan membahas mengenai konsep dan perhitungan berbagai macam persamaan diffferensial, transformasi laplace, dan pengenalan penggunaan program Mat Lab atau Mathematica. Diharapkan di akhir kuliah mahasiswa mampu menerapkan konsep perhitungan tersebut pada bidang yang berkaitan Teknik Material dan Metallurgi sehingga mampu menyelesaikan bermacam permasalah yang terjadi dalam perhitungan teknik dan desain. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri..

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 menginternalisasi nilai, norma, dan etika akademik;
   - 1.4 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri
   - 1.5 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.6 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.7 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.5 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.6 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.7 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional
   - 2.8 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.9 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus

4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menghitung dan menunjukkan perbedaan metode penyelesaian pada turunan sederhana orde pertama dan aplikasinya (single mixing, newton law of cooling, exponential growth-decay, torricelli's law)
2. Mahasiswa mampu menghitung dan menunjukkan perbedaan metode penyelesaian pada turunan sederhana orde kedua dan aplikasinya (sistem pegas)
3. Mahasiswa mampu menghitung dan menunjukkan perbedaan metode penyelesaian pada turunan sederhana orde tinggi dan aplikasinya (double spring, double mixing, elastic beam)
4. Mahasiswa mampu menyederhanakan proses penyelesaian persamaan diferensial sederhana ke dalam menjadi bentuk algebra dan transformasi serta mampu mengaplikasikannya dalam dunia teknik material dan metallurgi (mixing, getaran teredam)
5. Mahasiswa mampu menggunakan matriks untuk menyelesaikan permasalahan matematika teknik
6. Mahasiswa mampu menganalisis dan mengevaluasi persamaan diferensial parsial
7. Mahasiswa mampu menerjemahkan dan menyelesaikan permasalahan/perhitungan Matematika Teknik ke dalam bahasa pemrograman (Mat Lab atau Mathematica)

POKOK BAHASAN

1. Persamaan turunan sederhana orde pertama dan aplikasinya
2. Persamaan turunan sederhana orde kedua dan aplikasinya
3. Persamaan turunan sederhana orde tinggi dan aplikasinya
4. Transformasi laplace
5. Matriks
6. Persamaan turunan parsial
7. MATLAB

PRASYARAT

Mata Kuliah Matematika 1 dan Matematika 2 dengan minimal nilai D

PUSTAKA UTAMA

Erwin Kreyzig, *"Advance Engineering Mathematics"*, 10th Edition, New York, John Wiley and Sons, 2011.

PUSTAKA PENDUKUNG

1. Desmond J. Higham, Nicholas J. Higham. MATLAB guide, 2nd edition, Society for Industrial and Applied Mathematic, 2005
2. Martha L. Abell et al.,Mathematic by Example, 4th edition,Elsevier, 2009

MATA KULIAH	**Nama Mata Kuliah : Karakterisasi Material**
	Kode Mata Kuliah : TL184411
	Kredit : 3 sks
	Semester : 4

DESKRIPSI MATA KULIAH

Mata kuliah Karakterisasi Material memberikan pemahaman tentang dasar-dasar karakterisasi material dan peralatan uji yang digunakan, dasar pemilihan pengujian untuk mengidentifikasi material meliputi sifat fisik/kimia, struktur mikro, struktur kristal, fasa dan sifat termal. Mata Kuliah Karakterisasi Material juga memberikan konsep perhitungan ukuran butir, indeks Miller, parameter kisi dan struktur Kristal serta analisis data yang digunakan dalam proses identifikasi material, kegagalan material dan rekayasa material.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila
   - 1.4. taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.5. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.3. menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menguasai dasar-dasar karakterisasi material dan aplikasinya dalam bidang teknik material dan metalurgi
2. Mahasiswa mampu menguasai konsep fisisorpsi dan kemisorpsi dan menerapkan dalam penggunaan yang berkaitan dengan teknik material dan metallurgi
3. Mahasiswa mampu menguasai konsep pengujian dan identifikasi struktur mikro
4. Mahasiswa mampu menguasai konsep pengujian elemen dan penggunaannya dalam material dan metalurgi
5. Mahasiswa mampu menguasai konsep kristalografi material dan menerapkan dalam perhitungan
6. Mahasiswa mampu menguasai analisis termal dan menerapkan dalam penentuan sifat material

POKOK BAHASAN

1. Konsep Karakterisasi Material
2. Identifikasi Fisis (Fisisorpsi, kemisorpsi, densitas dan porositas, particle size analyzer)
3. Analisis Struktur Mikro Material (Mikroskop Optik, SEM, TEM dan AFM)
4. Pengujian dan Analisis Spektroskopi (FTIR, Spektroskopi, XRF, EDX)
5. Kristalografi dan Analisis Struktur Kristal (Struktur kristal, Prinsip Difraksi, pengujian XRD dan analisis lanjut dengan pemrograman pendukung)
6. Analisis Termal (DSC, TGA, DTA, TMA)

PRASYARAT

Mata Kuliah Pengantar Teknik Material, Transformasi dan Diagram Fasa, Metalurgi 1+P dengan minimal nilai C

PUSTAKA UTAMA

1. Kehl, George L, The Principle of Metallographic Laboratory Practice, Mc Graw Hill Book Company, New York,1949
2. Cullity,B.D., Elements of X-Ray Diffraction, 2 edition, Addison Wesley Publishing Company Inc, Notre Dame, 1959
3. Dodd, W. James, dan Tonge, H.Kenneth, Analytical Chemistry by Open Learning, Termal Methods, John Wiley & sons, Inggris, 1987
4. Wiles, D.B., dan Young, R.A, A new Computer Program for Rietveld Analysis of X-Ray Diffraction Pattern, J. Apply.Cryst,1981

PUSTAKA PENDUKUNG

ASM Handbook volume 10, Material Characterization, USA, 1986

MATA KULIAH	**Nama Mata Kuliah : Korosi dan Pengendalian Korosi +P**
	Kode Mata Kuliah : TL184412
	Kredit : 3 sks
	Semester : 4

DESKRIPSI MATA KULIAH

Memahami deskripsi korosi dan jenis-jenisnya, mampu menganalisis mekanisme korosi, mengetahui faktor yang mempengaruhi dan dapat merencanakan metode pengendalian korosi, mampu melakukan pememilihan material untuk media korosif tertentu

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.4 berperan sebagai warga negara yang bangga dan cinta tanah air, memiliki nasionalisme serta rasa tanggungjawab pada negara dan bangsa;
   - 1.5 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.7 taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9. mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan konsep dasar korosi
2. Mahasiswa mampu melakukan identifikasi jenis-jenis korosi
3. Mahasiswa mampu merancang/ memilih material dan struktur bangun teknik yang aman untuk kondisi lingkungan tertentu
4. Mahasiswa mampu mendesain sistem perlindungan korosi
5. Mahasiswa mampu memilih perlakuan untuk pelapisan logam

POKOK BAHASAN

1. Konsep Energi dan Termodinamika,
2. Kinetika dan Elektrokimia Korosi,
3. Klasifikasi Korosi,
4. Korosi pada Beberapa Logam dan Pengujiannya,
5. Konsep Pengendalian Korosi

PRASYARAT

Mata Kuliah Kimia Material dengan minimal nilai C

PUSTAKA UTAMA

McCafferty,E., INTRODUCTION TO CORROSION SCIENCE, Springer New York Dordrecht Heidelberg London, 2010

PUSTAKA PENDUKUNG

1. KOROSI UNTUK MAHASISWA DAN REKAYASAWAN, K.R. Trethewey, J. Chamberlain, Longman Group, UK Limited

2. CORROSION ENGINEERING, Mars Guy Fontana, McGraw-Hill Book Company; 3rd edition (November 1, 1985)
3. CORROSION, METAL/ ENVIRONMENT REACTION, L.L. Shreir, R.A. Jarman, G.T. Burstein, Butterworth-Heinemann, 2000
4. UHLIG'S CORROSION HANDBOOK, R. Winston Revie, John Wiley and Sons, Canada, 2000
5. Principles of Corrosion Engineering and Corrosion Control, Zaki Ahmad, Elsevier Science and Technology Book, 2006
6. Handbook of Cathodic Corrosion Protection, W. von Baeckmann, W. Schwenk, W. Prinz, Gulf Professional Publishing, Houston, 1997
7. Corrosion Mechanisms in Theory and Practice, Philippe Marcus, Marcel Dekker, Inc. 270 Madison Avenue, New York, 2002

MATA KULIAH	**Nama Mata Kuliah : Proses Manufaktur**
	Kode Mata Kuliah : TL184413
	Kredit : 3 sks
	Semester : 4

DESKRIPSI MATA KULIAH

Proses pembuatan produk material dalam dunia industri tidak lepas dari pemahaman mengenai dasar-dasar proses manufaktur. Dalam mata kuliah proses manufaktur ini akan dibahas tentang proses pemotongan dengan metode konvensional dan non konvensional, pengelasan dengan jenis-jenisnya, pengecoran dengan jenis-jenisnya, pengerjaan pada temperatur ruang maupun tinggi dan pembuatan produk dari plastic. Dengan pembahasan ini diharapkan mahasiswa mampu menerapkan dasar-dasar proses manufaktur untuk menyelesaikan permasalahan yang berkaitan dengan manufaktur di industri. Untuk mencapai tujuan tersebut maka strategi pembelajaran yang dilakukan adalah kuliah di kelas, pemberian tugas mandiri, presentasi dan praktikum

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan

3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus

4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan definisi proses manufaktur
2. Mahasiswa mampu menjelaskan proses manufaktur secara konvensional dan non konvensional
3. Mahasiswa mampu menjelaskan proses penyambungan logam (OAW, SMAW dan GTAW)
4. Mahasiswa mampu menjelaskan proses pengecoran (sand casting, mould casting, centrifugal casting, die casting dan investment casting)
5. Mahasiswa mampu menjelaskan proses pengerjaan dingin dan panas
6. Mahasiswa mampu menjelaskan proses pembuatan plastik

POKOK BAHASAN

1. Konsep dasar/definisi proses manufaktur
2. Proses manufaktur konvensional
3. Proses manufaktur non konvensional
4. Proses penyambungan logam
5. Proses pengecoran logam
6. Proses pengerjaan dingin
7. Proses pengerjaan panas
8. Proses pembuatan plastik

PRASYARAT

Tidak ada

PUSTAKA UTAMA

Kalpakjian, Manufacturing Process for Engineering Materials

PUSTAKA PENDUKUNG

1. John Schey
2. Amstead

MATA KULIAH	**Nama Mata Kuliah : Metalurgi 2 +P**
	Kode Mata Kuliah : TL184414
	Kredit : 3 sks
	Semester : 4

DESKRIPSI MATA KULIAH

Matakuliah Metalurgi II mempelajari tentang jenis / klasifikasi dari baja paduan dan besi tuang, pengaruh unsur paduan, dan paduan non ferrous

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur

material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengenal macam-macam baja, sifat dan penggunaannnya, memahami hubungan antara komposisi, struktur mikro dan sifat baja
2. Mahasiswa mampu menalar besi tuang, sifat mekanik dan aplikasinya
3. Mahasiswa mampu menganalisis logam non ferrous dan paduannya
4. Mahasiswa mampu memahami spesifikasi baja perkakas, jenis dan penggunaannya
5. Mahasiswa mampu menganalisis aplikasi logam non ferrous

POKOK BAHASAN

1. Metalurgi Besi-Baja, klasifikasi baja, sifat dan penggunaannya, unsur paduan dan pengaruhnya, standar dan spesifikasi baja, karakteristik beberapa macam baja
2. Besi tuang: jenis, struktur mikro, sifat mekanik dan aplikasi.
3. Baja tahan karat, klasifikasi berdasarkan struktur mikro, spesifikasi standar, sifat dan penggunaan, kendala dalam proses pengerjaan dan pemakaian.
4. Baja perkakas, klasifikasi, spesifikasi standard, jenis, sifat dan penggunaan
5. Logam non ferrous

PRASYARAT

Mata Kuliah Pengantar Teknik Material dan Metalurgi dan Metalurgi dengan minimal nilai D

PUSTAKA UTAMA

1. Avner, Sidney H, Introduction to Physical Metallurgy, Second Edition, Tokyo: Mc Graw Hill, International Book Company, 1987
2. Thelning, Karl Erik, Steel and Its Heat Treatment, Second Edition, London: Butterworths, 1984.

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Analisis Numerik dan Pemodelan**
	Kode Mata Kuliah : TL 144415
	Kredit : 3 SKS
	Semester : 4

DESKRIPSI MATA KULIAH

Studi operasi aljabar dan teknik untuk memperoleh pendekatan numerikal untuk fungsi, turunan fungsi dan solusi dari sistem persamaan

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami konsep dasar dari galat/error, deret taylor dan pendekatan numerikal
2. Mahasiswa mampu menerapkan operasi aljabar untuk memecahkan turunan dan integrasi sebuah fungsi secara numerik
3. Mahasiswa mampu menerapkan operasi aljabar untuk memecahkan persamaan linear dan nonlinear
4. Mahasiswa mampu menerapkan teknik-teknik numerik untuk problem fitting data dan optimisasi
5. Mahasiswa mampu menerapkan teknik-teknik numerik yang tepat beserta pemrogramannya untuk memecahkan masalah-masalah di bidang teknik material dan metalurgi

POKOK BAHASAN

1. Pendahuluan pemodelan untuk problem-problem teknik
2. Error, deret taylor dan aproksimasi
3. Metode mencari akar persamaan-metode grafis, metode bagi-dua, metode iterasi
4. Matrik dan solusi sistem persamaan aljabar linear (eliminasi gauss, dekomposisi lu dan metode iterasi)
5. Diferensiasi numerik (metode beda bagi hingga) dan integrasi (metode trapezoidal, metode simpson, newton-cotes, metode romberg, metode gauss quadrature)
6. Persamaan diferensial biasa dan solusinya (metode euler, runge-kutta dan adaptive runge-kutta)
7. Fitting data dan problem optimisasi
8. Klasifikasi persamaan diferensial parsial (jenis persamaan elliptic, parabolic and hyperbolic)

PRASYARAT

Mata Kuliah Pemrograman Komputer

PUSTAKA PENDUKUNG

1. Steven C. Chapra And Raymond P. Canale. Numerical Methods For Engineers. Mc Graw Hill. 2010
2. G. Miller. Numerical Analysis For Engineers And Scientists. Cambridge University Press. 2014

MATA KULIAH	**Nama Mata Kuliah : Statistik dan Perencanaan Eksperimen**
	Kode Mata Kuliah : TL184416
	Kredit : 3 sks
	Semester : 4

DESKRIPSI MATA KULIAH

Perencanaan penelitian yang baik merupakan faktor yang penting dalam menentukan hasil eksperimen. Selain perencanaan eksperimen yang baik kemampuan menganalisa kumpulan data-data eksperimen diperlukan dalam ilmu statistik. Untuk itu dalam mata kuliah Statistik dan Perencanaan Eksperimen mahasiswa diharapkan mampu menganalisa uji hipotesa dengan benar dan menentukan metode penelitian yang tepat sehingga didapatkan hasil yang optimal. Sehingga mata kuliah ini akan mempelajari tentang konsep dasar statistika, peluang dan penerapannya di dalam bidang teknik serta memberikan dasar - dasar statistik untuk eksperimen. Selain itu mata kuliah ini juga mempelajari tentang pembuatan model dan hipotesa, analisa data dan dapat menentukan perbedaan antara rata - rata perlakuan. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;

3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan konsep deskripsi data dan konsep peluang.
2. Mahasiswa mampu menalar dan dan menghitung penaksiran.
3. Mahasiswa mampu menganalisis uji hipotesis dan regresi linier.
4. Mahasiswa mampu merancang metode penelitian dan analisa data.
5. Mahasiswa mampu untuk mengambil keputusan berdasarkan hasil dan analisa penelitian.

POKOK BAHASAN

1. DISTRIBUSI NORMAL
   1.1.Distribusi Z dan t
   1.2.Distribusi Normal Standart
   1.3.Pooled Estimate s^2
   1.4.One tiled test
   1.5.Two Tiled Test
   1.6.Perbandingan Dua Mean Dengan Distribusi t
2. INFERENSI TERHADAP VARIAN PADA DATA TERDISTRIBUSI NORMAL
   2.1.Distribusi chi-square
   2.2.Distribusi F
3. INFERENSI PROPORSI
   3.1.Distribusi binomial
   3.2. Pendekatan dengan distribusi normal
   3.3. Pendekatan dengan distribusi poisson
4. TESTING PERBEDAAN DIANTARA K MEAN
   4.1 analisa variance
   4.2 langkah-langkah untuk analisa variance
   4.3 tabel anova
   4.4 95% multiply t confidence internal
5. RANDOMIZED BLOCK EXPERIMENT
   5.1. randomized block eksperiment
   5.2. two-way (factorial) design
6. LATIN SQUARE DESIGN
7. TWO LEVEL FACTORIAL DESIGN
   7.1 Metode YATES untuk menghitung efek utama dan interaksi
   7.2 Penentuan Confidence Interval
   7.3 Blocking

8. ANALISA REGRESI
   8.1 Persamaan Regresi Linear
   8.2. Inferensi Sudut β
   8.3. Pure Error dan Lack of Fit
   8.4 Pengamatan Residual
   8.5 Check Model Garis Lurus
   8.6 Metode Matrik Untuk Analisa Regresi
   8.7. Multiple Linier Regression
   8.8 Analisa Regresi untuk Two-level Factorial Design
   8.9.Non Linear Regression
9. METODA RESPONSE SURFACE
   9.1 Model Respon
   9.2. Pengecekan Model
   9.3. Pendakian tercuram
   9.4. Desain ke dua
   9.5 Penerapan Model Derajat Dua
   9.6. Penentuan kondisi optimal pada persamaan polynomial derajat dua
10. KONTROL KUALITAS
   10.1. Diagram control rata-rata
   10.2 Diagram Kontrol
   10.3. Diagram Kontrol Proporsi (p)
   10.4. Diagram Kontrol Cacat (C)

PRASYARAT

Mata Kuliah Matematika 1 dan Matematika 2 dengan nilai minimal D

PUSTAKA UTAMA

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4. Montgomery D.C. "Design and Analysis of Experiment", John Wiley & Sons, New York, 1984
5. Sudjana, "Desain dan Analisa Experimen", Tarsito, Jakarta,1991

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Material Keramik dan Gelas**
	Kode Mata Kuliah : TL184517
	Kredit : 3 sks
	Semester : 5

DESKRIPSI MATA KULIAH

Keramik dan gelas merupakan salah satu jenis material yang memiliki aplikasi yang luas. Selain itu material keramik juga memiliki jenis struktur Kristal yang komplek sehingga membuka peluang yang luas dalam teknik rekayasanya. Mata kuliah Keramik dan Glas ini merupakan mata kuliah yang mempelajari tentang sifat dan karakteristik material keramik dan glas. Juga proses rekayasa, pembuatan dan aplikasinya. Diharapkan di akhir kuliah mahasiswa mampu memahami karakteristik keramik dan glas dan mampu mengembangkan rekayasa material ini untuk aplikasi teknik lebih lanjut. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan

3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan sejarah perkembangan material keramik, jenis keramik, dan propertis keramik
2. Mahasiswa mampu menghitung, mengembangkan dan menganalisis Ikatan antar atom dari keramik
3. Mahasiswa mampu menghitung dan menyelesaikan persoalan sistem kristal
4. Mahasiswa mampu menghitung dan menyelesaikan persoalan cacat pada kristal
5. Mahasiswa mampu menghitung dan menyelesaikan persoalan manufaktur pada keramik dan glas
6. Mahasiswa mampu menjelaskan aplikasi dari material keramik

POKOK BAHASAN

1. Pengantar
2. Ikatan Atom dalam Keramik dan Gelas
3. Sistem kristal pada keramik dan gelas
4. Defects/Cacat dalam Keramik
5. Proses manufaktur keramik :
   - Raw Materials
   - Powders, Fibers, Platelets, dan Composites
   - Shaping dan forming
   - Coating process untuk keramik struktur dan elektronik
   - Sintering
6. Properties dan aplikasi keramik

PRASYARAT

Tidak ada

PUSTAKA UTAMA

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2. Barsoum, M.W., Fundamentals of Ceramics,New York: McGraw-Hill Company, Inc, 1997.
3. Yet Ming Chiang et al, Physical Ceramics, New York John Wiley and Sons, Inc, 1997

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Mekanika Patahan dan Analisa Kegagalan**
	Kode Mata Kuliah : TL184518
	Kredit : 3 sks
	Semester : 5

DESKRIPSI MATA KULIAH

Kegagalan pada material terjadi karena terjadinya dislokasi pada material benda kerja akibat beban eksternal yang melebihi kekuatan material tersebut. Sehingga diperlukan metoda yang tepat untuk menganalisa kegagalan yang terjadi pada sebuah material. Untuk itu dalam mata kuliah ini mempelajari tentang faktor konsentrasi tegangan, tegangan akibat beban, momen, torsi, panas, mode bukaan retak, distribusi tegangan disekitar retakan, faktor intensitas tegangan, penyebab kegagalan komponen, pengertian pola patahan, intrusi ekstrusi, cleavage, analisis kegagalan, laporan analisis kegagalan. Diharapkan di akhir kuliah mahasiswa mampu menjelaskan tegangan yang terjadi akibat beban gaya, momen dan panas. Selain itu mahasiswa juga mampu menghitung tegangan dislokasi yang memiliki konsentrasi tegangan. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

4. Ketrampilan Khusus
   - 4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menganalisa Tegangan dan regangan akibat beban kompresi, kriteria luluh (yield), kriteria fracture, mekanisme patahan dan penampakannya, patah ulet dan patah getas, dan aspek makroskopis
2. Mahasiswa mampu menganalisa Perilaku mekanik material akibat beban berulang, mikroskopik dan makrokospik akibat fatigue dan perambatan retakan (crack propagation), fatigue life, inisiasi cack, pertumbuhan crack, dan total life, infinite life kekuatan fatigue, finite life kekuatan fatigue, langkah praktis
3. Mahasiswa mampu menganalisa faktor intensitas tegangan dan tegangan sisa akibat adanya retak Ketangguhan Fracture Logam
4. Mahasiswa mampu menganalisa Linear elastic fracture mechanics, Griffith-Irwin theory, Indikasi dan kriteria Fracture, plastisitas crack tip, ductile dan brittle fracture, Plane strain fracture toughness

POKOK BAHASAN

1. Konsep tegangan pada suatu titik dan transformasi tegangan
2. *Linear elastic fracture mechanics*
3. *Elastic elastic fracture mechanics*
4. Standar dan pengukuran parameter retak
5. Mekanisme retakan
6. Prediksi umur pakai dan kontrol kerusakan
7. Analisa kegagalan dan masalah pada prakteknya

PRASYARAT

Mata kuliah Mekanika Teknik dan Elemen Mesin dengan minimal nilai D

PUSTAKA UTAMA

1. Fracture Mechanics: Fundamental and Application, third ed,by TL Anderson, publ :Tailor and Francis, 2005
2. Failure Analysis of engineering structure, by AC Raghuram, Khrishnan, Bhaumik, publ: ASM Interl., 2005

PUSTAKA PENDUKUNG

Mata Kuliah	**Nama Mata Kuliah : Keselamatan dan Kesehatan Kerja**
	Kode Mata Kuliah : TL184519
	Kredit : 3 sks
	Semester : 5

Deskripsi Mata Kuliah

Mata kuliah kesehatan dan keselamatan kerja menjelaskan tentang pentingnya perhatian engineer terhadap pola dan metode kerja yang baik. Sehingga para pekerja yang mengikuti pola dan metode tersebut dapat bekerja dengan sehat dan selamat di lingkungan kerja. Setiap pekerjaan terdapat resiko-resiko bahaya terutama di dunia industri. Apabila bahaya-bahaya tersebut tidak ditangani dengan pengaturan yang baik maka berpotensi menimbulkan kecelakaan. Kecelakaan tersebut merugikan berbagai pihak seperti pekerja, keluarga pekerja, perusahaan dan lingkungan. Setelah mempelajari mata kuliah K3 diharapkan mahasiswa mampu menganalisa konsep dasar K3, peraturan standard K3, jenis-jenis bahaya, faktor penyebab bahaya, cara menanggulangi bahaya, peranan manusia dalam menimbulkan dan mencegah bahaya serta pengaturan prosedur keselamatan dan kesehatan kerja. Untuk mencapai tujuan tersebut strategi pembelajaran pada mata kuliah meliputi pertemuan tatap muka, tugas, kunjungan laboratorium atau kunjungan industry untuk analisa K3 suatu sistem kerja.

CAPAIAN PEMBELAJARAN YANG DIBEBANKAN KE MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.7 taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;

3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan pengenalan kesehatan dan keselamatan kerja
2. Mahasiswa mampu menjelaskan hukum, peraturan dan standard kesehatan dan keselamatan kerja
3. Mahasiswa mampu menganalisa bahaya dan cara control bahaya
4. Mahasiswa mampu menjelaskan faktor manusia dalam pelaksanaan kesehatan dan keselamatan kerja
5. Mahasiswa mampu menganalisa pengaturan keselamatamn dan kesehatan kerja

POKOK BAHASAN

1. Pengenalan kesehatan dan keselamatan kerja
2. Hukum, peraturan dan standard kesehatan dan keselamatan kerja
3. Bahaya dan cara control bahaya
4. Faktor manusia dalam pelaksanaan kesehatan dan keselamatan kerja
5. Pengaturan keselamatan dan kesehatan kerja

Prasyarat

Tidak ada

PUSTAKA UTAMA

1. Roger, (2006), safety and health for engineers, willey interscience, canada

PUSTAKA PENDUKUNG

Mata Kuliah	**Nama Mata Kuliah : Perlakuan Panas**
	Kode Mata Kuliah : TL184520
	Kredit : 3 sks
	Semester : 5

Deskripsi Mata Kuliah

Perubahan structure suatu logam paduan hasil maching/deformation akan berpengaruh terhadap sifat-sifatnya. Proses perlakuan panas (heat treatment) dapat berperan penting terhadap perubahan structur tersebut, sehingga akan memperluas penggunaan paduan logam akibat variasi sifat yang dihasilkan. Pada mata kuliah Perlakuan Panas mempelajari tentang diffusion and diffusionless, transformasi pada pemanasan/pindinginan (diagram phase, diagram transformasi, decomposisi martensit, recrystalisasi), hardenability, residual stress, macam-macam proses heat treatment (general dan spesific). Setelah menyelesaikan mata kuliah ini mahasiswa mampu menjelaskan dan memprediksi perubahan fase pada pemanasan/pendinginan, mengukur/menghitung dan menggunakan data hardenability, memahami pengaruh unsur paduan serta pengaruh variasi methode proses dalam perlakuan panas (general heat treatment and spesific heat treatment). Untuk mencapai tujuan tersebut strategi pembelajaran pada mata kuliah meliputi: pertemuan tatap muka, tugas, project praktikum, presentas, diskusi dan kunjungan industri.

CAPAIAN PEMBELAJARAN YANG DIBEBANKAN KE MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur

material produk;

3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan interaksi paduan, strukturmikro, sifat, perlakuan panas, metode manufaktur
2. Mahasiswa manpu menjelaskan transformasi fase; equilibrium, non-equilibrium
3. Mahasiswa mampu menjelaskan unsur paduan pada baja
4. Mahasiswa mampu menghitung hardenability
5. Mahasiswa mampu menjelaskan tegangan sisa
6. Mahasiswa mampu menjelaskan proses perlakuan panas baja ; annealing
7. Mahasiswa mampu menjelaskan proses perlakuan panas baja: pengerasan dan penemperan
8. Mahasiswa mampu menjelaskan pengerasan permukaan
9. Mahasiswa mampu menjelaskan perlakuan panas khusus antara lain : baja perkakas

POKOK BAHASAN

1. Interaksi paduan, strukturmikro, sifat, perlakuan panas, metode manufaktur
2. Transformasi fase; equilibrium, non-equilibrium
3. Unsur paduan pada baja
4. Hardenability
5. Tegangan sisa
6. Proses perlakuan panas baja ; annealing
7. Proses perlakuan panas baja: pengerasan dan penemperan
8. Pengerasan permukaan
9. Perlakuan panas khusus antara lain : baja perkakas,

Prasyarat

Mata Kuliah Metalurgi 1, Metalurgi 2, Diagram fasa dan Transformasi dengan minimal pernah mengambil

PUSTAKA

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2. George E. Totten, “Steel Heat Treatment – Metallurgy and Technologies”, CRC, 2007.
3. Frank Czerwinski, “Heat Treatment Conventional and Novel Application”, InTech, 2012.

Mata Kuliah	**Nama Mata Kuliah : Teknologi Pengecoran**
	Kode Mata Kuliah : TL184521
	Kredit : 3 sks
	Semester : 5

Deskripsi Mata Kuliah

Proses pengecoran merupakan bagian dari metalurgi manufaktur untuk membuat paduan logam menjadi bentuk sesuai produk yang dibutuhkan. Pada mata kuliah Teknologi Cor mempelajari tentang prinsip dasar pengecoran, jenis-jenis pengecoran, desain komponen pengecoran (pattern, riser, sistem saluran), perlakuan cetakan pasir agar memenuhi sifat cetakan pasir yang baik, material balance non reactive system untuk mengatur komposisi paduan target, heat balance untuk memprediksi kebutuhan panas dalam peleburan, jenis-jenis furnace, solidifikasi hasil cor, cacat-cacat dalam pengecoran dan mekanisme cacat. Setelah menyelesaikan mata kuliah ini mahasiswa mampu menjelaskan kebutuhan teknologi untuk suatu proses pengecoran, merancang seluruh komponen dari cetakan, menganalisa dan merekomendasikan langkah-langkah untuk meminimalisir cacat hasil cor. Untuk mencapai tujuan tersebut strategi pembelajaran pada mata kuliah meliputi pertemuan tatap muka, tugas, praktikum, presentasi dan kunjungan industry.

CAPAIAN PEMBELAJARAN YANG DIBEBANKAN KE MATA KULIAH

1. Sikap
   1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   1.8. menginternalisasi nilai, norma, dan etika akademik;
   1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk

menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan teknologi cor dan jenis-jenis pengecoran
2. Mahasiswa mampu menjelaskan mekanisme solidifikasi
3. Mahasiswa mampu menghitung desain pattern dan core
4. Mahasiswa mampu menghitung desain riser
5. Mahasiswa mampu menghitung desain saluran masuk
6. Mahasiswa mampu menganalisa perlakuan cetakan pasir yang tepat
7. Mahasiswa mampu menghitung material dan heat balance
8. Mahasiswa mampu membandingkan proses peleburan dan tahap penyelesaian benda cor
9. Mahasiswa mampu menganalisa penyebab cacat-cacat hasil pengecoran
10. Mahasiswa mampu menganalisa penanggulangan cacat-cacat hasil pengecoran
11. Mahasiswa mampu menganalisa steel casting, aluminium casting dan cooper casting

POKOK BAHASAN

1. Teknologi cor dan jenis-jenis pengecoran
2. Mekanisme solidifikasi
3. Desain pattern dan core
4. Desain riser
5. Desain saluran masuk
6. Perlakuan cetakan pasir
7. Material dan heat balance
8. Proses peleburan dan penyelesaian
9. Cacat-cacat hasil pengecoran
10. Penanggulangan cacat-cacat hasil pengecoran
11. steel casting, aluminium casting dan cooper casting

Prasyarat

Mata Kuliah Metalurgi 1, Metalurgi 2, Diagram Fasa dan Transformasi dengan minimal pernah mengambil

PUSTAKA UTAMA

1. Rao P. N. “Manufacture Technology
2. William D Callister “An Introduction : Material Science and Engineering. 8th Edition” US: John Willey and Sons, Inc. 2007
3. American Foundry Society

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Deformasi dan Proses Pembentukan**
	Kode Mata Kuliah : TL184522
	Kredit : 3 sks
	Semester : 5

DESKRIPSI MATA KULIAH

Mata kuliah Deformasi dan Proses Pembentukan merupakan mata kuliah yang mempelajari tentang deformasi (perubahan bentuk) yang terjadi pada benda padat (solid). Mata kuliah ini selanjutnya juga terkait dengan kemajuan teknologi proses pembentukan (forming process) yakni proses pembuatan benda kerja pada kondisi solid.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   - 4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses

manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menalar perilaku mekanik dari material.
2. Mahasiswa mampu menalar hubungan antara tegangan dengan regangan material
3. Mahasiswa mampu menjelaskan teknik analisa perhitungan pada kajian deformasi solid untuk melakukan analisa pada kasus-kasus proses pembentukan logam (metal forming process)
4. Mahasiswa mampu menjelaskan kemajuan teknologi proses pembentukan logam (metal forming process)
5. Pembelajar mampu menalar kurva alir dari teori pastisitas
6. Mahasiwa mampu menjelaskan Kurva tegangan -regangan dan kriteria luluh dari teori plastisitas
7. Mahasiswa mampu menjelaskan prinsip dasar Analisis slab
8. Mahasiswa mampu melakukan kalkulasi dengan menggunakan analisis tegangan- regangan lokal
9. Mahasiswa mampu menggunakan dan menganalisis Teori Medan Garis Slip
10. Mahasiswa mampu merumuskan dan menganalisis Teori analisis batas atas dan batas bawah
11. Mahasiswa mampu mengidentifikasi dan menganalisis proses pembentukan biocomposite
12. Mahasiswa mampu mengidentifikasi dan menganalisis proses pembentukan biopolymers
13. Mahasiswa mampu melakukan identifikasi dan analisis proses pembentukan komposit nano berbasis selulosa

POKOK BAHASAN

1. Tensor tegangan
2. Kompabilitas
3. Kriteria luluh
4. Persamaan konstitutif
5. Slab calculations
6. Slip line theory, Upper bound & Lower bound
7. Proses pembentukan komposit berbahan serat natural dengan teknologi ekstrusi
8. Teknologi proses pembentukan

PRASYARAT

Mata Kuliah Mekanika Teknik, Proses Manufaktur dengan minimal pernah mengambil

PUSTAKA UTAMA

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2. R. H. Wagoner and J.- L. Chenot, Metal Forming Analysis, Cambridge University Press, Cambridge.
3. Mohanty, Amar K., ed., Natural Fibers, Biopolymers, and Biocomposites, CRC Press, New York.

MATA KULIAH	**Nama Mata Kuliah : Teknopreneur**
	Kode Mata Kuliah : UG184915
	Kredit : 2 sks
	Semester : 6

DESKRIPSI MATA KULIAH

Mata kuliah Teknopreneur digunakan untuk menentukan bisnis menggunakan teknologi. Teknopreneur mempelajari ilmu tentang bisnis, teknologi, manajemen, biaya dan keuangan. Teknopreneur digunakan untuk merekayasa dan mengembangkan bisnis di bidang material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;

2. Ketrampilan Umum
   2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat Konsep dasar teknopreneur
2. Mahasiswa mampu memahami Prinsip bisnis
3. Mahasiswa mampu menjelaskan Studi kelayakan
4. Mahasiswa mampu menjelaskan Model bisnis
5. Mahasiswa mampu menerapkan Rencana bisnis
6. Mahasiswa mampu mengaplikasikan Manajemen bisnis
7. Mahasiswa mampu menganalisis Analisis biaya dan keuangan

POKOK BAHASAN

1. Konsep dasar teknopreneur
2. Prinsip bisnis
3. Studi kelayakan
4. Model bisnis
5. Rencana bisnis
6. Manajemen bisnis
7. Analisis biaya dan keuangan

PRASYARAT

Tidak ada

PUSTAKA UTAMA

Entrepreneurship
Bisnis
Business

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Material Polimer *layanan pengayaan**
	Kode Mata Kuliah : TL184623*
	Kredit : 3 sks
	Semester : 6

DESKRIPSI MATA KULIAH

Material polimer digunakan untuk berbagai komponen teknik. Material polimer digunakan sebagai roda mobil, pembungkus kabel, botol, komponen elektronik dan pipa. Material polimer perlu didisain dan direkayasa tertentu. Mata kuliah material polimer mempelajari ilmu pengetahuan dan teknologi struktur, pemprosesan dan sifat material polimer. Mata kuliah material polimer memiliki bahasan konsep dasar material teknik, klasifikasi material teknik, pemilihan material teknik, konsep dasar material polimer, klasifikasi material polimer, struktur kimia material polimer, struktur molekul material polimer, sintesis material polimer, sifat kimia material polimer, sifat fisik material polimer, sifat mekanik material polimer, proses manufaktur material polimer, dan aplikasi material polimer

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus
4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat konsep dasar material teknik
2. Mahasiswa mampu mengingat klasifikasi dan pemilihan material teknik
3. Mahasiswa mampu memahami konsep dasar material polimer
4. Mahasiswa mampu memahami klasifikasi material polimer
5. Mahasiswa mampu menjelaskan struktur kimia material polimer
6. Mahasiswa mampu menjelaskan struktur molekul material polimer
7. Mahasiswa mampu menerapkan sintesis material polimer
8. Mahasiswa mampu mengaplikasikan sifat kimia, fisik dan mekanik material polimer
9. Mahasiswa mampu menganalisis proses manufaktur material polimer
10. Mahasiswa mampu menganalisis aplikasi material polimer

POKOK BAHASAN

1. Konsep dasar material teknik
2. Klasifikasi dan pemilihan material teknik
3. Konsep dasar material polimer
4. Klasifikasi material polimer
5. Struktur kimia material polimer
6. Struktur molekul material polimer
7. Sintesis material polimer
8. Sifat kimia, fisik dan mekanik material polimer
9. Proses manufaktur material polimer
10. Aplikasi material polimer

PRASYARAT

Mata Kuliah Kimia, Fisika, matematika dengan minimal pernah mengambil

PUSTAKA UTAMA

2. Fred W Billmeyer, Jr, Textbook of Polimer Science, John Wiley and Sons, New York, 1971

PUSTAKA PENDUKUNG

1. William D Callister “An introduction: Material science and Engineering. 8th edition”USA: John Wiley and Sons, Inc. 2007

2. L.H. Sperling, Introduction to physical polymer science, 4th Edition, New York, John Wiley and Sons, 2006.
3. John McMurry, Fundamentals of Organic Chemistry, Thomson Learning, California, 2003
4. A Brent Strong, Plastics: Materials and Processing, Prentice Hall, New Jersey, 2000
5. Manas Chanda, Salil K Roy, Plastics Fundamentals, Properties, and Testing, Taylor & Francis, Boca Raton, 2009
6. Richard G Griskey, Polymer Process Engineering, Chapman & Hall, New York, 1995
7. Ulf W Gedde, Polymer Physics, Chapman & Hall, London, 1995
8. Ger Challa, Polymer Chemistry An Introduction, Ellis Horwood, New York
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12. Walter Klopffer, Introduction to Polymer Spectroscopy, Springer-Verlag, Berlin, 1984
13. Serope kalpakjian, steven r schmid, Manufacturing Engineering and Technology, Addison wesley longman, India, 2000

MATA KULIAH	**Nama Mata Kuliah : Proses Pembuatan Besi dan Baja**
	Kode Mata Kuliah : TL184624
	Kredit : 3 sks
	Semester : 6

DESKRIPSI MATA KULIAH

Dalam mata kuliah ini akan dipelajari proses pembuatan besi baja serta peralatan yang di pergunakan mulai dari persiapan bahan baku hingga produk baja. Proses pembuatan besi dan baja merupakan proses pengolahan besi dari bijih nya dan diikuti dengan pengolahan besi tadi menjadi baja yang bisa diaplikasikan (produk setengah jadi). Proses pengolahan besi diawali dengan persiapan bahan baku bijih besi, mulai dari crushing, grinding, screening, konsentrasi, aglomerasi. Kemudian, pada tahap selanjutnya ialah pengolahan aglomerat menggunakan dua rute pengolahan, baik melalui rute *Blast Furnace – Basic Oxygen Furnace (BF-BOF)* dan *Direct Reduced Iron – Electric Arc Furnace (DRI-EAF)*. Pada dua rute proses tersebut dijelaskan juga mengenai fundamental teori untuk lebih memahami proses di dalam reaktor, mulai dari termodinamika, aerodinamika dan kinetika reaksi. Setelah memahami proses pembuatan besi dari dua rute tersebut, pada mata kuliah ini juga dijelaskan mengenai rute alternatif pengolahan besi. Kemudian, pada mata kuliah ini juga dibahas mengenai proses pembuatan baja pada umumnya *(billet, bloom dan slab)* dan baja khusus (*Stainless steel* dan baja paduan).

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;

3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus
4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat statistik besi-baja dan klasifikasi baja serta pengembangan baja
2. Mahasiswa mampu mengingat mengenai macam-macam bijih besi dan proses aglomerasi
3. Mahasiswa mampu memahami termodinamika dan kinetika dalam proses pembuatan besi dan baja
4. Mahasiswa mampu menjelaskan proses pembuatan baja pada tanur tinggi *(Blast Furnace)*
5. Mahasiswa mampu menjelaskan proses pembuatan baja di dalam *ladle* dan *BOF (Basic Oxygen Furnace)*
6. Mahasiswa mampu menjelaskan proses reduksi langsung *(Direct Reduction Iron)*
7. Mahasiswa mampu menjelaskan pembuatan baja di *EAF (Electric Arc Furnace)*
8. Mahasiswa mampu menganalisis proses sekunder metalurgi
9. Mahasiswa mampu menganalisis proses pembuatan baja tahan karat dan baja paduan

POKOK BAHASAN

1. Statistik Industri Besi – Baja dan Klasifikasi Baja dan Pengembangan Baja
2. Bijih Besi & Proses Aglomerisasi
3. Termodinamika dan Kinetika dalam Proses Pembuatan Besi dan Baja
4. Tanur Tinggi *(Blast Furnace)*
5. Proses Pembuatan Baja di dalam *Ladle* dan *BOF (Basic Oxygen Furnace)*
6. Proses Reduksi Langsung *(Direct Reduction Iron)*
7. Proses Pembuatan Baja di EAF *(Electric Arc Furnace)*
8. Proses Sekunder Metalurgi
9. Proses Pembuatan Baja tahan karat dan baja paduan

PRASYARAT

Mata Kuliah Pengantar Teknik Material Metalurgi, Kimia, Kimia material, Termodinamika Material, Fenomena Transport dengan minimal sudah atau sedang mengambil

PUSTAKA UTAMA

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PUSTAKA PENDUKUNG

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5. Allain Vignes, Extractive Metallurgy 2 “ Metallurgical Reaction Process “, Wiley, 2011.
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MATA KULIAH	**Nama Mata Kuliah : Teknologi Pengelasan +TB**
	Kode Mata Kuliah : TL184625
	Kredit : 3 sks
	Semester : 6

DESKRIPSI MATA KULIAH

Mengerti dan memahami konsep pengelasan dan jenis-jenisnya. Memahami karakteristik sumber panas las, mengenal dan memahami proses las. Memahami konsep perpindahan panas akibat pengelasan, metalurgi las dan pengaruhnya terhadap struktur mikro logam. Memahami proses pengelasan pada logam ferrous, non ferrous dan dissimilar metal. Memahami kualitas pengelasan dan memilih prosedur pengelasan dan cara-cara evaluasi hasil pengelasan

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.5 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.7 taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.8 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3 Pengetahuan
- 3.1 konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
- 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
- 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
- 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus
- 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen;
- 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
- 4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
- 4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
- 4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
- 4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa memahami prinsip dasar dan karakteristik pengelasan
2. Mahasiswa mampu menganalisa konsep energi dalam pengelasan
3. Mahasiswa mampu menerapkan teori metalurgi pada pengelasan
4. Mahasiswa mampu mendesain proses pengelasan logam ferrous dan non ferrous serta dissimilar metal
5. Mahasiswa mampu mengevaluasi dan menganalisa kualitas sambungan las
6. Mahasiswa mampu merancang proses pengelasan sederhana dan mengevaluasi hasilnya
7. Mahasiswa memahami dan mampu menerapkan standar keselamatan dalam proses pengelasan

POKOK BAHASAN

1. Klasifikasi dan Karakteristik Las
2. Konsep Panas Input pada Pengelasan
3. Metalurgi Las
4. Pengelasan Beberapa Jenis Logam
5. Pengujian Kualitas Hasil Pengelasan
6. Cacat Pengelasan
7. Desain Prosedur Las

PRASYARAT

Mata Kuliah Metalurgi 1 dan Proses Manufaktur dengan minimal nilai C

PUSTAKA UTAMA

1. AWS, Welding Handbook, 9th ed, Volume 1, WELDING SCIENCE AND TECHNOLOGY, 9th ed., American Welding Society, Miami Florida

PUSTAKA PENDUKUNG

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2. Wiryosumarto, Harsono, Teknologi Pengelasan Logam, Jakarta: Pradnya Paramita
3. ASM Metal Handbook Committee, Metal Handbook Vol.6, ASM, Ohio:Metal Park

MATA KULIAH	**Nama Mata Kuliah : Metode Elemen Hingga**
	Kode Mata Kuliah : TL184626
	Kredit : 3 SKS
	Semester : 6

DESKRIPSI MATA KULIAH

Sebuah teknik pendekatan numerikal berdasarkan perumusan elemen hingga pada domain yang kontinyu.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan
4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; da
4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami konsep dasar diskritisasi dan metode elemen hingga
2. Mahasiswa mampu menerapkan teknik-teknik penurunan matrik kekakuan dan melakukan proses penggabungan
3. Mahasiswa mampu menerapkan metode residu berbobot
4. Mahasiswa mampu memahami dan memilih fungsi interpolasi dan jenis-jenis elemen untuk problem berdimensi lebih tinggi
5. Mahasiswa mampu menerapkan teknik-teknik metode elemen hingga untuk memecahkan problem-problem di bidang material dan metalurgi

POKOK BAHASAN

1. Pendahuluan dan konsep dasar metode elemen hingga
2. Penurunan matrik kekakuan dengan metode langsung
3. Metode residu berbobot
4. Fungsi interpolasi dan jenis elemen
5. Solusi numerikal dari persamaan metode elemen hingga
6. Terapan metode elemen hingga untuk perpindahan panas, komposit dan problem-problem dinamika

PRASYARAT

Mata Kuliah Analisa Numerik dan Pemodelan dengan minimal pernah mengambil

PUSTAKA PENDUKUNG

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2. Klaus J. Bathe. Finite Element Procedures. Prentice Hall. 1996
3. David V. Hutton. Fundamentals Of Finite Element Analysis. 2004
4. Singiresu S. Rao. The Finite Element Method In Engineering. 2011

MATA KULIAH	**Nama Mata Kuliah : Fenomena Transport**
	Kode Mata Kuliah : TL184627
	Kredit : 4 sks
	Semester : 6

DESKRIPSI MATA KULIAH

Mata kuliah Fenomena Transport mempelajari konsep dasar fenomena transport (transfer panas, massa dan momentum) serta menekankan pada transfer momentum dan panas dalam aplikasi material dan metalurgi. Pada mata kuliah ini akan dibahas konsep dasar fluida, aliran fluida, persamaan perubahan untuk menyelesaikan persoalan-persoalan aliran fluida, mekanisme perpindahan panas dan persamaan-persamaan untuk menyelesaikan proses perpindahan panas. Selain itu, mata kuliah ini juga mempelajari transfer massa dan analogi dari transfer panas, massa dan momentum dalam aplikasi material dan metalurgi. Pada mata kuliah ini akan dibahas mengenai difusi dalam material-material baik metal maupun non-metal, perpindahan massa dalam aliran laminair dan turbulen, serta persamaan dan perbedaan dari ketiga fenomena transfer (momentum, massa dan panas).

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 Bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 Menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 Berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 Bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 Menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 Menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 Menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 Berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 Bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
   - 2.1 Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 Mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 Mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 Mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 Mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 Mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 Mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 2.4 Konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 2.5 Konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 2.6 Prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen
   - 2.7 Prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan

2.8 Teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1 Mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2 Mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3 Mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4 Mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5 Mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6 Mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan konsep dasar aliran fluida, meliputi pengertian fluida, klasifikasi aliran fluida, hukum viscositas Newton, streamline, lapisan batas momentum dan besaran-besaran dalam koefisien transfer momentum yang lain.
2. Mahasiswa mampu menghitung neraca massa sederhana.
3. Mahasiswa mampu menghitung neraca momentum dan menggunakan persamaan Navier-Stokes untuk menyelesaikan permasalahan transfer momentum dalam aliran fluida.
4. Mahasiswa mampu menghitung perubahan besaran-besaran aliran fluida dalam aliran turbulen.
5. Mahasiswa mampu menghitung koefisien-koefisien transfer momentum untuk aliran external dan internal.
6. Mahasiswa mampu mengaplikasikan persamaan Bernoulli untuk aliran-aliran fluida.
7. Mahasiswa mampu menghitung perpindahan panas melalui mekanisme konduksi, konveksi dan radiasi.
8. Mahasiswa mampu menghitung property thermal dan distribusi suhu dengan persamaan laju konduksi
9. Mahasiswa mampu menghitung konduksi 1 D steady state dan distribusi suhu dalam aliran fluida
10. Mahasiswa mampu menghitung koefisien difusi dalam solid, liquid dan gas.
11. Mahasiswa mampu menghitung perpindahan massa menggunakan neraca perpindahan massa.
12. Mahasiswa mampu menghitung difusi dalam solid metal dan non metal.
13. Mahasiswa mampu menghitung perpindahan massa dalam aliran turbulen.
14. Mahasiswa mampu menjelaskan perbedaan dan persamaan ketiga transfer

POKOK BAHASAN

1. Pendahuluan Aliran Fluida:
   Konsep Dasar Aliran Fluida:
   - Definisi fluida
   - Klasifikasi aliran fluida:
   - Aliran Compressible dan Incompressible, pengenalan bilangan Mach
   - Aliran Laminar, Turbulen, dan Transisi berdasar bilangan Reynold
   - Aliran Viscous dan Inviscid
   - Aliran Steady dan Unsteady
   - Aliran 1 fasa dan multi fasa
   - Aliran External dan internal
   - Hukum Viskositas Newton
   - Streamline
   - Lapisan batas momentum untuk aliran external dan internal
   - Koefisien transfer momentum dan koefisien yang lain
2. Persamaan Neraca Massa:
   - Neraca Massa Overall dan penurunanannya : konsep control surface
   - Neraca Massa Diferensial dan penurunannya: persamaan kontinuitas
3. Persamaan Neraca Momentum:

• Neraca Momentum Overall dan penurunanannya : konsep control surface
• Neraca Momentum Diferensial dan penurunannya: persamaan Navier-Stokes, bentuk tak berdimensi, kondisi batas
• Persamaan Neraca Momentum Diferensial dalam fungsi aliran dan pusaran dan penurunannya

4. Aliran Turbulen:
   •Variabel rata-rata waktu (time-smoothed variables)
   • Persamaan pengendali rata-rata waktu (time-smoothed governing equation)
   • Flux momentum turbulen
5. Korelasi-korelasi Transfer Momentum:
   • External flow
   • Internal flow
6. Aplikasi Neraca Energi dalam Aliran Fluida (Pers. Bernoulli):
   • Konservasi Energi, evaluasi dari energi kinetik, energi potensial, energi mekanik, kehilangan friksi di dalam saluran lurus.
   • Persamaan Bernoulli
   • Aplikasi persamaan Bernoulli untuk aliran-aliran fluida.
7. Pendahuluan Perpindahan Panas:
   • Perpindahan Panas melalui mekanisme konduksi : Hukum Fourier
   • Perpindahan Panas melalui mekanisme konveksi
   • Perpindahan Panas melalui mekanisme radiasi
   • Konservasi Panas
8. Pendahuluan Konduksi:
   •Persamaan laju konduksi
   •Property thermal dari konduksi
   •Persamaan Difusi Panas
   •Kondisi batas dan kondisi awal
9. Konduksi 1 dimensi steady state:
   • Bidang Datar
   • Sistem Radial: silinder dan bola
   • Konduksi dengan Generasi Panas
   • Perpindahan momentum disertai perpindahan panas
10. Perpindahan Massa: Hukum Fick dan Difusivitas dari Material:
    • Definisi flux
    • Difusi dalam solid
    • Difusi dalam solid non metal
    • Difusi dalam liquid
    • Difusi dalam gas
    • Difusi dalam media berpori
11. Persamaan Neraca Perpindahan Massa Overall:
    • penurunan
    • contoh

    Persamaan Neraca Perpindahan Massa diferrensial:
    • penurunan
    • contoh
12. Difusi di dalam Solid:
    • Difusi steady state
    • Permeabilitas gas melalui metal dan non metal
13. Turbulensi:
    • Variabel rata-rata waktu (time-smoothed variables)
    • Persamaan pengendali rata-rata waktu (time-smoothed governing equation)
    • Flux massa turbulen
14. Persamaan dan Perbedaan dari Type-type Tranfer:
    •Transfer Panas (Hukum Fourier)
    •Transfer Massa (Hukum Fick)
    •Transfer Momentum (Hukum Newton)
    • Bentuk Analogi
    • Difusivitas panas, massa dan momentum: konduktivitas thermal, koefisien difusi dan viskositas.
    • Perbandingan ketiga transfer
    • Analogi Chilton-Colburn

PRASYARAT

Mata Kuliah Kimia dan Fisika 2 dengan minimal nilai C

PUSTAKA UTAMA

1. Kou, S "Transport Phenomena and Materials Processing", 1st edition, John Wiley and Sons, Inc. , 1996

PUSTAKA PENDUKUNG

1. Robert W. Fox & Alan T Mc Donald, "Introduction to Fluid Mechanics", Fourth Edition, New York: John Wiley & Sons, 1994
2. Bird R.B., Stewart W.E., and Lightfoot, E.N., “Transport Phenomena”, Wiley, New York, 1966
3. Geiger, G.H. and Poirier, D.R., “Transport Phenomena Metallurgy”, Addism Wesley Publishing Company, Reading, Massachussetts.
4. Brodkey, R.S. and Hershey H.C., “Transport Phenomena: A Unified Approach, Mc. Graw Hill Book, Co, Ltd., 1988

MATA KULIAH	**Nama Mata Kuliah : Wawasan dan Aplikasi Teknologi**
	Kode Mata Kuliah : UG184916
	Kredit : 3 sks
	Semester : 7

DESKRIPSI MATA KULIAH

Mata kuliah Wawasan dan Aplikasi Teknologi digunakan untuk menerapkan suatu teknologi. Wawasan dan Aplikasi Teknologi mempelajari ilmu tentang teknologi, daya saing, potensi, inovasi dan hak cipta. Wawasan dan Aplikasi Teknologi digunakan untuk merekayasa dan mengembangkan teknologi material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat Konsep teknologi
2. Mahasiswa mampu memahami Pembangunan berkelanjutan
3. Mahasiswa mampu menjelaskan Daya saing
4. Mahasiswa mampu menjelaskan Potensi
5. Mahasiswa mampu menerapkan Inovasi
6. Mahasiswa mampu mengaplikasikan Kreativitas
7. Mahasiswa mampu menganalisis Teknologi informasi dan komunikasi
8. Mahasiswa mampu menganalisis Hak cipta dan plagiarisme

POKOK BAHASAN

1. Konsep teknologi
2. Pembangunan berkelanjutan
3. Daya saing
4. Potensi
5. Inovasi
6. Kreativitas
7. Teknologi informasi dan komunikasi
8. Hak cipta dan plagiarisme

PRASYARAT

Tidak ada

PUSTAKA UTAMA

Teknologi
Inovasi

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Ekstraksi Metalurgi dan Proses Pemurnian**
	Kode Mata Kuliah : TL184728
	Kredit : 3 sks
	Semester : 7

DESKRIPSI MATA KULIAH

Dalam mata kuliah ini akan dipelajari segala hal yang berkaitan dengan metalurgi ekstraksi beserta proses pemurnian, yang mana meliputi basis termodinamika dan kinetika, proses persiapan bahan baku mulai dari kominusi, benefisiasi hingga ekstraksi dan pemurnian. Mineral – mineral yang akan diekstraksi antara lain, tembaga, seng, timbal, nikel, aluminium dan emas. Selain itu, pada mata kuliah ini juga dipelajari mengenai peran insinyur metalurgi dalam industri ekstraksi dan pemurnian.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus

4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat perkembangan proses ekstraksi di Indonesia dan dunia serta review proses pra-ektraksi
2. Mahasiswa mampu memahami prinsip dasar metalurgi ekstraksi
3. Mahasiswa mampu memahami konsep dan perubahan besaran termodinamika; Ellingham Diagram dan prinsip elektrokimia
4. Mahasiswa mampu menjelaskan proses ekstraksi Cu
5. Mahasiswa mampu menjelaskan proses ekstraksi Pb dan Zn
6. Mahasiswa mampu menjelaskan proses ekstraksi Ni
7. Mahasiswa mampu menjelaskan proses ekstraksi Al
8. Mahasiswa mampu menjelaskan proses ekstraksi Au
9. Mahasiswa mampu menganalisis proses ekstraksi sekunder

POKOK BAHASAN

1. Perkembangan proses ekstraksi di Indonesia dan dunia serta review proses pra-ektraksi
2. Prinsip dasar metalurgi ekstraksi
3. Konsep dan perubahan besaran termodinamika; Ellingham Diagram dan prinsip elektrokimia
4. Proses ekstraksi Cu
5. Proses ekstraksi Pb dan Zn
6. Proses ekstraksi Ni
7. Proses ekstraksi Al
8. Proses ekstraksi Au
9. Proses ekstraksi sekunder

PRASYARAT

Mata Kuliah Termodinamika Material, Kimia Material, Proses Pembuatan Besi dan Baja, Fenomena Transport dengan minimal sudah atau sedang mengambil

PUSTAKA UTAMA

1. Habashi. Fathi, Handbook of Extractive Metallurgy, Canada, 1997

PUSTAKA PENDUKUNG

1. Allain Vignes, Extractive Metallurgy 1 “ Basic Thermodynamics and Kinetics “, Wiley, 2011.
2. Allain Vignes, Extractive Metallurgy 2 “ Metallurgical Reaction Process “, Wiley, 2011.
3. Allain Vignes, Extractive Metallurgy 3 “ Processing Operations and Routes “, Wiley, 2011.

MATA KULIAH	**Nama Maya Kuliah : Manajemen Produksi**
	Kode Mata Kuliah : TL184729
	Kredit : 3 sks
	Semester : 7

DESKRIPSI MATA KULIAH

Mata kuliah Manajemen Produksi merupakan mata kuliah yang pengetahuan konsep-konsep optimasi yang dapat diterapkan pada sistem industri. Memberikan mahasiswa kemampuan tentang manajemen, sistem produksi, perencanaan dan pengendalian produksi, dan mampu mengintegrasikan berbagai aktivitas dan proses untuk menghasilkan produk dan layanan yang mempunyai nilai kompetitif. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional,
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengidentifikasi dan menjelaskan Produktivitas, pengambilan keputusan
2. Mahasiswa mampu mengidentifikasi dan menjelaskan Struktur proses dalam manufaktur dan proses otomasi
3. Mahasiswa mampu mengidentifikasi dan menjelaskan Pareto chart, diagram sebab – akibat
4. Mahasiswa mampu mengidentifikasi dan menjelaskan Total Quality Management
5. Mahasiswa mampu mengidentifikasi dan menjelaskan Program linier, metode transportasi
6. Mahasiswa mampu mengidentifikasi dan menjelaskan E-commerce dan enterprise resource planning
7. Mahasiswa mampu menghitung dengan Model-model forecasting
8. Mahasiswa mampu menghitung dengan Model-model inventory
9. Mahasiswa mampu menganalisis dengan metode schedulling
10. Mahasiswa mampu menganalisis time value of money
11. Mahasiswa mampu menganalisis Benefit cost and ratio
12. Mahasiswa mampu menganalisis Breakeven analysis

POKOK BAHASAN

1. Produktivitas, pengambilan keputusan
2. Struktur proses dalam manufaktur dan proses otomasi
3. Pareto chart, diagram sebab – akibat
4. Total Quality Management
5. Program linier, metode transportasi
6. E-commerce dan enterprise resource planning
7. Model-model forecasting
8. Model-model inventory
9. Schedulling
10. Time value of money
11. Benefit cost and ratio
12. Breakeven analysis

PRASYARAT

Mata Kuliah Mekanika Teknik dan Proses Manufaktur dengan minimal pernah mengambil

PUSTAKA UTAMA

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PUSTAKA PENDUKUNG

1. Subir Chowdhury, Jay A. Conger, Edgar H. Shein, et.al., Organization 21C, Pearson Education, 2003
2. Hamdy A. Taha, Operation Research: An Introduction, 7rd Ed. New Jersey: Pearson Education, Inc., 2003

MATA KULIAH	**Nama Mata Kuliah : Material Komposit *layanan pengayaan**
	Kode Mata Kuliah : TL184730*
	Kredit : 3 sks
	Semester : 7

DESKRIPSI MATA KULIAH

Dalam memenuhi kebutuhan teknologi serta inovasi material, material komposit merupakan salah satu material yang banyak diaplikasikan di berbagai produk di dunia material. Sehingga dalam Mata kuliah Material komposit ini akan membahas materi mengenai konsep dasar komposit, material dasar komposit, proses pembuatan komposit, desain dan anailsa kegagalan serta kekuatan komposit. Diharapakan di akhir kuliah mahasiswa mampu memahami konsep perilaku komposit serta aplikasinya serta mampu mendesain project material komposit untuk apklikasi tertentu**.** Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional,
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menunjukkan aplikasi material komposit
2. Mahasiswa mampu menunjukkan klasifikasi material komposit
3. Mahasiswa mampu menunjukkan komponen material komposit
4. Mahasiswa mampu membandingkan dan menjelaskan proses pembuatan material komposit
5. Mahasiswa mampu menganalisa dan menjelaskan pengaruh interface material komposit
6. Mahasiswa mampu menganalisa dan memprediksi mikromekanik material komposit
7. Mahasiswa mampu menganalisa kegagalan pada material komposit

POKOK BAHASAN

1. Pengantar dan Aplikasi Material Komposit
2. Klasifikasi Material Komposit
3. Komponen Material Komposit
4. Proses Pembuatan Material Komposit
5. Interface Material Komposit
6. Mikromekanik Material Komposit
7. Kegagalan pada Material Komposit

PRASYARAT

Tidak ada

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1. William D Callister “An introduction: Material science and Engineering. 8th edition”USA: John Wiley and Sons, Inc. 2007

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2. Derek Hull, An Introduction to Composite Materials, Cambridge University Press, Cambridge, 1990
3. T J Pinnavaia, G W Beall, Polymer-Clay Nanocomposites, John Wiley & Sons, Chichester, 2000
4. L H Sperling, Polymeric Multicomponent Material An Introduction, John Wiley & Sons, New York, 1997

MATA KULIAH	**Nama Mata Kuliah : Kerja Praktek**
	Kode Mata Kuliah : TL184731
	Kredit : 2 sks
	Semester : 7

DESKRIPSI MATA KULIAH

Mata kuliah Kerja Praktek digunakan untuk menentukan material dan metalurgi di industri. Kerja praktek mempelajari penerapan ilmu material dan metalurgi. Kerja praktek digunakan untuk merekayasa dan mengembangkan penerapan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami Pendahuluan masalah
2. Mahasiswa mampu menjelaskan Tinjauan pustaka
3. Mahasiswa mampu menerapkan Pengumpulan data
4. Mahasiswa mampu mengaplikasikan Pengolahan data
5. Mahasiswa mampu menganalisis Laporan kerja praktek

POKOK BAHASAN

1. Pendahuluan masalah
2. Tinjauan pustaka
3. Pengumpulan data
4. Pengolahan data
5. Laporan kerja praktek

PRASYARAT

Tidak ada

PUSTAKA UTAMA

Tulisan ilmiah

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Inspeksi Tanpa Merusak dan Berbasis Resiko**
	Kode Mata Kuliah : TL184732
	Kredit : 3 sks
	Semester : 7

DESKRIPSI MATA KULIAH

Mata kuliah Inspeksi Tanpa Merusak dan Berbasis Resiko digunakan untuk memeriksa kondisi material komponen. Inspeksi Tanpa Merusak dan Berbasis Resiko mempelajari ilmu tentang pemeriksaan dan pengujian kondisi material komponen. Inspeksi Tanpa Merusak dan Berbasis Resiko digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertaqwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses, atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan *issue* terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini;

4. Ketrampilan Khusus
   - 4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   - 4.4. mampu merumuskan alternatif solusi untuk memyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   - 4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   - 4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;

2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami Konsep dasar inspeksi
2. Mahasiswa mampu memahami Konsep dasar pengujian tanpa merusak
3. Mahasiswa mampu menjelaskan Pengujian visual
4. Mahasiswa mampu menjelaskan Pengujian penetran
5. Mahasiswa mampu menerapkan Pengujian magnetik
6. Mahasiswa mampu mengaplikasikan Pengujian radiografi
7. Mahasiswa mampu mengaplikasikan Pengujian ultrasonik
8. Mahasiswa mampu mengaplikasikan Pengujian arus eddy
9. Mahasiswa mampu mengaplikasikan Kode internasional eksaminasi tanpa merusak
10. Mahasiswa mampu menganalisis Konsep dasar inspeksi berbasis resiko
11. Mahasiswa mampu menganalisis Resiko
12. Mahasiswa mampu menganalisis Kemungkinan kegagalan
13. Mahasiswa mampu menganalisis Konsekuensi kegagalan

POKOK BAHASAN

1. Konsep dasar inspeksi
2. Konsep dasar pengujian tanpa merusak
3. Pengujian visual
4. Pengujian penetran
5. Pengujian magnetik
6. Pengujian radiografi
7. Pengujian ultrasonik
8. Pengujian arus eddy
9. Kode internasional eksaminasi tanpa merusak
10. Konsep dasar inspeksi berbasis resiko
11. Resiko
12. Kemungkinan kegagalan
13. Konsekuensi kegagalan

PRASYARAT

Mata Kuliah Kimia, Fisika, matematika, karakterisasi material, metalurgi 1, metalurgi 2 dengan minimal pernah mengambil

PUSTAKA UTAMA

ASM, Non Destructive Evaluation
ASME, Non Destructive Examination

AWS, Non Destructive Testing ASNT, Non Destructive Testing API
PUSTAKA PENDUKUNG
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SEMESTER VIII

MATA KULIAH	**Nama Mata Kuliah : Desain Proses Industri**
	Kode Mata Kuliah : TL184833
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Dalam mata kuliah ini akan dipelajari segala hal yang berkaitan dengan desain proses industri secara *preliminary* tahapan perancangan suatu industri meliputi penentuan konsep desain, penentuan basis desain, pembuatan konsep desain yang mungkin, pengujian kecocokan, optimasi dan seleksi, pembuatan *block diagram*, perhitungan neraca massa dan energi, pembuatan *process flow diagram*, analisa utilitas, SHE, penentuan desain awal dan seleksi equipment serta analisa ekonomi. Sehingga diharapkan mahasiswa mampu menerapkan konsep-konsep desain proses industri dalam perancangan industri di bidang teknik material dan metalurgi. Untuk mencapai tujuan tersebut maka strategi pembelajaran yang dilakukan adalah kuliah di kelas, pemberian tugas kelompok dan presentasi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 2.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 2.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 2.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

2.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
2.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat pengenalan desain proses industri dan aplikasinya di bidang material dan metalurgi
2. Mahasiswa mampu memahami alur desain industri proses
3. Mahasiswa mampu memahami latar belakang penentuan pembangunan industri
4. Mahasiswa mampu membuat *Block Diagram*
5. Mahasiswa mampu menghitung neraca massa dan energi dalam desain proses industri
6. Mahasiswa mampu membuat *Process Flow Diagram (PFD)*
7. Mahasiswa mampu menentukan *supporting equipment* dalam industri proses
8. Mahasiswa mampu menentukan spesifikasi alat secara kuantitatif
9. Mahasiswa mampu menganalisis utilitas industri proses
10. Mahasiswa mampu menganalisis SHE industri proses
11. Mahasiswa mampu menganalisis keekonomian industri proses

POKOK BAHASAN

1. Pengenalan desain proses industri dan Aplikasinya di bidang Material dan Metalurgi
2. Alur desain industri proses
3. Latar belakang penentuan pembangunan industri
4. Block Diagram
5. Penggunaan neraca massa dan energi dalam desain proses industri
6. Process Flow Diagram (PFD)
7. Penentuan supporting equipment
8. Penentuan spesifikasi alat secara kuantitatif
9. Utilitas industri proses
10. SHE industri proses
11. Analisa keekonomian industri proses

PRASYARAT

Mata Kuliah Proses Pembuatan Besi dan Baja, Manajemen Produksi (sudah atau sedang mengambil), , Ekstraksi Metalurgi dan Proses Pemurnian dengan minimal sedang atau sudah mengambil

PUSTAKA UTAMA

1. Gavin Towler, Ray Sinnott, Chemical Engineering Design-Principles, Practice and Economics of Plant and Process Design 2nd Ed, El Sevier, 2013

PUSTAKA PENDUKUNG

1. Sean Moran, An Applied Guide to Process and Plant Design, El Sevier, 2015 (Pustaka Utama)
2. William D. Baasel, Preliminary Chemical Engineering Plant Design, El Sevier, 1974
3. Nayef Ghasem, Principles of Chemical Engineering Processes-Material and Energy Balances 2nd edition, CRC Press, 2015
4. Max S. Peters, Plant Design and Economics for Chemical Engineers 4th ed, McGraw-Hill, 1991

MATA KULIAH	**Nama Mata Kuliah : Tugas Akhir**
	Kode Mata Kuliah : TL184834
	Kredit : 6 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Tugas Akhir digunakan untuk mempelajari dan menganalisis sifat dan teknologi material dan metalurgi. Mata Kuliah Tugas Akhir mempelajari ilmu tentang material dan metalurgi. Tugas Akhir berupa kegiatan penelitian, pengamatan hipotesis dan pembuatan rancangan. Tugas Akhir digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;

2. Ketrampilan Umum
   2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami Pendahuluan masalah
2. Mahasiswa mampu menjelaskan Tinjauan pustaka
3. Mahasiswa mampu menerapkan Metodologi
4. Mahasiswa mampu mengaplikasikan Proposal Tugas Akhir
5. Mahasiswa mampu menganalisis Laporan Tugas Akhir

POKOK BAHASAN

1. Pendahuluan masalah
2. Tinjauan pustaka
3. Metodologi
4. Proposal Tugas Akhir
5. Laporan Tugas Akhir

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Aturan penyusunan tugas akhir institut teknologi sepuluh nopember
2. Metode penelitian
3. Prosedur penelitian

PUSTAKA PENDUKUNG

-

MATA KULIAH	**Nama Mata Kuliah : Pilihan 3 Pengayaan**
	Kode Mata Kuliah : TL184835
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Pilihan 3 Pengayaan digunakan untuk mempelajari ilmu pengetahuan dan teknologi. Pilihan 3 Pengayaan mempelajari ilmu teknik dari disiplin yang beragam dan meningkatkan kekayaan ilmu. Pilihan 3 digunakan untuk memperkaya rekayasa dan pengembangan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9. mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan Konsep dasar ilmu teknik
2. Mahasiswa mampu mengaplikasikan Struktur ilmu
3. Mahasiswa mampu menganalisis Mekanisme ilmu

POKOK BAHASAN

1. Konsep dasar ilmu teknik
2. Struktur ilmu
3. Mekanisme ilmu

PRASYARAT

Tidak ada

PUSTAKA UTAMA

Ilmu Teknik

PUSTAKA PENDUKUNG

-

MATA KULIAH	**Nama Mata Kuliah : Pilihan 1**
	Kode Mata Kuliah : TL18483X
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Pilihan 1 digunakan untuk mempelajari ilmu pengetahuan dan teknologi material dan metalurgi spesifik. Mata kuliah Pilihan 1 digunakan untuk mempelajari ilmu pengetahuan dan teknologi material dan metalurgi spesifik pada mata kuliah pilihan. Pilihan 1 digunakan untuk merekayasa dan mengembangkan material dan metalurgi spesifik.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
2. Ketrampilan Umum
3. Pengetahuan
4. Ketrampilan Khusus

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan Konsep dasar ilmu teknik material dan metalurgi spesifik
2. Mahasiswa mampu mengaplikasikan Struktur ilmu teknik material dan metalurgi spesifik
3. Mahasiswa mampu menganalisis Mekanisme ilmu teknik material dan metalurgi spesifik

POKOK BAHASAN

1. Konsep dasar ilmu teknik teknik material dan metalurgi spesifik
2. Struktur ilmu teknik material dan metalurgi spesifik
3. Mekanisme ilmu teknik material dan metalurgi spesifik

PRASYARAT

Tidak ada

PUSTAKA UTAMA

Ilmu Teknik material dan metalurgi spesifik

PUSTAKA PENDUKUNG

-

MATA KULIAH	**Nama Mata Kuliah : Pilihan 2**
	Kode Mata Kuliah : TL18483X
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Pilihan 2 digunakan untuk mempelajari ilmu pengetahuan dan teknologi material dan metalurgi spesifik. Mata kuliah Pilihan 2 digunakan untuk mempelajari ilmu pengetahuan dan teknologi material dan metalurgi spesifik pada mata kuliah pilihan. Pilihan 2 digunakan untuk merekayasa dan mengembangkan material dan metalurgi spesifik.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
2. Ketrampilan Umum
3. Pengetahuan
4. Ketrampilan Khusus

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan Konsep dasar ilmu teknik material dan metalurgi spesifik
2. Mahasiswa mampu mengaplikasikan Struktur ilmu teknik material dan metalurgi spesifik
3. Mahasiswa mampu menganalisis Mekanisme ilmu teknik material dan metalurgi spesifik

POKOK BAHASAN

1. Konsep dasar ilmu teknik teknik material dan metalurgi spesifik
2. Struktur ilmu teknik material dan metalurgi spesifik
3. Mekanisme ilmu teknik material dan metalurgi spesifik

PRASYARAT

Tidak ada

PUSTAKA UTAMA

Ilmu Teknik material dan metalurgi spesifik

PUSTAKA PENDUKUNG

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MATA KULIAH	**Nama Mata Kuliah : Kekuatan Material Lanjut**
	Kode Mata Kuliah : TL184836
	Kredit : 3 SKS
	Semester : 8

DESKRIPSI MATA KULIAH

Studi tentang kekuatan material dalam hubungannya dengan deformasi, regangan dan stress yang dialami oleh material/struktur/komponen tersebut akibat pengaruh gaya-gaya luar, temperatur atau eksitasi internal/eksternal lainnya berdasarkan kriteria-kriteria kekuatan tertentu.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1 Sikap
- 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
- 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
- 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
- 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
- 1.10 menginternalisasi nilai, norma, dan etika akademik;
- 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
- 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
- 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
- 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
- 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
- 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
- 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
- 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
- 2.7 mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
- 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
- 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
- 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
- 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
- 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3 Pengetahuan
- 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
- 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
- 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
- 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
- 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus

4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami konsep dasar tegangan pada sebuah titik
2. Mahasiswa mampu menerapkan transformasi tegangan 3d
3. Mahasiswa mampu menghitung komponen tegangan deviatoric dan menerapkan teori-teori kegagalan
4. Mahasiswa mampu menghitung/mengukur regangan dan mampu menerapkan transformasi regangan
5. Mahasiswa mampu memahami dan menerapkan analisis tegangan eksperimental
6. Mahasiswa mampu memahami tegangan sisa dan memahami/menerapkan teknik-teknik pengukurannya

POKOK BAHASAN

1. Konsep tegangan pada sebuah titik
2. Transformasi tegangan 3D
3. Komponen tegangan deviatoric dan teori-teori kegagalan
4. Regangan dan transformasi regangan
5. Analisis tegangan experimental
6. Tegangan sisa dan pengukurannya

PRASYARAT

Mata Kuliah Mekanika Teknik dan Elemen Mesin

PUSTAKA PENDUKUNG

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2. Boresi, A.P. And Chong, K.P., Elasticity In Engineering Mechanics, 1987.
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4. Cook, R.D., Advanced Mechanics Of Materials, Macmillan, 1985.
5. Fertis, D.G., Advanced Mechanics Of Structures, Marcel Dekker, 1996.
6. Popov, E.P., Engineering Mechanics Of Solids, Prentice Hall 1990.
7. Timoshenko, S.P., History Of Strength Of Materials, Mcgraw-Hill, 1953.
8. Timoshenko, S.P., Theory Of Elasticity, Mcgraw-Hill, 1951.
9. Ugural, A.C. And S.K. Fenster, Advanced Strength And Applied Elasticity, 3rd Edition, Prentice Hall, 1995.

MATA KULIAH	**Nama Mata Kuliah : Komputasi Dinamika Fluida**
	Kode Mata Kuliah : TL184837
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Computational fluid dynamics (CFD) atau Komputasi Dinamika Fluida telah menjadi alat yang sangat diperlukan bagi para insinyur. Simulasi CFD dapat memberikan gambaran tentang rincian bagaimana phenomena suatu proses, dan memungkinkan produk/proses baru dievaluasi di komputer, bahkan sebelum prototip dibuat. Oleh karena itu mata kuliah ini diajarkan untuk untuk memecahkan masalah yang lebih kompleks yang melibatkan pemodelan turbulensi, pencampuran, reaksi pembakaran dan aliran multiphase. Sehingga diharapkan mahasiswa mampu menerapkan konsep-konsep CFD dalam perancangan industri di bidang teknik material dan metalurgi. Untuk mencapai tujuan tersebut maka strategi pembelajaran yang dilakukan adalah kuliah di kelas, pemberian tugas kelompok dan presentasi tugas besar.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.11 menginternalisasi nilai, norma, dan etika akademik;
   - 1.12 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.13 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.14 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.15 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2 Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.5 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.6 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 3.1 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 3.2 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 3.3 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

4. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

5. Ketrampilan Khusus
   4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat pengenalan CFD dan aplikasinya di bidang material dan metalurgi
2. Mahasiswa mampu memahami persamaan2 CFD seperti continuity, momentum, energy and species
3. Mahasiswa mampu memahami memilih methode yang cocok untuk simulasi CFD
4. Mahasiswa mampu memodelkan aliran turbulen dengan beberapa model turbulensi
5. Mahasiswa mampu mendeskripsikan phenomena fisik dari pengadukan turbulensi yang dipengaruhi oleh reaksi kimia
6. Mahasiswa mampu memodelkan aliran multiphasa
7. Mahasiswa mampu mengimplementasikan teknik CFD untuk menyelesaikan problem aliran fluida untuk dua/tiga dimensi

POKOK BAHASAN

1. Pengenalan Komputasi Dinamika Fluida (CFD) dan Aplikasinya di bidang Material dan Metalurgi
2. Modelling
3. Numerical aspects of CFD
4. Turbulent-flow modelling
5. Turbulent mixing and chemical reactions
6. Multiphase flow modelling
7. Best-practice guidelines

PRASYARAT

Mata Kuliah Analisa Numerik dan Pemodelan dengan minimal pernah mengambil

PUSTAKA UTAMA

1. Computational Fluid Dynamics for Engineers, by BENGT ANDERSSON Chalmers University, Sweden, RONNIE ANDERSSON Chalmers University, Sweden LOVE H, AKANSSON Engineering Data Resources – EDR, Norway MIKAEL MORTENSEN Norwegian Defence Research Establishment, Norway RAHMAN SUDIYO, University of Gadjah Mada, Indonesia, BEREND VAN WACHEM, Imperial College London, University. 2012
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, by H. Versteeg , W. Malalasekera. 1995

PUSTAKA PENDUKUNG

1. Computational Methods for Fluid Dynamics 3rd Edition, by Joel H. Ferziger, Milovan Peric.
2. Introduction to Simulation with ANSYS Mechanical APDL, 2016, by Hussien M. Al-Khafaji, Al-Khafaji Ali J. Dawood.

MATA KULIAH	**Nama Mata Kuliah : Komposit Kayu**
	Kode Mata Kuliah : TL184838
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah ini memberikan pemahaman kepada mahasiswa prinsip-prinsip mekanika yang berbasis pada mekanika rigid body dan material komposit. Memberikan pengetahuan tentang kekuatan material khususnya yang berkaitan dengan material kayu yang non-isotropik dan tidak homogen. Selanjutnya juga memberikan dasar pengetahuan tentang cara menentukan sifat-sifat mekanik dan karakteristik struktur kayu balok, kayu laminasi, dan material komposit berbasis kayu

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus

4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengidentifikasi karakteristik kayu dan kompositnya
2. Mahasiswa mampu menganalisis sifat mekanik dan sifat rheologi material komposit berbasis kayu
3. Mahasiswa mampu menganalisa kegagalan pada komposit kayu.
4. Mahasiswa mampu menerapkan analisis dan desain, serta melakukan evaluasi kekuatan material komposit berbasis kayu
5. Mahasiswa mampu merancang material inovatif berbasis limbah kayu termasuk WPC (Wood Polymer Composite)

POKOK BAHASAN

1. Karakteristik Komposit Kayu (Kayu sebagai material terbarui, Komposisi Kimia Kayu , Organisasi Dinding Sel, Struktur Seluler Kayu, Komposit Kayu, Specific Gravity and Moisture Content)
2. Tegangan, Regangan, dan Transformasi
3. Elastisitas Orthrotopi
4. Aplikasi Teori Elastisitas pada Sistem Sederhana
5. Karakteristik Rheologi
6. Analisa kegagalan
7. Sistem tumpukan
8. Organisiasi material

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Bodig, J., Jayne A., B., Mechanics of Wood and Wood Composites, Van Nostrand Reinhold Company, New York, 1992

PUSTAKA PENDUKUNG

1. Gibson, R., Cellular Solid, John Wiley & Sons, New York, 1989
2. Wagner, B., Wood Structure, Spring-Verlag, 1999
3. Kollmann, F.P., Kuenzi, E.W., Stamm, A.J., Principles of Wood Science and Technology, Spring-Verlag, 1975

MATA KULIAH	**Nama Mata Kuliah : Material Bio**
	Kode Mata Kuliah : TL184839
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Pengetahuan mengenai Biomaterials untuk Biomedial Aplikasi sangat diperlukan untuk membantu pemilihan materials yang berpotensi bagi aplikasi medis. Mata kuliah biomaterial ini mempelajari berbagai macam materials (metal, polymer, bioglass, bioceramic, biocomposite, degradable) yang berpotensi untuk aplikasi biomedical, metode charaterization dan testing (in-vivo and in-vitro), respon jaringan akibat implantasi, tribology biomaterial, teknik jaringan, material perancah dan teknik pembuatannya, serta aplikasi dan teknik pembuatan Material medis. Pada akhir mata kuliah ini, mahasiswa nantinya dapat menjelaskan dan menganalisa dasar pemilihan material untuk aplikasi medis, metode karakterisasi dan pengujian yang dilakukan, proses reaksi setelah implantasi, peran tribology dan berbagai macam aplikasi biomaterials. Untuk dapat mencapai target tersebut, dilakukan beberapa strategi pembelajaran diantaranya perkuliahan tatap muka, tugas, kunjungan industri, kuliah tamu, dan rancangan ide tentang "*development of biomedical devices*".

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CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya;

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus

4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami dan menjelaskan klasifikasi biomaterial
2. Mahasiswa mampu memahami dan menjelaskan kembali mengenai konsep sel, jaringan dan sistem organ
3. Mahasiswa mampu menunjukkan hubungan antara respon jaringan akibat proses implantasi
4. Mahasiswa mampu menunjukkan dan mengklasifikasikan tingkatan biokompatibilitas serta teknik pengujian biokompatibilitas
5. Mahasiswa mampu menunjukkan pengaruh dari tribology biomaterial
6. Mahasiswa mampu menujukkan jenis material perancah dan teknik jaringan
7. Mahasiswa mampu menganalisa pemilihan material untuk aplikasi medis tertentu serta membandingkan beberapa jenis proses pembuatan material dan peralatan medis

POKOK BAHASAN

1. Overview dan klasifikasi Biomaterial
2. Biokompabilitas
3. Polimer sebagai material bio
4. Komposit sebagai material bio
5. Logam sebagai material bio
6. Respon jaringan tubuh ke implan
7. Proses fabrikasi material bio
8. Beberapa aplikasi material bio

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Joon B. Park, Joseph D. Bronzino, Biomaterials Principles and Applications", CRC Press,2003.
2. Joon Park, "Biomaterials An introduction", springer, 2007.
3. Robert Lanza "Principles of Tissue Engineering" Academic Press, 2007

PUSTAKA PENDUKUNG

1. Glen S. Kwon, "Polymetric Drg Delivery Systems", Taylor and Fraciss, 2005.
2. Kay C. Dee, David A. Puleo. Rena Bizios," Tissue-Biomaterial Interactions", Wiley-Liss, 2002.
3. J Paulo Davim,"Biomaterials and Medical Tribology**"** Woodhead publishing, 2013

MATA KULIAH	**Nama Mata Kuliah : Material Elektronik**
	Kode Mata Kuliah : TL184840
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah ini membahas sifat-sifat elektronik dari material, klasifikasi material berdasarkan sifat elektroniknya meliputi material konduktor, semikonduktor dan isolator, serta aplikasi dari material di bidang elektronik.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya;

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami sifat-sifat elektronik dari material, klasifikasi material berdasar sifat elektronik serta aplikasi material di bidang elektronik.

POKOK BAHASAN

1. Pendahuluan: Pengantar Material Elektronik
2. Konduksi Listrik
3. Material Konduktor
4. Material Semikonduktor
5. Material Isolator
6. Aplikasi Material Elektronik

PRASYARAT

Mata Kuliah Kimia Dasar, Kimia Material, Fisika Dasar 1, Fisika Dasar 2, dan Karakterisasi Material

PUSTAKA UTAMA

1. Callister Jr, W. D., & Rethwisch, D. G. (2012). Fundamentals of materials science and engineering: an integrated approach. John Wiley & Sons.

PUSTAKA PENDUKUNG

2. Kasap, S. O. (2006). Principles of electronic materials and devices (Vol. 2). New York: McGraw-Hill.

MATA KULIAH	**Nama Mata Kuliah : Material Konversi dan Penyimpan Energi**
	Kode Mata Kuliah : TL184841
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Krisis energi akibat semakin langkanya bahan bakar minyak bumi membutuhkan alternative sumber energi. Material konversi energi adalah salah satu alternative pembangkit energy yang menggunakan prinsip elektrokimia yang mengubah proses kimia menjadi energy listrik. Selain itu dibutuhkan juga material yang bersifat menyimpan energy sebagai tempat menyimpan energy cadangan yang dihasilkan oleh material konversi energy. Sehingga mata kuliah ini memberikan pemahaman mengenai latar belakang, fundamental ilmu dan analisis material energi berbasis pada proses elektrokimia sebagai bahan konversi energi dan penyimpan energi. Diharapkan di akhir kuliah mahasiswa mampu memahami konsep elektrokimia untuk mensintesis material yang tepat digunakan dalam aplikasi konversi energy dan penyimpan energy. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.4 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna;

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.9. mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya;

3. Pengetahuan
   - 2.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 2.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 2.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

4. Ketrampilan Khusus
   - 2.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 2.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan proses elektrokimia

2. Mahasiswa mampu menjelaskan karakteristik anoda dan katoda
3. Mahasiswa mampu menganalisis sel primer konversi energi
4. Mahasiswa mampu menganalisis sel sekunder konversi energi

POKOK BAHASAN

1. Proses elektrokimia
2. Karakteristik anoda dan katoda
3. Sel primer konversi energi
4. Sel sekunder konversi energi

PRASYARAT

Mata Kuliah Elektrokimia dengan minimal nilai D

PUSTAKA UTAMA

1. David S. Ginley, David Cahen,'Fundamentals of Materials for Energy and Environmental Sustainability
2. Allen J. Bard, Larry R. Faulkner, Electrochemical Methods: Fundamentals and Applications. Augustin McEvoy, L. Casyaner, Tom Markvart,'Solar Cells, Second Edition: Materials, Manufacture and Operation
3. Augustin McEvoy, L. Casyaner, Tom Markvart,'Solar Cells, Second Edition: Materials, Manufacture and Operation
4. Linden's Handbook of Batteries, 4th Edition, James Larminie, Andrew Dicks, Fuel Cell Systems Explained (Second Edition). Materials for Electrochemical Energy Storage and Conversion II-Batteries, Capacitors and Fuel Cells: Volume 496 (MRS Proceedings)

PUSTAKA PENDUKUNG

Jurnal

MATA KULIAH	**Nama Mata Kuliah : Perilaku Mekanik Material**
	Kode Mata Kuliah : TL184842
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Pemilihan material untuk berbagai aplikasi sangat membutuhkan analisa sifat mekanik yang sesuai aplikasinya. Untuk mendapatkan sifat mekanik, dibutuhkan pengetahuan sifat mekanik dan pengujian mekanik sehingga dapat dianalisa sifat yang dimiliki material tersebut. Mata kuliah perilaku mekanik material ini akan membahas materi mengenai macam sifat mekanik material serta cara pengujiannnya, memahami perilaku sifat mekanik dari berbagai macam material dan menganalisa penyebab kegagalan material. Diharapkan di akhir kuliah mahasiswa mampu memahami sifat dan pengujian mekanik berbagai macam material serta perilakunya, sehingga mampu melakukan pemilihan material yang sesuai dengan aplikasi yang dibutuhkan dan meminimalisir terjadinya kegagalan produk. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional,
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12. mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus

4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami dan menjelaskan klasifikasi material
2. Mahasiswa mampu menghitung dan menganalisa sifat mekanik dari hasil pengujian
3. Mahasiswa mampu menghitung dan menganalisa mekanika kegagalan material
4. Mahasiswa mampu menganalisa perilaku mekanik beberapa material teknik

POKOK BAHASAN

1. KLASIFIKASI MATERIAL: Jenis jenis material (logam *ferrous* dan *non ferrous*, keramik, polimer, dan komposit) dan aplikasinya
2. SIFAT MEKANIK DAN PENGUJIANNYA: Pengujian tarik, tekan, bending, kekerasan, impak, fatig, dan abrasi beserta sifat mekanik yang didapatkan
3. MEKANIKA KEGAGALAN MATERIAL: Jenis patahan, pemuluran (*creep*), dan kegagalan (*failure*)
4. PERILAKU MEKANIK BEBERAPA MATERIAL TEKNIK: Perilaku mekanik polimer, keramik dan komposit

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Thomas H. Courtney “Mechanical behavior of materials” Singapore: McGraw-Hill Publishing Company. 1990
2. William D Callister “An introduction: Material science and Engineering. 8th edition”USA: John Wiley and Sons, Inc. 2007

PUSTAKA PENDUKUNG

1. Norman E Dowling “Mechanical Behavior of Materials”

MATA KULIAH	**Nama Mata Kuliah : Material Magnetik**
	Kode Mata Kuliah : TL184843
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Material magnetik memiliki aplikasi yang sangat luas salah satunya adalah superkonduktor untuk aplikasi kereta maglev. Rekayasa dibidang magnetik,juga dapat dilakukan sesuai aplikasinya. Topik-topik yang dibahas dalam mata kuliah magnet mencakup Pengembangan Sifat dan Material Magnetik, Perkembangan Aplikasi. Dipol Magnetik , Medan Magnet, Momen Magnet dan Magnetisasi, Teori Quantum Sifat Kemagnetan, Moment Elektronik magnetik, Sifat Kemagnetan, Domain Magnetik, Kurva Histerisis, Metode Pengukuran Sifat Kemagnetan, Alat Ukur Sifat Kemagnetan (VSM, Squid), Material Magnetik, Superkonduktivitas. Diharapkan di akhir kuliah mahasiswa mampu memahami sifat dan aplikasi material magnet sehingga dapat digunakan untuk dasar aplikasi material magnet lebih lanjut. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas, praktikum dan pemberian tugas mandiri

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;

4. Ketrampilan Khusus
   - 4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa dapat memahami, menjelaskan, menganalisa dan menyelesaikan masalah berkaitan dengan konsep dasar kemagnetan
2. Mahasiswa dapat memahami, menjelaskan, menganalisa dan menyelesaikan masalah berkaitan dengan sifat kemagnetan
3. Mahasiswa dapat memahami, menjelaskan, menganalisa dan menyelesaikan masalah berkaitan dengan domain magnetik
4. Mahasiswa dapat memahami, menjelaskan, menganalisa dan menyelesaikan masalah berkaitan dengan kurva histerisis dan pengukuran sifat kemagnetan

5. Mahasiswa dapat memahami, menjelaskan, menganalisa dan menyelesaikan masalah berkaitan dengan material magnetik
6. Mahasiswa dapat memahami, menjelaskan, menganalisa dan menyelesaikan masalah berkaitan dengan superconductivity
7. Mahasiswa dapat memahami, menjelaskan, menganalisa dan menyelesaikan masalah berkaitan dengan aplikasi sifat dan material magnetik

POKOK BAHASAN

1. Pendahuluan
2. Konsep dasar kemagnetan
3. Sifat kemagnetan
4. Domain magnetik
5. Kurva histerisis dan pengukuran sifat kemagnetan
6. Material magnetik
7. Superconductivity
8. Aplikasi sifat dan material magnetik

PRASYARAT

Tidak ada

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1. Spaldin, Nicola A.A.2013.Magnetic Materials Fundamental and Application,Second Ed.Cambridge : Cambridge Unversity Press
2. Jiles, David.1989. Introduction to Magnetism and Magnetic Materials . London.Chapman and Hall
3. Cullity, B.D, Graham C.D.2009. Introduction To Magnetic Materials. Piscataway : IEEE Press
4. Charles Kittel, 2004, "Introduction to Solid State Physics" 8 edition, Wiley
5. WD Callister . 2012. Introduction of Material Science & Engineering. John Wiley and Son

PUSTAKA PENDUKUNG

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MATA KULIAH	**Nama Mata Kuliah : Material Optik**
	Kode Mata Kuliah : TL184844
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Serat optik adalah salah satu material optik yang mendasari perkembangan internet saat ini. Sehingga pemahaman terhadap mekanisme sifat optik pada material sangat dibutuhkan. Mata kuliah ini mencakup Konsep dasar fenomena optik berupa gelombang, Interaksi cahaya dengan material, material optik dan warna, laser dan serat optik serta peralatan uji sifat optis Material dan peralatan uji yang menggunakan sifat optis. Diharapkan di akhir kuliah mahasiswa mampu memahami sifat dan aplikasi material optik sehingga dapat digunakan untuk dasar aplikasi material optik lebih lanjut. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas, praktikum dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN PADA MATA KULIAH

2. Sikap
   1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   1.8. menginternalisasi nilai, norma, dan etika akademik;
   1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;

3. Ketrampilan Umum
   2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;

   3. Pengetahuan
   3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;

   4. Ketrampilan Khusus
   4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan Konsep gelombang
2. Mahasiswa mampu menjelaskan konsep Interaksi Atomik- Elektronik dan Polarisasi Elektronik Konsep Cahaya (Newton & Huygens) , Teori kuantum Cahaya
3. Mahasiswa mampu menjelaskan tentang konsep Interaksi cahaya dengan material
4. Mahasiswa mampu menjelaskan Material Optik dan Warna
5. Mahasiswa mampu menjelaskan konsep tentang Laser dan Serat optik
6. Mahsiswa mampu menjelaskan Peralatan Uji Sifat Optis Material dan Peralatan Uji yang menggunakan Sifat Optis

POKOK BAHASAN

1. Konsep dasar fenomena optik
   Gelombang (Getaran, persamaan Gelombang, amplitudo, frekwensi, periode, jenis gelombang (transversal &

longitudinal), kecepatan gelombang, intensitas)Gelombang Elektromagnetik , Interaksi Atomik- Elektronik dan Polarisasi Elektronik Konsep Cahaya (Newton & Huygens) , Teori kuantum Cahaya (Dualisme Gelombang Partikel, Efek Compton, Efek Foto Listrik, Fotokonduktivitas dan Fotoelastisitas)

2. Interaksi cahaya dengan material
   Pemantulan (Refleksi), Pembiasan dan Dispersi, Absorpsi, Transmisi, Interferensi, Difraksi
3. Material Optik dan Warna
   Sifat Optik Pada Logam , Sifat Optik Pada Non Logam, Opasitas & Translusen pada material Insulator Luminescence , Absorbansi, Fosforensi dan Fluorensi
4. Laser dan Serat optik
   Laser, Laser dan Sifatnya, Prinsip Dasar Laser (Kondisi Ambang(Threshold), Pemompaan Laser, Jenis, Material dan Proses pembuatan Laser. Definisi, Jenis dan Prinsip kerja Serat Optik , Material dan Proses Pembuatan Serat Optik, Penelitian Material Optik Saat ini
5. Peralatan Uji Sifat Optis Material dan Peralatan Uji yang menggunakan Sifat Optis
   Spektrometer, Microskop optik, Fotoelastisitas , VNA (Vektor Network Analyzer)
6. Proses Manufaktur Material Optis
7. Teknologi Terbaru di bidang material Optik
8. Serat optik,

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Wooten, F., Optical Properties of Solids, Academic Press, New York, 1972.

PUSTAKA PENDUKUNG

1. Amon Yariv, "Optical Electronics in Modern Communications",
2. W. Greiner, “Quantum Mechanics: An introduction”
3. Charles Kittel, "Introduction to Solid State Physics"

MATA KULIAH	**Nama Mata Kuliah : Material Refraktori**
	Kode Mata Kuliah : TL184845
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Material refraktori adalah salah satu jenis material yang mampu bertahan pada temperatur tinggi. Material ini sangat dibutuhkan untuk aplikasi pada struktur atau sebagai komponen pada system yang harus terpapar temperature diatas 538^0C. Biasanya digunakan sebagai lining untuk dinding furnace, kiln, incinerator dan reactor. Sehingga dalam Mata kuliah ini akan membahas materi tentang Pembuatan bata tahan api dan pemasangan pada tanur peleburan, diagram kesetimbangan fasa terak dan bata tahan api. Diharapkan di akhir kuliah mahasiswa mampu mengerti karakteristik bermacam-macam refraktori, mampu merancang dan memilih refraktory yang sesuai dengan kondisi kerja dapur peleburan. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan peradaban berdasarkan Pancasila;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses, atau manufaktur material dan metalurgi komponen;

4. Ketrampilan Khusus
   - 4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   - 4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen.

CAPAIAN PEMBELAJARAN MATA KULIAH

2. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan klasifikasi material refraktori berdasarkan komposisi kimia

3. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan klasifikasi material refraktori berdasarkan metode manufaktur
4. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan klasifikasi material refraktori berdasarkan temperatur fusi
5. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan refraktori insulasi
6. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan pemilihan refraktori
7. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan proses manufaktur refraktori
8. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan konservasi energi dan kehilangan panas
9. Mahasiswa memahami, menjelaskan, dan menyelesaikan permasalahan berkaitan dengan aplikasi Refraktori industri baja dan semen

POKOK BAHASAN

1. Pendahuluan
2. Klasifikasi material refraktori berdasarkan komposisi kimia
3. Klasifikasi material refraktori berdasarkan metode manufaktur
4. Klasifikasi material refraktori berdasarkan temperatur fusi
5. Refraktori insulasi
6. Pemilihan refraktori
7. Proses manufaktur refraktori
8. Konservasi energi dan kehilangan panas
9. Aplikasi Refraktori industri baja
10. Aplikasi refraktori industri semen

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. WD Callister, . 2012. Introduction of Material Science & Engineering. John Wiley and Son
2. W.David Kingery et al, 1975, Introduction to Ceramics, 2nd Edition 2nd Edition, John Wiley and Son
3. Ritwik Sarkar, 2016, Refractory Technology: Fundamentals and Applications 1st Edition CRC Press;
4. A. O. Surendranathan, 2014, An Introduction to Ceramics and Refractories 1st Edition, CRC Press;
5. Tom Vert, 2016, Jeffrey D. Smith, Refractory Material Selection for Steelmaking 1st Edition, Wiley-American Ceramic Society

PUSTAKA PENDUKUNG

-

MATA KULIAH	**Nama Mata Kuliah : Ekonomi Teknik**
	Kode Mata Kuliah : TL184846
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah yang berisi tentang nilai uang menurut fungsi waktu di dalam melakukan pertimbangan-pertimbangan ekonomis mengenai investasi, pemanfaatan asset, pendapatan, perpajakan, depresiasi dalam rangka mencapai benefit semaksimal mungkin.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.4. menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.5. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.7. menginternalisasi nilai, norma, dan etika akademik;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10. menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11. berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12. bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4. menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6. mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9. mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengaplikasikan konsep Time Value of Money
2. Mahasiswa mampu melakukan analisa permodalan menggunakan time value of money
3. Mahasiswa mampu menganalisa pertimbangan-pertimbangan ekonomis dalam pengambilan keputusan teknis
4. Mahasiswa mampu merencanakan investasi berdasarkan Rate of Retun
5. Mahasiswa memahami konsep pajak dan melakukan perhitungan investasi yang dipengaruhi pajak dan depresiasi
6. Mahasiswa memahami konsep breakeven point dan mampu menganalisa umur investasi hingga mencapai titik impas

POKOK BAHASAN

1. Konsep Time Value of Money
2. Konsep Permodalan dan Titik Impas
3. Konsep Perpajakan dan Depresiasi
4. Konsep Perawatan dan Pergantian Aset

PRASYARAT

Tidak ada

PUSTAKA UTAMA

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PUSTAKA PENDUKUNG

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2. Grant, Eugene L.at. Al., Principles of Engineering Economy, New York: John Wiley & Sons,1976
3. Ostwald Philip F, Cost Estimating for Engineering and Management, Englewood Cliffs, N.J. Prentice-Hall, Inc, 1974

MATA KULIAH	**Nama Mata Kuliah : Mekanika Komposit**
	Kode Mata Kuliah : TL184847
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Komposit didefinisikan sebagai suatu material yang terdiri dari dua komponen atau lebih yang memiliki sifat atau struktur yang berbeda yang dicampur secara fisik menjadi satu bentuk ikatan mekanik yang dengan struktur homogen secara makroskopik dan heterogen secara mikroskopik. material campuran tersebut akan menghasilkan material baru yang mempunyai sifat unggul dari material pembentuknya. dengan penggabungan dua atau lebih material yang berbeda, maka dapat diperbaiki dan dikembangkan sifat-sifat mekanik dan fisik dari material-material tersebut.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1. bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2. menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3. berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.4. menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.5. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.7. menginternalisasi nilai, norma, dan etika akademik;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9. menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;

2. Ketrampilan Umum
   - 2.1. mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2. mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3. mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7. mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8. mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10. mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11. mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.13. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.
   - 2.14. mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1. konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2. konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3. prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4. prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5. teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus

4.1. mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2. mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3. mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4. mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5. mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6. mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan definisi dan proses mekanika komposit
2. Mahasiswa mampu menjelaskan proses mekanika-mikro lamina
3. Mahasiswa mampu menjelaskan proses komposit serat pendek
4. Mahasiswa mampu menjelaskan proses mekanika-makro lamina
5. Mahasiswa mampu menjelaskan proses mekanika laminat

POKOK BAHASAN

1. Pengenalan material komposit
2. Mekanika-mikro lamina
3. Komposit serat pendek
4. Kekuatan lamina
5. Mekanika-makro lamina
6. Mekanika laminat

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Prof. Dr. Ir. Sulistijono, Mekanika Material Komposit

PUSTAKA PENDUKUNG

1. Jones, Mechanics of composite materials
2. Gibson R.F, Principle of Composite Material Mechanics

MATA KULIAH	**Nama Mata Kuliah : Metalurgi Manufaktur**
	Kode Mata Kuliah : TL184848
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Metalurgi Manufaktur digunakan untuk menentukan struktur metalurgi berdasarkan proses manufaktur. Metalurgi manufaktur mempelajari ilmu tentang struktur metalurgi pada proses manufaktur pengecoran, pengelasan, perlakuan panas dan pembentukan. Metalurgi manufaktur digunakan untuk pengembangan iilmu dan teknologi material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya;

3. Pengetahuan
   - 2.2 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 2.3 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 2.4 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 2.5 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 2.6 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami Metalurgi manufaktur coran
2. Mahasiswa mampu menjelaskan metalurgi manufaktur lasan
3. Mahasiswa mampu mengaplikasikan metalurgi manufaktur perlakuan panas
4. Mahasiswa mampu menganalisis metalurgi manufaktur pembentukan

POKOK BAHASAN

1. Metalurgi manufaktur coran
2. Metalurgi manufaktur lasan
3. Metalurgi manufaktur perlakuan panas
4. Metalurgi manufaktur pembentukan

PRASYARAT

Mata Kuliah Metalurgi 1 dan Metalurgi 2 dengan minimal nilai D

PUSTAKA UTAMA

1. Flemings, Merton Chapter, “Solidification Processing”, New York: Mc Graw Hill Book Company, 1974
2. Avner, Sidney H, Introduction to Physical Metallurgy, Second edition, Tokyo: Mc Graw Hill International Book Company, 1987

PUSTAKA PENDUKUNG

1. Welding Handbook Vol. 1 : Fundamental of Welding, America Welding Society, Miami, Florida 33125, 1976
2. Dieter, George E.,”Mechanical Metallurgy”, Mc Graw Hill International Book Company, Singapore, 1981
3. Dodd, W. James, dan Tonge, H.Kenneth, Analytical Chemistry by Open Learning, Termal Methods, John Wiley & sons, Inggris, 1987

MATA KULIAH	**Nama Mata Kuliah : Metalurgi Serbuk**
	Kode Mata Kuliah : TL184849
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Metalurgi serbuk merupakan salah satu proses manufaktur pada logam. Metalurgi serbuk dapat digunakan untuk menghasilkan produk logam dengan kepresisian tinggi. Topik pembahasan pada mata kuliah ini adalah proses pembuatan serbuk logam, proses pembuatan komponen dengan metalurgi serbuk, keuntungan dan kerugian teknologi metalurgi serbuk , Karakterisasi Serbuk, proses pencampuran (jenis pencampuran (Wet dan Dry), faktor-faktor yang mempengaruhi kualitas pencampuran, kompaksi, sintering dan Pengerjaan Akhir seperti bubut, forging, rolling. Diharapakan di akhir kuliah mahasiswa mampu manufaktur dengan metalurgi serbuk dan mampu membuat produk dengan proses metalurgi serbuk. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas, praktikum dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN PADA MATA KULIAH

1. Sikap
   - 2.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;

2. Ketrampilan Umum
   - 2.6 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.7 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;

2 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;

4. Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem)* pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan sejarah perkembangan teknologi metalurgi serbuk
2. Mahasiswa mampu menghitung, mengembangkan dan menganalisis proses karakterisasi pada serbuk
3. Mahasiswa mampu menghitung dan menyelesaikan persoalan proses pembuatan serbuk dan variabel prosesnya
4. Mahasiswa mampu menghitung dan menyelesaikan persoalanpencampuran, jenis pencampuran dan variabel proses pencampuran
5. Mahasiswa mampu menghitung dan menyelesaikan persoalan kompaksi pada serbuk, gaya yang digunakan, waktu penahanan saat kompaksi
6. Mahasiswa mampu menghitung dan menyelesaikan persoalan sintering pada produk serbuk, pengaruh temperatur dan waktu sintering.
7. Mahasiswa mampu menghitung dan menyelesaikan persoalan pengerjaan akhir pada produkmetalurgi serbuk

POKOK BAHASAN

1. Pendahuluan
   Latar belakang pengembangan metalurgi serbuk, tren pengembangan P/M saat ini, aplikasi P/M
2. Karakterisasi Serbuk
   Definisi karakterisasi serbuk, alasan proses karakterisasi serbuk, sifat-sifat serbuk yang dikarakterisasi dan metode karakterisasi serbuk
3. Pembuatan Serbuk
   Proses pembuatan serbuk, variabel proses pembuatan serbuk, karakteristik serbuk berdasarkan proses pembuatannya
4. Pencampuran
   Jenis pencampuran (Wet dan Dry), faktor-faktor yang mempengaruhi kualitas pencampuran
5. Kompaksi
   Pengukuran besarnya gaya kompaksi, jenis kompaksi (Dingin, panas, Single punch, Double Punch, lubrikasi)
6. Sintering
   Jenis-jenis sintering, variabel proses sintering
7. Pengerjaan Akhir
   Bubut, Forging, rolling

PRASYARAT

Mata Kuliah Metalurgi 1 dan Metalurgi 2 dengan minimal nilai C

PUSTAKA UTAMA

1. Randal M. German, Powder Metallurgy Science, Metal powder Industries Federation, 1984
2. "Frizt V. Lenel, Powder Metallurgy Principles and Application, Metal Powder Industries Federation Princenton, 1980 "
3. "Joel S. Hirschron, Indroction to powder Metallurgi, America Powder Mellurgy Institute, Princenton, 1976"

PUSTAKA PENDUKUNG

Jurnal-jurnal terbaru tentang PM

MATA KULIAH	**Nama Mata Kuliah : Paduan Super**
	Kode Mata Kuliah : TL184850
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Paduan Super ini membahas materi tentang klasifikasi paduan super Fe, Ni, Co, dan aplikasinya. Mekanisme penguatan pada paduan super serta pengaruh fasa, strukturmikro dan komposisi serta metode karakterisasi dari paduan super juga didiskusikan. Seleksi material yang tepat serta aplikasi paduan super juga akan dipelajari sehingga mahasiswa mampu melakukan analisa dan seleksi material yang tepat.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 Mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 Mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi
   - 2.5 Mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;

3. Pengetahuan
   - 3.1 Konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 Konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 Prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.5 Teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1. Mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2. Mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3. Mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   - 4.4. Mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   - 4.5. Mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   - 4.6. Mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan klasifikasi paduan super dan konsep dasar material paduan super seperti penguatan pada paduan super, fase, dan klasifikasi paduan super.
2. Mahasiswa mampu mengkarakterisasi paduan super

3. Mahasiswa mampu memilih material untuk desain paduan super

POKOK BAHASAN

1. Introduksi paduan super
2. Klasifikasi paduan super
3. Mekanisme penguatan
4. Fase dan struktur mikro dari paduan super
5. Pengaruh komposisi
6. Aplikasi dan pertimbangan pemilihan material paduan super

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Blaine Geddes Hugo Leon Xiao Huang , ‘’Superalloys Alloying and Performance’’, ASM International, 2010

PUSTAKA PENDUKUNG

1. Frederik E. Wang, ‘’Bonding Theory for Metals and Alloys’’, Elsevier Science, 2005
2. Jean-Marie Dubois, Ester, Urban, ‘’Complex Metallic Alloys’’, Willey, 2011

MATA KULIAH	**Nama Mata Kuliah : Kontrol kualitas dan reliabilitas**
	Kode Mata Kuliah : TL 184851
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Kualitas dan reliabilitas suatu produk tidak bisa dilepaskan dari proses control terhadap kualitasnya. Sehingga dalam Mata kuliah ini akan membahas materi tentang Konsep reliabilitas dan Manajemen kualitas. Diharapkan di akhir kuliah mahasiswa mampu mengaplikasikan metode penjadwalan untuk suatu produk, mengukur kualitas suatu produk berdasarkan kriterianya beserta cara-caranya. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   - 4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   - 4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   - 4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen.

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menganalisa kinerja proses dan pengendalian kualitas
2. Mahasiswa mampu menerapkan manajemen kualitas
3. Mahasiswa mampu penganalisa proses reliabilitas

POKOK BAHASAN

1. Acceptance sampling: single double sampling plan, OC curve, military standard 105 D
2. SPC: p-Chart, c-Chart, np-Chart
3. Konsep reliabilitas
4. Manajemen kualitas
5. Standar ISO

PRASYARAT

Mata Kuliah Matematika 1 dan Matematika 2 dengan minimal pernah mengambil

PUSTAKA UTAMA

1. Introduction to Quality Control and Industrial Statistic, Montgomery, 1974

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Teknologi Pelapisan**
	Kode Mata Kuliah : TL184852
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah ini membahas dasar teori teknologi pelapisan mulai dari reaksi antara permukaan substrat dengan material pelapis, konsep kekuatan adesi dan jenis – jenis teknologi pelapisan untuk aplikasi meningkatkan ketahanan korosi dan ketahananan aus diantaranya Elektroplating dan Elektroless, Hot-dip Galvanizing, Anodizing, Pelapisan Organik, dan Thermal Spray. Selain itu juga dibahas tentang pelapisan tipis dengan metode chemical vapor deposition (CVD), atomic layer deposition (ALD) dan physical vapor deposition (PVD) untuk aplikasi rekayasa permukaan biomedis, cutting tool, dan microelectronics mechanical system (MEMS).

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi
   - 2.5. mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;

3. Pengetahuan
   - 2.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 2.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 2.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1 Mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.2 Mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.3 Mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   - 4.4 Mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   - 4.5 Mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   - 4.6 Mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen.

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami konsep - konsep dasar teknologi pelapisan

2. Mahasiswa mampu memahami proses persiapan permukaan sebelum proses pelapisan
3. Mahasiswa mampu memahami dan mengalisa berbagai teknologi pelapisan diantaranya elektroplating dan elektroless, Hot-dip Galvanizing, Oxidizing, Pelapisan Organik, Thermal Spray
4. Mahasiswa mampu memahami dan mengalisa teknologi pelapisan tipis diantaranya CVD, PVD dan ALD serta aplikasinya

POKOK BAHASAN

1. Pengantar Teknologi Pelapisan
2. Persiapan Permukaan
3. Elektroplating dan Elektroless
4. Hot-dip Galvanizing
5. Pelapisan Organik
6. Thermal Spray
7. Pelapisan Tipis

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. ASM Handbook 5: Surface Engineering, ASM International, 1994
2. Arthur A. Tracton, Coatings Materials And Surface Coatings, CRC Press, 2007
3. Arthur A. Tracton, Coatings Technology Fundamentals, Testing, And Processing Techniques , CRC Press, 2007

PUSTAKA PENDUKUNG

1. Peter Maaß and Peter Peißker, Handbook of Hot-dip Galvanization, Wiley-VCH Verlag GmbH & Co. KgaA, 2011
2. Lech Pawlowski, The Science and Engineering of Thermal Spray Coatings, Second Edition, John Wiley & Sons, 2008
3. J.F.H. Van Eijnsbergen, Duplex Systems Hot-dip Galvanzing Plus Painting, Elsevier, 1994
4. M. Ohring, The Materials Science of Thin Films The Materials Science of Thin Films, Academic Press, 1992
5. Hugh O. Pierson, Handbook Of Chemical Vapor Deposition (CVD), Second Edition, Noyes Publications, 1999

MATA KULIAH	**Nama Mata Kuliah : Riset Operasional**
	Kode Mata Kuliah : TL 84853
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Riset Operasional merupakan mata kuliah mengenai pengetahuan konsep-konsep optimasi yang dapat diterapkan pada sistem industri. Memberikan mahasiswa kemampuan tentang manajemen, sistem produksi, perencanaan dan pengendalian produksi, dan mampu mengintegrasikan berbagai aktivitas dan proses untuk menghasilkan produk dan layanan yang mempunyai nilai kompetitif. Untuk mencapai tujuan tersebut maka metode pembelajaran yang digunakan antara lain dengan perkuliahan kelas dan pemberian tugas mandiri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6. bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8. menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus

4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengidentifikasi tantangan-tantangan yang dihadapi dalam manajemen operasi dan produksi"
2. Mahasiswa mampu mengidentifikasi dan menjelaskan strategi operasi
3. Mahasiswa mampu mengidentifikasi dan menalar strategi desain proses
4. Mahasiswa mampu menganalisis proses termasuk evaluasi performansi, redisain proses
5. Mahasiswa mampu menganalisa kinerja proses dan kualitas
6. Mahasiswa mampu menerapkan proses perencanaan agregat dan perencanaan produksi dengan menggunakan teknik matematika dari Riset Operasional
7. Mahasiswa mampu menjelaskan peran teknologi informasi dan Value Chains
8. Mahasiswa mampu memilih teknik forecasting sebagai bagian dari teknik Riset Operasional untuk situasi tertentu
9. Mahasiswa mampu menerapkan manajemen inventori sebagai bagian dari implementasi dari Riset Operasinal
10. Mahasiswa mampu membuat sistem penjadwalan (scheduling)

POKOK BAHASAN

1. Strategi korporasi, analisa pasar, hubungan strategi operasi dan pola pengambilan keputusan.
2. Desain proses, struktur proses dalam manufaktur, proses otomasi manufaktur, intensitas kapital.
3. Pareto charts, diagram sebab-akibat, simulasi proses, benchmarking.
4. Total Quality Managent, Statistical Process Control, ISO, kapabilitas proses.
5. Program linier, metoda transportasi.
6. komponen teknologi informasi, e-commerce, electronic data interchange, Enterprise Resource Planning,
7. Model-model forecasting: moving average technique, exponential smoothing, regression.
8. Model-model inventori: EOQ, inventory control system.
9. Demand scheduling, workforce scheduling, operations scheduling Process Flow Diagram (PFD).

PRASYARAT

Mata Kuliah Matematika 1 dan Matematika 2 dengan minimal pernah mengambil

PUSTAKA UTAMA

1. Lee J. Krajewski, Larry P Ritzman, Operation Management: Process and Value Chains, 7rd Ed, New Jersey: Pearson Education, Inc., 2005.
2. Hamdy A. Taha, Operation Research: An Introduction, 7rd Ed. New Jersey: Pearson Education, Inc., 2003

PUSTAKA PENDUKUNG

1. Subir Chowdhury, Jay A. Conger, Edgar H. Shein, et.al., Organization 21C, Pearson Education, 2003

MATA KULIAH	**Nama Mata Kuliah : Pesawat Tenaga**
	Kode Mata Kuliah : TL184854
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah ini akan membahas pesawat tenaga yang banyak digunakan di industry. Pesawat tenaga yang akan dibahas meliputi pompa, kompresor, mesin Otto, mesin Diesel, turbin uap dan turbin gas. Mahasiswa akan dikenalkan pada dasar-dasar mesin tersebut, cara kerja, dan aplikasi sederhana dari mesin tersebut. Sebagai tambahan untuk memperdalam pengetahuan mahasiswa, mahasiswa akan belajar untuk menganalisa system pipa dan ducting. Selain itu mahasiswa belajar menganalisa efisiensi thermal beserta strategi untuk meningkatkan efisiensi thermal mesin tersebut.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 2.5 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   4.1 Mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2 Mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3 Mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4 Mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5 Mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6 Mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengenal jenis mesin pesawat tenaga
2. Mahasiswa mampu mengenal aplikasi mesin pesawat tenaga
3. Mahasiswa mampu mendesain system pipa untuk pompa
4. Mahasiswa mampu mendesain system ducting untuk compresor
5. Mahasiswa mengenal cara kerja dan aplikasi mesin Otto dan Diesel
6. Mahasiswa mengenal cara kerja dan aplikasi turbin gas dan turbin uap
7. Mahasiswa mampu menganalisa efisiensi mesin Otto, mesin Diesel, turbin uap dan turbin gas

POKOK BAHASAN

1. Pengenalan pesawat tenaga dan berhubungan contoh aplikasi di industri
2. Dasar-dasar pompa
3. Jenis pompa, aplikasi dan desain sistem
4. Dasar-dasar kompresor
5. Jenis kompresor, aplikasi dan desain system
6. Pengenalan mesin pembakaran dalam dan luar beserta aplikasinya
7. Dasar mesin Otto dan cara kerja
8. Mesin Otto 2 tak dan 4 tak
9. Dasar mesin Diesel dan cara kerja
10. Turbin gas untuk pesawat dan industry
11. Turbin uap dan siklus Carnot

PRASYARAT

Mata Kuliah Termodinamika material, Elemen mesin dan Fenomena Ttransport

PUSTAKA UTAMA

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PUSTAKA PENDUKUNG

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2. Meinhard Scobeiri, Gas turbine design, components, and system design integration, Springer, 2018
3. Michael J. Moran, Howard N. Shapiro, Fundamentals of engineering thermodynamics, 8ed, Springer, 2014
4. Tanuma, Tadashi, Advances in steam turbines for modern power plants, Woodhead Publishing is an imprint of Elsevier, 2017

MATA KULIAH	**Nama Mata Kuliah : Elektronika dan Instrumentasi**
	Kode Mata Kuliah : TL184855
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Elektronika dan Instrumentasi merupakan matakuliah pendukung yang sangat diperlukan dalam memahami prinsip kerja peralatan pengukuran dan pengendalian industri, khususnya dibidang proses industri material dan metalurgi.Mata kuliah ini terdiri atas dua bagian pokok pembahasan, yakni Elektronika Dasar dan Instrumentasi pengukuran dan pengendalian dasar. Pada bagian Elektronika dasar, mahasiswa diharapkan mampu memahami, melakukan perhitungan dan mengaplikasikan konsep dasar arus dan tegangan, komponen dasar elektronika RLC. Sedangkan pada bagian instrumentasi pengukuran dan pengendalian, mahasiswa diharapkan mampu memahami prinsip kerja sistem pengukuran dan pengendalian, dan prinsip kerja elemen-elemen penyusun sistem; sensor/transducer, pengkondisian sinyal, ADC-DAC, display/storage, controller, dan final kontrol. Metoda pembelajaran yang diapilikasikan dalam matakuliah ini adalah kuliah, diskusi, dan presentasi studi berbagai sistem instrumentasi industri.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertaqwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan peradaban berdasarkan Pancasila;
   - 1.4 berperan sebagai warga negara yang bangga dan cinta tanah air, memiliki nasionalisme serta rasa tanggungjawab pada negara dan bangsa;
   - 1.5 menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.7 taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri; dan
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni;
   - 2.4 mampu menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu memelihara dan mengembangkan jaringan kerja dengan pembimbing, kolega, sejawat baik di dalam maupun di luar lembaganya;
   - 2.7 mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi serta evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggung jawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada di bawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (*engineering sciences*), prinsip-prinsip rekayasa (*engineering principles*), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan sistem, proses, produk atau komponen;

3.2 konsep sains alam dan prinsip dalam mengaplikasikan matematika rekayasa;
3.3 prinsip dan teknik perancangan sistem, proses, atau komponen;

4 Ketrampilan Khusus
4.1 mampu menerapkan prinsip-prinsip matematika dan sains alam, serta prinsip rekayasa (*engineering principles*) untuk menyelesaikan masalah rekayasa kompleks (*complex engineering problem*);
4.2 mampu menemukan sumber masalah rekayasa melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa; mampu melakukan pengumpulan data untuk menyelesaikan masalah yang berkaitan dengan bidang teknik material dan metalurgi;

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami dan mengaplikasikan dalam kehidupan sehari-hari konsep dasar arus dan tegangan (AC/DC) dan hukum-hukum yang terkait dengan listrik, serta safety factor dalam elektronika (ohmic losses)
2. Mahasiswa mengenal dan mendeskripsikan komponen dasar dalam rangkaian elektronika dan teknologi pembuatan komponen dasar elektronika tersebut
3. Mahasiswa mampu menghitung, mengukur dan menganalisis Resistance, Capacitance, Inductance, Reactance komponen dasar elektronika baik secara individual maupun dalam rangkaian
4. Mahasiswa mampu memahami konsep Pengukuran Listrik : Amperemeter, Voltmeter, Ohmmeter, dll
5. Mahasiswa mampu memahami konsep dasar sistem instrumentasi
6. Mahasiswa mengenal macam-macam dan memahami prinsip kerja Sensor/Transducer
7. Mahasiswa mampu memahami konsep power supply
8. Mahasiswa mampu memahami konsep komunikasi data digital, interfacing, controlling, dan konversi data (ADC/DAC)

POKOK BAHASAN

1. Elektronika dan Listrik
2. Arus listrik : Tegangan Rendah, Tegangan Tinggi, Satu Fasa, Tiga Fasa, Daya Listrik
3. Komponen Elektronika dan Listrik : Resistor, Induktor, Kapasitor, Dioda, Transistor, Diagram Rangkaian, Simbol Listrik, dll
4. Pengukuran Listrik : Amperemeter, Voltmeter, Ohmmeter, dll
5. Motor Listrik
6. Konsep dasar instrumentasi
7. Sensor dan Transducer
8. Power Supply
9. Operational Amplifier
10. Komunikasi data (digital dan analog)
11. Konversi data (ADC/DAC)

PRASYARAT

PUSTAKA UTAMA

1. Physics, vol 2, Wolfson, Pearson Pub. 2007. Chapter 24 pp 398-408
2. Horowitz and Hill, The Art of Electronics, Cambridge University Press, 1989.
3. Physics, vol 2, Wolfson, Pearson Pub. 2007. Chapter 25 pp 398-408
4. Rizzoni, G. Principles and Applications of Electrical Engineering, McGraw Hill, 2007
5. Prinsip Dasar Instrumentasi Elektronika dan Industri, FISIKA FMIPA
6. C.A Grimes, E. C. Dickey and M.V Pishko, Encyclopedia of Sensors, American Scientific Publishers, 2006
7. G.E. tobey, J.G Graeme, and L.P. Huelsman, Operational amplifiers-Design and Applications, Publisher Mc Graw Hill, 1971. 2. Walden, R.H, Analog to digital converter survey and analysis, IEEE Journal on Selected Areas in Communications 17, 539-550, 1999
8. H.M Berlin (Book 1 &2), Howard W, Introductory Experiments in Digital Electronics, Sams & Co, Inc Publisher SAMS

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Teknologi Daur Ulang**
	Kode Mata Kuliah : TL184856
	Kredit : 3sks
	Semester : 8

Deskripsi Mata Kuliah

Produk polimer sangat diperlukan manusia karena beberapa kelebihannya, seperti kemudahan proses dalam berbagai bentuk, berbiaya rendah, ringan, dan tahan lama, dibanding produk konvensional. Tapi ironinya adalah beberapa keuntungan membuat bahan polimer menjadi ancaman bagi kehidupan di Bumi karena kerusakan lingkungan yang meluas dan tidak dapat diperbaiki. Hal ini terutama terjadi karena beberapa dari kita masih percaya bahwa produk polimer adalah tipe "use and throw". Karena ini, tanah, air, dan udara kita terkena dampak bencana. Oleh karena itu, sekarang saatnya untuk berpikir dan bekerja untuk mengurangi efek buruk dari polimer dan mencoba meregenerasi lingkungan kita untuk generasi mendatang. Salah satu kemungkinan solusi yang sedang dipertimbangkan dan diperdebatkan oleh masyarakat umum, ilmuwan, dan akademisi adalah daur ulang polimer. Ini karena semua alternatif lain sangat berbahaya atau tidak layak secara ekonomi. Kita dapat melihat bahwa dua pengganti yang umum untuk daur ulang polimer adalah (i) pembakaran sederhana dari polimer bekas di udara terbuka, yang lebih berbahaya bagi lingkungan, dan (ii) penggunaan polimer yang dapat terurai, yang tidak ekonomis. Oleh karena itu, "daur ulang dan penggunaan kembali" dianggap sebagai pilihan terbaik untuk lingkungan yang berkelanjutan. Kedua, daur ulang meminimalkan kebutuhan bahan baku agar hutan hujan bisa dilestarikan. Sejumlah besar energi digunakan saat membuat produk dari bahan baku. Daur ulang membutuhkan lebih sedikit energi dan karena itu membantu kita melestarikan sumber daya alam. Kursus ini, Teknologi Daur Ulang Polimer disajikan untuk memberikan pengetahuan dan teknologi metode daur ulang, diikuti oleh aplikasi dan akhirnya, kelebihan dan kekurangan produk polimer daur ulang termasuk hampir semua kategori polimer, yaitu plastik, elastomer, dan serat, dan, selain itu, juga campuran, komposit, dan resin.

CAPAIAN PEMBELAJARAN

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan

2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus
   4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
   4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
   4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
   4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa dapat memahami urgensi proses daur ulang polimer berdasarkan produk dan energi dan lingkungan
2. Mahasiswa dapat memahami jenis-jenis limbah polimer
3. Mahasiswa dapat memahami aditif yang digunakan dalam proses daur ulang
4. Mahasiswa dapat memahami metode daur ulang limbah polimer
5. Mahasiswa dapat memahami dan menangani prosedur setiap jenis daur ulang polimer
6. Mahasiswa dapat merancang proses daur ulang limbah polimer, komposit, logam dan keramik

POKOK BAHASAN

1. Pendahuluan (3R, sumber limbah polimer, urgensi dan prosedur daur ulang)
2. Aditif / agen umum yang digunakan dalam daur ulang Polimer
3. Metode Daur Ulang
4. Daur Ulang Plastik
5. Daur ulang Karet
6. Daur Ulang Plastik Campuran Berikat Lainnya atau Resin: Poliuretan
7. Daur Ulang Campuran Polimer dan Komposit (Campuran Epoksi)
8. Perancangan dan implementasi proses daur ulang produk polimer
9. Daur ulang logam
10. Daur ulang keramik

PRASYARAT

Tidak ada

PUSTAKA

1. Dr. Raju Francis, “Recycling of Polymers: Methods, Characterization and Applications”, Wiley-VCH Verlag GmbH & Co, Germany, 2017

MATA KULIAH	**Nama Mata Kuliah : Material Untuk Maritim**
	Kode Mata Kuliah : TL184857
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah material maritim membahas tentang aplikasi disiplin ilmu pengetahuan material dan metalurgi dalam dunia perkapalan. Setelah mengikuti mata kuliah ini, mahasiswa mampu mengetahui jenis-jenis kapal dan kegunaannya, bagian-bagian kapal, komponen-komponen kapal, pemilihan material untuk konstruksi kapal, korosi pada kapal, anti-fouling, pengecatan kapal, dry-docking, inspeksi, perawatan dan keamanan dalam lingkungan kapal. Untuk mencapai hal tersebut maka dilaksanakan kegiatan perkuliahaan secara ceramah, diskusi, pengerjaan tugas dan ujian

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.6 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;

4 Ketrampilan Khusus

4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan.

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan jenis-jenis kapal dan kegunaannya
2. Mahasiswa mampu menjelaskan bagian dan komponen kapal
3. Mahasiswa mampu menjelaskan kontruksi material untuk kapal
4. Mahasiswa mampu menjelaskan korosi pada kapal
5. Mahasiswa mampu menjelaskan pengecatan body kapal
6. Mahasiswa mampu menjelaskan anti pembusukan lambung kapal (anti fouling)
7. Mahasiswa mampu menjelaskan proteksi katodik pada kapal
8. Mahasiswa mampu menjelaskan dry docking dan inspeksi
9. Mahasiswa mampu menjelaskan maintenance dan safety

POKOK BAHASAN

1. Jenis-jenis kapal dan kegunaannya
2. Bagian dan komponen kapal
3. Kontruksi material untuk kapal
4. Korosi pada kapal
5. Pengecatan body kapal
6. Anti pembusukan lambung kapal (anti fouling)
7. Proteksi katodik pada kapal
8. Dry docking dan inspeksi
9. Maintenance dan safety

PRASYARAT

Mata Kuliah Elemen mesin, Korosi dan Pengendalian Korosi, Perilaku Mekanik Material dengan minimal nilai D

PUSTAKA UTAMA

1. Rudolf das, 2001, ship knowledge, third edition

PUSTAKA PENDUKUNG

MATA KULIAH	**Nama Mata Kuliah : Pengolahan Mineral**
	Kode Mata Kuliah : TL184858
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Dalam mata kuliah ini akan dipelajari segala hal yang berkaitan dengan pengolahan mineral setelah mineral tersebut diperoleh dari tambang. Pengolahan mineral tersebut meliputi penanganan mineral *(mineral handling)*, pengancuran, klasifikasi ukuran, proses konsentrasi, penghilangan air. Proses konsentrasi yang dipelajari pada mata kuliah ini ialah konsentrasi melalui prinsip gravitasi, konsentrasi melalui prinsip magnetik, konsentrasi melalui prinsip elektrik.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.4 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.13 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.14 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.15 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3 Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus

4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;

4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu mengingat pengenalan tentang pengolahan mineral
2. Mahasiswa mampu memahami *ore handling*
3. Mahasiswa mampu memahami analisis ukuran partikel
4. Mahasiswa mampu menjelaskan proses kominusi
5. Mahasiswa mampu menjelaskan proses klasifikasi
6. Mahasiswa mampu menjelaskan proses konsentrasi mineral melalui prinsip gravitasi
7. Mahasiswa mampu menjelaskan proses flotasi
8. Mahasiswa mampu menjelaskan proses pemisahan magnetik dan elektrik
9. Mahasiswa mampu menganalisis proses pengurangan air

POKOK BAHASAN

1. Pengenalan pengolahan mineral
2. *Ore handling*
3. Analisis ukuran partikel
4. Kominusi
5. Klasifikasi
6. Pengkonsentrasian mineral melalui prinsip gravitasi
7. Flotasi
8. Pemisahan magnetik dan elektrik
9. Pengurangan air

PRASYARAT

Mata Kuliah Pengantar Teknik Material dan Metalurgi dengan minimal nilai D

PUSTAKA UTAMA

1. Minerals Processing Technology, Barry A. Wills, 2006.

PUSTAKA PENDUKUNG

1. Introduction to Mineral Processing Desgn and Operation, Gupta, A., 2006
Speciality Chemicals in Mineral Processing, Skuse, D.R., 2002

MATA KULIAH	**Nama Mata Kuliah : Elektrokimia**
	Kode Mata Kuliah : TL184859
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Elektrokimia adalah ilmu yang mempelajari hubungan antara perubahan (reaksi) kimia dengan kerja listrik, yang biasanya melibatkan sel elektrokimia yang menerapkan prinsip reaksi redoks dalam aplikasinya. Reaksi elektrokimia melibatkan perpindahan elektron – elektron bebas dari suatu logam kepada komponen di dalam larutan. Kesetimbangan reaksi elektrokimia penting dalam sel galvani (yang menghasilkan arus listrik) dan sel elektrolisis (yang menggunakan arus listrik). Pengukuran daya gerak listrik (DGL) suatu sel elektrokimia dalam jangkauan suhu tertentu dapat digunakan untuk menentukan nilai – nilai termodinamika reaksi yang berlangsung serta koefisien aktifitas dari elektrolit yang terlibat.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan

3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4 Ketrampilan Khusus
- 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
- 4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
- 4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
- 4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
- 4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
- 4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan definisi dan proses elektrokimia
2. Mahasiswa mampu menjelaskan dan menghitung konduksi listrik dan larutan ionik
3. Mahasiswa mampu menjelaskan dan menghitung sel elektrokimia dan elektroda
4. Mahasiswa mampu menjelaskan dan menghitung polarisasi dan diagram Pourbaix
5. Mahasiswa mampu menjelaskan dan menganalisa aplikasi elektrokimia dalam korosi dan pelapisan logam

POKOK BAHASAN

1. Pengenalan elektrokimia
2. Konduski listrik
3. Sel elektrokimia
4. Elektroda
5. Polarisasi dan diagram pourbaix
6. Aplikasi elektrokimia pada bidang korosi dan pelapisan logam

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Thomas F. Fuller Electrochemical Engineering Principles
2. Geoffrey A. Prentice Electrochemical Engineering Principles

PUSTAKA PENDUKUNG

Riyanto, elektrokimia dan aplikasinya

MATA KULIAH	**Nama Mata Kuliah : Korosi Temperatur Tinggi**
	Kode Mata Kuliah : TL184860
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Korosi temperatur tinggi merupakan proses degradasi atau penurunan mutu material, termasuk degradasi sifat-sifat mekanisnya yang disebabkan oleh adanya pengaruh atmosfer pada temperatur tinggi

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

1. Sikap
   - 1.1 bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;
   - 1.2 menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;
   - 1.3 berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;
   - 1.6 bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;
   - 1.8 menginternalisasi nilai, norma, dan etika akademik;
   - 1.9 menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri;
   - 1.10 menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan;
   - 1.11 berusaha secara maksimal untuk mencapai hasil yang sempurna; dan
   - 1.12 bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki.

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan
   - 2.13 mampu menerapkan kewirausahaan dan memahami kewirausahaan berbasis teknologi.

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.1 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;

4.2 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
4.3 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;
4.4 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;
4.5 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan
4.6 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu menjelaskan definisi dan proses korosi temperatur tinggi
2. Mahasiswa mampu menjelaskan proses korosi temperatur tinggi oleh oksigen
3. Mahasiswa mampu menjelaskan proses korosi temperatur tinggi oleh karbon
4. Mahasiswa mampu menjelaskan proses korosi temperatur tinggi oleh nitrogen
5. Mahasiswa mampu menjelaskan proses korosi temperatur tinggi oleh sulfur

POKOK BAHASAN

1. Pengenalan korosi temperatur tinggi
2. Korosi temperatur tinggi oleh oksigen (oksidasi)
3. Korosi temperatur tinggi oleh karbon (karburisasi)
4. Korosi temperatur tinggi oleh nitrogen (nitridasi)
5. Korosi temperatur tinggi oleh sulfur (sulfidasi)
6. Aplikasi korosi temperatur tinggi di industri

PRASYARAT

Tidak ada

PUSTAKA UTAMA

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2. Thretewey, KR, and J. Chamberlain, Corrosion for Students and Engineers

PUSTAKA PENDUKUNG

1. Sulistijino, Diktat Kuliah Korosi Temperatur Tinggi

MATA KULIAH	**Nama Mata Kuliah : Topik Khusus**
	Kode Mata Kuliah : TL184861
	Kredit : 3 sks
	Semester : 8

DESKRIPSI MATA KULIAH

Mata kuliah Topik Khusus digunakan untuk mempelajari dan menganalisis sifat dan teknologi material dan metalurgi. Mata Kuliah Topik Khusus mempelajari ilmu tentang material dan metalurgi spesifik. Topik Khusus mempelajari konsep ilmu spesifik, teori ilmu spesifik, mekanisme ilmu spesifik dan aplikasi ilmu spesifik. Topik Khusus digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. Ketrampilan Umum
   - 2.1 mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya;
   - 2.2 mampu menunjukkan kinerja mandiri, bermutu, dan terukur;
   - 2.3 mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni, menyusun deskripsi saintifik hasil kajiannya dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.4 menyusun deskripsi saintifik hasil kajian tersebut di atas dalam bentuk skripsi atau laporan tugas akhir, dan mengunggahnya dalam laman perguruan tinggi;
   - 2.5 mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data;
   - 2.7 mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;
   - 2.8 mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri;
   - 2.9 mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi;
   - 2.10 mampu mengembangkan diri dan bersaing di tingkat nasional maupun internasional;
   - 2.11 mampu mengimplementasikan prinsip keberlanjutan (sustainability) dalam mengembangkan pengetahuan;
   - 2.12 mampu mengimplementasikan teknologi informasi dan komunikasi dalam konteks pelaksanaan pekerjaannya; dan

3. Pengetahuan
   - 3.1 konsep teoretis sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan material dan metalurgi serta proses manufaktur material dan metalurgi produk atau komponen;
   - 3.2 konsep sains alam dan prinsip aplikasi matematika rekayasa pada teknologi material dan manufaktur material produk;
   - 3.3 prinsip dan teknik perancangan sistem, proses atau manufaktur material dan metalurgi komponen;
   - 3.4 prinsip dan issue terkini dalam ekonomi, sosial, ekologi secara umum; dan
   - 3.5 teknik komunikasi dan perkembangan teknologi material dan metalurgi terbaru dan terkini.

4. Ketrampilan Khusus
   - 4.7 mampu menerapkan matematika, sains alam, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa kompleks (complex engineering problem) pada proses manufaktur material dan metalurgi produk atau komponen;
   - 4.8 mampu menemukan sumber masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen melalui proses penyelidikan, analisis, interpretasi data dan informasi berdasarkan prinsip-prinsip rekayasa;
   - 4.9 mampu melakukan riset yang mencakup identifikasi, formulasi dan analisis masalah rekayasa pada material, metalurgi dan proses manufaktur material produk atau komponen;

4.10 mampu merumuskan alternatif solusi untuk menyelesaikan masalah rekayasa kompleks pada material, metalurgi dan proses manufaktur material produk atau komponen dengan memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan;

4.11 mampu merancang proses manufaktur material dan metalurgi produk atau komponen dengan pendekatan analitis dan mempertimbangkan standar teknis, aspek kinerja, keandalan, kemudahan penerapan, keberlanjutan, serta memperhatikan faktor-faktor ekonomi, kesehatan dan keselamatan publik, kultural, sosial dan lingkungan; dan

4.12 mampu memilih sumberdaya dan memanfaatkan perangkat perancangan dan analisis rekayasa berbasis teknologi informasi dan komputasi yang sesuai untuk melakukan aktivitas rekayasa pada proses manufaktur material produk atau komponen

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mahasiswa mampu memahami Pendahuluan Topik Khusus
2. Mahasiswa mampu menjelaskan Konsep dan Teori Topik Khusus
3. Mahasiswa mampu mengaplikasikan Mekanisme Topik Khusus
4. Mahasiswa mampu menganalisis Aplikasi Topik Khusus

POKOK BAHASAN

1. Pendahuluan Topik Khusus.
2. Konsep dan teori dari Topik Khusus.
3. Mekanisme Topik Khusus.
4. Aplikasi Topik Khusus

PRASYARAT

Tidak ada

PUSTAKA UTAMA

1. Joon B. Park, Joseph D. Bronzino, Biomaterials Principles and Applications", CRC Press,2003.
2. Joon Park, "Biomaterials An introduction", springer, 2007.
3. Robert Lanza "Principles of Tissue Engineering" Academic Press, 2007

PUSTAKA PENDUKUNG

1. Glen S. Kwon, "Polymetric Drg Delivery Systems", Taylor and Fraciss, 2005.
2. Kay C. Dee, David A. Puleo. Rena Bizios," Tissue-Biomaterial Interactions", Wiley-Liss, 2002.
3. J Paulo Davim,"Biomaterials and Medical Tribology**"** Woodhead publishing, 2013

SYLLABUS ITS CURRICULUM 2018-2023
FACULTY OF INDUSTRIAL TECHNOLOGY

Study Program	**MATERIALS ENGINEERING**
Education Level	**BACHELOR STUDY PROGRAM**

Ist SEMESTER

COURSE	**Course Name**	**: Bahasa Indonesia**
	Course Code	: UG184912
	Credit	: 2 sks
	Semester	: 1

DESCRIPTION OF COURSE

Bahasa Indonesia course is used to study the knowledge of Bahasa Indonesia language. Bahasa Indonesia course is a course that studies structure, vocabulary, reading, conversation and writing of Bahasa Indonesia. Bahasa Indonesia course is used to write a scientific paper of material and metallurgical science and engineering.

LEARNING OUTCOMES

3. General Skill
   - 2.5 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.10 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

COURSE LEARNING OUTCOMES

8. Student is able to understand sentence structure.
9. Student is able to understand effective sentence.
10. Student is able to explain paragraf framework.
11. Student is able to explain vocabulary.
12. Student is able to apply paper writing.
13. Student is able to apply word spelling.
14. Student is able to analyze literature review.

MAIN SUBJECT

1. Sentence structure.
2. Effective sentence.
3. Paragraf framework.
4. Vocabulary.
5. Paper writing.
6. Word spelling.
7. Literature review.

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Rahardi, R. Kunjana. 2012. *Bahasa Indonesia untuk Perguruan Tinggi.* Jakarta : Erlangga

SUPPORTING REFERENCE
-

COURSE	**Course Name : Civics**
	Course Code : UG184913
	Credit : 2 sks
	Semester : 1

DESCRIPTION OF COURSE

Civics course is used to study the knowledge of citizen behaviour. Civics course is a course that studies country, nationality, citizen right, citizen responsibility, constitution, law and globalization. Civics is used to develop material and metallurgical science and engineering in the country.

LEARNING OUTCOMES

1. Attitude
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.7 Law abiding and disciplined in community and state life;

COURSE LEARNING OUTCOMES

1. Student is able to understand Pancasila and its implementation.
2. Student is able to understand National Identity and people.
3. Student is able to explain Democracy.
4. Student is able to explain Right and responsibility of citizen.
5. Student is able to apply Constitution and rule.
6. Student is able to apply Human right.
7. Student is able to apply Geopolitic.
8. Student is able to analyze Geostrategy.
9. Student is able to analyze Regional autonomy.
10. Student is able to analyze Good governance and globalization.

MAIN SUBJECT

1. Pancasila and its implementation.
2. National Identity and people.
3. Democracy.
4. Right and responsibility of citizen.
5. Constitution and rule.
6. Human right.
7. Geopolitic.
8. Geostrategy.
9. Regional autonomy.
10. Good governance and globalization.

PREREQUISITES

There is no prerequisite course

REFERENCE

4. Darmodihardjo, dkk. 1991. Santiaji Pancasila (Suatu Tinjauan Filosofis, Historis dan Yuridis Konstitusional). Usaha Nasional. Surabaya.
5. Mansur, Hamdan, dkk. 2002. Pendidikan Kewarganegaraan. Gramedia Pustaka Utama. Jakarta.

SUPPORTING REFERENCE

COURSE	**Course Name : Chemistry 1**
	Course Code : SK184101
	Credit : 3 sks
	Semester : 1

DESCRIPTION OF COURSE

Chemistry 1 course is used to study the knowledge of chemical. Chemistry 1 is a course that studies chemical internal structure, chemical bonding, chemical transformation. Chemistry 1 is used to develop chemistry of material and metallurgical science and engineering.

LEARNING OUTCOMES

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3 Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;

COURSE LEARNING OUTCOMES

1. Student is able to memorize Atomic structure.
2. Student is able to understand Periodic table.
3. Student is able to explain Chemical bonding.
4. Student is able to explain Stoichiometry.
5. Student is able to apply Matter phase.
6. Student is able to apply Solution and colligative properties.
7. Student is able to analyze Phase transformation.
8. Student is able to analyze Thermochemistry.
9. Student is able to analyze Chemistry application in Industry.

MAIN SUBJECT

1. Atomic structure.
2. Periodic table.
3. Chemical bonding.
4. Stoichiometry.
5. Matter phase.
6. Solution and colligative properties.
7. Phase transformation.
8. Thermochemistry.
9. Chemistry application in Industry.

PREREQUISITES

There is no prerequisite course
REFERENCE
5. Kimia 6. Kimia Dasar 7. Chemistry 8. General Chemistry
SUPPORTING REFERENCE

COURSE	**Course Name : Physics 1 +P**
	Course Code : SF184101
	Credit : 4 sks
	Semester : 1

DESCRIPTION OF COURSE

Physics 1 course is used to study the knowledge of physic. Physics 1 is a course that studies motion of matter. Physics 1 is used to develop motion of material and metallurgical science and engineering.

LEARNING OUTCOMES

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;

COURSE LEARNING OUTCOMES

1. Student is able to memorize Basic motion unit: reference framework, position displacement, distance, speed (average and shortly), linear velocity (average and shortly), linear acceleration (average and shortly), angular velocity (average and shortly), and angular acceleration (average and shortly).
2. Student is able to understand Types of motion: motion in straight line, motion in a plane, motion in a room, relative motion (position and relative velocity).
3. Student is able to explain Motion of matter in a curve coordinate (polar, sphere, cylinder).
4. Student is able to explain Newton's Law of motion.
5. Student is able to apply Newton's Law of motion.
6. Student is able to apply The concept of work and energy.
7. Student is able to analyze Newton's Law of gravitation.
8. Student is able to analyze Linear vibration.
9. Student is able to analyze Wave.

MAIN SUBJECT

1. Basic motion unit: reference framework, position displacement, distance, speed (average and shortly), linear velocity (average and shortly), linear acceleration (average and shortly), angular velocity (average and shortly), and angular acceleration (average and shortly).
2. Types of motion: motion in straight line, motion in a plane, motion in a room, relative motion (position and relative velocity).
3. Motion of matter in a curve coordinate (polar, sphere, cylinder).

4. Newton’s Law of motion.
5. Application of Newton’s Law of motion.
6. The concept of work and energy.
7. Newton’s Law of gravitation.
8. Linear vibration.
9. Wave.

PREREQUISITES

There is no prerequisite course

REFERENCE

4. Fisika Universitas
5. Physics
6. University Physics

SUPPORTING REFERENCE

COURSE	**Course Name : Mathematics 1**
	Course Code : KM184101
	Credit : 3 sks
	Semester : 1

DESCRIPTION OF COURSE

Mathematics 1 course is used to study the knowledge of number. Mathematics 1 is a course that studies number, function, differential, integral and matrix. Mathematics 1 is used to develop material and metallurgical science and engineering.

LEARNING OUTCOMES

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3. Knowledge
   - 6.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;

COURSE LEARNING OUTCOMES

1. Student is able to memorize Basic concept of real number system, absolute number, inequality, line, distance of two points, circle, parabola.
2. Student is able to understand Concept of function, domain limit, range, linear function, quadratic, trigonometry, function graphic, function limit, continuity.
3. Student is able to explain Differential, differential rule, chain rule, implicit function differential.
4. Student is able to apply Differential application, velocity, interval, curve, asymptote, peak, approximation, extreme.
5. Student is able to apply Definite integral, indefinite integral, finite limit, infinite limit, summation of Riemann, area, calculus.
6. Student is able to analyze Matrix and determinant.

MAIN SUBJECT

1. Basic concept of real number system, absolute number, inequality, line, distance of two points, circle, parabola.
2. Concept of function, domain limit, range, linear function, quadratic, trigonometry, function graphic, function limit, continuity.
3. Differential, differential rule, chain rule, implicit function differential.
4. Differential application, velocity, interval, curve, asymptote, peak, approximation, extreme.
5. Definite integral, indefinite integral, finite limit, infinite limit, summation of Riemann, area, calculus.
6. Matrix and determinant.

PREREQUISITES
There is no prerequisite course
REFERENCE
1. Matematika Universitas 2. Matematika 3. Matematika Dasar
SUPPORTING REFERENCE

COURSE	**Course Name : Religion** **Islam Religion** **Christ Religion** **Catholic Religion** **Hindu Religion** **Buddha Religion** **Khonghucu Religion**	
	Course Code	: UG184 UG184901 UG184902 UG184903 UG184904 UG184905 UG184906
	Credit	: 2 sks
	Semester	: 1

DESCRIPTION OF COURSE

Religion course is used to study the knowledge of faith to God. Religion is a course that studies God, believe in God, life and God's Law. Religion is used to develop material and metallurgical science and engineering.

LEARNING OUTCOMES

1. Attitude
   1.1 believing in the oneness of God and able to demonstrate religious attitude;
   1.6 together, having social sensitivity and caring for community and environment;

COURSE LEARNING OUTCOMES

1. Student is able to understand Religion diversity.
2. Student is able to understand Tolerance value.
3. Student is able to explain Source religion.
4. Student is able to apply Religion fundamental.
5. Student is able to apply Modern religious people value.
6. Student is able to analyze Religion value in life.

MAIN SUBJECT

1. Religion diversity.
2. Tolerance value.
3. Source religion.
4. Religion fundamental.
5. Modern religious people value.
6. Religion value in life.

PREREQUISITES
There is no prerequisite course
REFERENCE
9. Muthahari, M. 1993. *Manusia dan Agama*. Bandung : Mizan. 10. Hasbullah. 2005. *Dasar - Dasar Ilmu Pendidikan*. Jakarta : PT. Raja Grafindo Persada. 11. Shihab, M.Q. 1996. *Wawasan Al-Quran*. Bandung : Mizan. 12. Ilmu Agama Kristen 13. Ilmu Agama Katolik 14. Ilmu Agama Hindu 15. Ilmu Agama Buddha 16. Ilmu Agama Khonghucu
SUPPORTING REFERENCE
-

COURSE	**Course : Introduction to Materials and Metallurgical Engineering**
	Course Code : TL184101
	Credit : 2 sks
	Semester : 1

DESCRIPTION OF COURSE

This course discusses about basic theory of materials and metallurgical engineering refer to materials life cycle such as metals, plastics or ceramics. The discussion topic from extraction, manufacture, material degradation processes and recycle of the materials. In addition, material engineering and characterizations process are also studied in this course.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 3.2 Being able to demonstrate independent performance, quality, and measurable;
   - 3.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 3.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 3.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 3.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 3.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 3.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 3.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 3.10 Being able to develop themselves and compete in national and international level;
   - 3.11 Being able to implement sustainability principles and develop knowledge: and
   - 3.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 3.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principle on materials technology and manufacturing material product;

3.3 Knowing principle and engineering design of system, process or material manufacturing and component metallurgy;
3.4 Knowing principle and latest issue on general overall economic, social, ecology;

4. Specific Skill
4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand basic concepts of materials and metallurgical for metals or non-metals (ceramics, plastics, composites)
2. Student is able to understand materials and minerals processing
3. Student is able to understand manufacturing technology such as casting, machining, welding, metals forming etc
4. Student is able to understand and analyse materials degradation processes for metals or non-metals and also factors that influence of the degradation control.

MAIN SUBJECT

1. Introduction to materials and life cycle of the materials
2. Technology of materials and minerals processing
3. Cyrstal struture and alloying system
4. Properties of materials (mechanical, physical and chemical properties) and its characterizations (Destructive Test (DT), Non-Destructive Test (NDT), XRD, SEM, FTIR, XRF, TGA, optical microscope, etc)
5. Phase and transformation diagrams
6. Material modification process (heat treatment, surface engineering, etc)
7. Manufacturing technology (casting, machining, welding etc) and polymer, ceramic and composite material
8. Corrosion and material degradation for metals or non – metals, factors and degradation control system
9. Recycle technology

PREREQUISITES

There is no prerequisite course

REFERENCE

4. Callister, Materials Science and Engineering An Introduction, Us, 2009
5. Schlenker, B.R., Introduction to Material Science, SI edition,Australia pty Sidney: John Wiley & Sons,1974.
6. Avner, Sidney H, Introduction to Physical Metallurgy, Second edition, Tokyo: Mc Graw Hill International Book Company, 1987

SUPPORTING REFERENCE

1. Barret, Craig R, Nix, William D, Tetelman, Alan S, The Principles of Engineering Materials, New Jersey: Prentice Hall Inc, Englewood Cliffs,1973
2. Kalpakijan, Seroke, Manufacturing Engineering and Technology, First Edition, Addison Wesley Pub.Company, 1989
3. M. Ohring, The Materials Science of Thin Films The Materials Science of Thin Films, Academic Press, 1992

4. ___ASM Handbook 5: Surface Engineering, ASM International, 1994
5. Arthur A. Tracton, Coatings Materials And Surface Coatings, CRC Press, 2007
6. Zaki Ahmad, Principles of Corrosion Engineering and Corrosion Control, Elsevier, 2006
7. Vijay Kumar Thakur, Recycled Polymers: Chemistry and Processing, Smithers Rapra, 2016

COURSE	**Course Name**	**: English**
	Course code	: UG184914
	Credit	: 2 sks
	Semester	: 2

COURSE DESCRIPTION

English courses are used for English use. English studies the science of reading, listening, writing, and speaking in English. English is used to engineer and develop materials science and metallurgy.

LEARNING OUTCOMES

2. General Skill
   2.1 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

COURSE LEARNING OUTCOMES

5. Students are able to explain reading English
6. Students are able to apply listening English
7. Students are able to apply writing English
8. Students are able to analyze speaking English

MAIN SUBJECT

1. Reading in English
2. Listening in English
3. Writing English
4. Speaking English

PREREQUISITES

There is no prerequisite course

REFERENCE

English Language, Grammar

SUPPORTING REFERENCE

-

COURSE	**Course Name**	**: Mathematics 2**
	Course code	: KM184201
	Credit	: 3 sks
	Semester	: 2

COURSE DESCRIPTION

Mathematics 2 course is used to define numbers. Mathematics 2 studies the science of integrals, coordinates, and sequences. Mathemathics 2 is used to engineer and develop materials and metallurgy.

LEARNING OUTCOMES

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3 Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;

COURSE LEARNING OUTCOMES

6. Student is able to remember Integration Techniques: partial integrals, integral of trigonometric functions, integral with rational breaking functions
7. Student is able to understand the Numerical Integral and Unnatural Integral: numerical integral, Simpson rule, improper integral
8. Student is able to explain Applied Certain Integral: wide area of flat, volume and surface area of rotary objects, emphasis and application on physics
9. Student is able to explain Polar Coordinates: draw function in the polar parametric coordinates, and can apply integration techniques in polar coordinates, parametric functions
10. Student is able to apply Unlimited Rows and Rows: unlimited sequences, incomplete series, convergence test, Taylor series, MacLaurin series

MAIN SUBJECTS

1. Integration Techniques: partial integrals, integral of trigonometric functions, integral with rational breaking functions
2. Numerical Integral and Unnatural Integral: numerical integral, Simpson rule, improper integral
3. Applied Certain Integral: wide area of flat, volume and surface area of rotary objects, emphasis and application on physics
4. Polar Coordinates: draw function in the polar parametric coordinates, and can apply integration techniques in polar coordinates, parametric functions
5. Unlimited Rows and Rows: unlimited sequences, incomplete series, convergence test, Taylor series, MacLaurin series

PREREQUISITES

There is no prerequisite course
REFERENCE
University Mathematics Mathematics
SUPPORTING REFERENCE
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COURSE	**Course Name : Pancasila**
	Course code : UG184911
	Credit : 2 sks
	Semester : 2

COURSE DESCRIPTION

The Pancasila course is used to determine the basic attitude of the Indonesian Nation. Pancasila studied the science of ideology, the basis of the state, the culture of the nation, the meaning of Pancasila, the function of Pancasila, and the application of Pancasila. Pancasila is used as an attitude to engineer and develop materials and metallurgy.

LEARNING OUTCOMES

3. Attitude
   - 3.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 3.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6 Working together, having social sensitivity and caring for community and environment;

COURSE LEARNING OUTCOMES

8. Student is able to explain good citizens.
9. Student is able to understand the philosophy contained in Pancasila.
10. Student is able to explain important events in Indonesia.
11. Student is able to explain the cultural values of the Indonesian nation.
12. Student is able to compare the characteristics of the Indonesian historical period.
13. Student is able to apply Pancasila in daily problems.
14. Student is able to analyze Pancasila as an open ideology.

MAIN SUBJECTS

8. Pancasila and its implementation
9. Philosophy of Pancasila.
10. Important events in Indonesia.
11. The cultural values of the Indonesian nation.
12. Characteristics of Indonesia's historical period.
13. Application of Pancasila in everyday life.
14. Pancasila as an open ideology.

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Magnis Suseno. 1997. Etika Politik, Jakarta : Gramedia.
2. Hamdan Mansoer, dkk. 2002. Kapita Selekta Pendidikan Pancasila (Untuk Mahasiswa), Jakarta : BPPTA - Ditjen Dikti, Depdiknas.

SUPPORTING REFERENCE

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COURSE	**Course Name**	**: Physics 2**
	Course code	: SF184202
	Credit	: 3 sks
	Semester	: 2

COURSE DESCRIPTION

Mata kuliah Fisika 2 digunakan untuk menentukan perilaku listrik, fluida, cahaya dan energi. Fisika 2 mempelajari ilmu tentang listrk, gerakan fluida, gerakan cahaya dan energi panas. Fisika 2 digunakan untuk merekayasa dan mengembangkan material dan metalurgi.

LEARNING OUTCOMES

2. General skill
   - 2.2 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.3 Being able to demonstrate independent performance, quality, and measurable
   - 2.4 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3 Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;

COURSE LEARNING OUTCOMES

9. Student is able to remember the Law of Coulomb, Potential and Electric Field
10. Student is able to understand Electric Flow
11. Student is able to explain the magnetic field
12. Student is able to explain induction motion force
13. Student is able to explain the current back and forth
14. Student is able to apply fluid mechanics
15. Student is able to apply Optics and light
16. Student is able to analyze Heat

MAIN SUBJECT

1. The Law of Coulomb, Potential and Electric Field
2. Electric Flow
3. Magnetic field
4. Induction motion force
5. Current back and forth
6. Fluid mechanics
7. Optics and light
8. Calor and heat

PREREQUISITES

There is no prerequisite course

REFERENCE

Physics University Physics
SUPPORTING REFERENCE
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COURSE	**Course Name : Engineering Mechanic-Static**
	Course code : TL184202
	Credit : 2 sks
	Semester : 2

COURSE DESCRIPTION

The mechanical behavior of materials such as strength and strain relates to external forces acting on an object that is the basis of engineering mechanics. These external forces need to be analyzed and calculated to determine the resultant force. These subjects will discuss the material on the force system of particles and solids, the equivalent force (Moment), Structure analysis, center of gravity, Moment of Inertia, Normal Field, Shear and field of moments, Strain and deflections on beams , combination stress analysis (Mohr circle). It is expected that at the end of the lecture students are able to understand the resultant concepts of forces acting on particles and solids, calculating the strength of the structure, determining the moment of inertia to calculate the shear plane and the moment plane and combining the stress with the Mohr circle method. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

3. Attitude
   - 3.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 3.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.11 Trying his/her best to achieve perfect results,

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.;

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skills
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

COURSE LEARNING OUTCOMES

5. Student is able to understand basic concepts related to force equilibrium on particles and solid objects
6. Student is able to calculate and resolve issues of equilibrium force, moment of inertia, structural strength and tension transformation
7. Student is able to express ideas and ideas related to basic concepts of material physics both orally and in writing

8. Student is able to have moral and good responsibility in completing their tasks

MAIN SUBJECTS

10. Particular force and equilibrium,
11. The equivalent force system (Moment),
12. The Equilibrium of Pigeons,
13. Analysis of structure,
14. The center of gravity,
15. Moments of Inertia, Normal Field, Shear Field and moment field,
16. Strain and deflection on the beam,
17. Stress due to temperature and voltage on thin walls,
18. Combined voltage analysis (Mohr circle)

PREREQUISITES

Physics 1 with minimum grade of D

REFERENCE

1. R.C. Hibbeler, "Engineering Mechanics: Statics", 12th edition
2. Ferdinand P. Beer, E. Russell Johnston, Jr., Elliot R. Eisenberg," Vector Mechanics for Engineers: Statics", 8th edition, McGraw Hill, New York, USA

SUPPORTING REFERENCE

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COURSE	**Course Name : Engineering Drawing +A**
	Course code : TL184203
	Credit : 3 sks
	Semester : 2

COURSE DESCRIPTION

Engineering drawing is a scientific representation of a project, where the project is the result of imagination or fiction of the manufacturer. In order for the results of the imagination recorded properly and can be followed up to make the object, it needs to be poured in a working drawing. Engineering drawing must meet national and international standards and standards to be understood and accepted universally. Engineering drawing is a communication medium between the creator and the industry as one of the tools in the process of making it. Engineering drawing and machines teaches the basics of drawing components and simple mechanical systems according to engineering standards, the use of drawing tools and the use of software in engineering drawing. To achieve these objectives, the learning strategy that is done is in the classroom, giving the task independently a big task

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.4. Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5. Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and

2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

10. Student is able to explain the definition and application of Engineering Graphic and Design in the field of Materials and Metallurgy
11. Student is able to explain the types of lines and media images.
12. Student is able to relate projection theory and pieces.
13. Student is able to apply basic rules to give a measure on engineering drawings.
14. Student is able to formulate specific depiction and repeating images (threads and springs).
15. Student is able to formulate specific drawings and recurrent images (Gears and Shafts).
16. Student is able to connect between the welding symbol and the location of the weld symbol in the image media.
17. Student is able to explain the description of a material component with 2D autocad.
18. Student is able to create 3D machine components using autocad.

MAIN SUBJECT

1. Introduction of Engineering Graphic and Design
2. The concept of image and image classification
3. Media image, line type and image scale
4. Theory of view / projection and illustrative example in simple form
5. The theory of pieces (section) and examples of drawing on simple shapes, shading
6. Detailed drawings and drawings
7. Drawing mechanical components (spring, thread, gear, bolt and nut, welding symbol)
8. Tolerance of surface, suaian, surface roughness and workmanship
9. Theory of device usage (software) to draw

PREREQUISITES

There is no prerequisite course

REFERENCE

5. Collin Simmons, Dennis E. Maguire, “Manual of Engineering Drawing 2nd ed”, Elsevier Newnes Burlington, M.A.
6. K.L Narayana, P. Kannaiah, K. Venkata Reddy, “Machine Drawing 3rd ed”, New Age International Publishers.
7. J. La Heij, L.A. De Bruijn, “Mechanical Engineering Drawing”. Kemperman

SUPPORTING REFERENCE

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COURSE	**Course Name : Materials Chemistry +P**
	Course Code : TL184204
	Credit : 3 sks
	Semester : 2

DESCRIPTION OF COURSE

The Materials Chemistry Course examines the analysis and separation of samples and electrochemical processes. The analysis can aim to determine what kinds of components are present in a sample (qualitative) and also determine how many components exist in a sample (quantitative). Not all of the elements or compounds present in the sample can be analyzed directly, most of which require a prior separation process from the disturbing element. Therefore, the ways or procedures of separation are important to learn. Electrochemistry is important in the field of materials and metallurgy, such as electrolysis processes for the synthesis of materials and galvanic processes such as in solar cells and supercapacitors. So that in this course we will learn about Introduction to Analytical Chemistry, Solubility and solubility product, Cation Analysis, Anion Analysis, Gravimetric Analysis, Volumetry, Acid Base Titration, Redox Titration, Deposition Titration, Introduction Electrochemistry, Electrical Conduction, Ionic Solutions, Electrochemical Cells, Electrodes, and Electrode Reactions It is expected that at the end of the course students are able to understand the theory and apply qualitative and quantitative analysis to inorganic compounds and be able to solve problems related to corrosion of electrochemical materials and processes in the field of materials and metallurgical engineering. To achieve these objectives, the learning method used, among others, with class lectures, presentations, self-giving tasks and experiments in the form of Chemical Materials practicum.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.4. Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5. Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;

3. Knowledge
   3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

COURSE LEARNING OUTCOMES

1. Student is able to explain the scope of analytical chemistry and explain the role of analytical chemistry
2. Student is able to:
   Explain the principle of volumetric analysis
   Explain the volumetric titration and back titration methods
3. Student is able to:
   Describes acid-base titration
   Describes acid-base titration curves
4. Student is able to:
   Explain the gravimetric analysis method
   Describes the properties of the precipitate
   Complete the gravimetric calculations
5. Student is able to:
   Describes precipitation reaction
   Describes the titration curve
   Complete the calculation of settling titration
6. Student is able to:
   Mention the physical properties of cations and anions useful for initial identification
   Mentioning common cations and anions and how they are analyzed
   Choose a specific test to determine a particular anion
7. Student is able to:
   Explain the concept of electrochemistry and the scope of its application
   Explain about electrical conduction
8. Student is able to:
   Explain the ionic solution
9. Student is able to:
   Explain the types and principles of reaction in electrochemical cells
10. Student is able to:
    Explain the properties of electrodes
    Explain the electrode reactions
11. Student is able to:
    Explain about electrochemical application in material and metallurgy

MAIN SUBJECT

1. Basic Concepts of Analytical Chemistry
2. Volumetric Analysis
3. Acid base balance
4. Equilibrium of Solution and Titration of Precipitation
5. Cation and cation separation analysis
6. Electrochemical Concepts
7. Electrical Conduction
8. Ionic Solutions
9. The types of electrochemical cells and principle of electrochemical cells
10. Electrode Properties

11. Electrode Reactions
12. Electrochemical Applications in the field of Materials and Metallurgy

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Jefrfery, B.H Basset J, Mendham J dan Denney R.C (revisors), Vogel's Textbook of Quantitative, 1989, Longman & Scientific essex, chemical analysis, edisi ke 5
2. Day, R.A Jr and A.L Underwood, Quantitative Analysis 6th ed, Toronto: Prentice-Hall International, 1991
3. Kennedy JH, Analytical Chemistry Principles, 2nd ed, New York: Saunders College Publishing, 1990
4. Keith B. Oldham, Jan C. Myland, "Fundamentals of Electrochemical Science", Academic Press Inc, 1994.
5. Geoffrey Prentice, "Electrochemical Engineering Principles", prentice Hall International, Inc

SUPPORTING REFERENCE

III[rd] SEMESTER

COURSE	**Course Name**	**: Materials Thermodynamics**
	Course Code	: TL184305
	Credit	: 3 sks
	Semester	: 3

DESCRIPTION OF COURSE

This course deals with the changes of thermodynamic properties which are included the first law of Thermodynamics, the second law of Thermodynamics and Gibb's free energy in material and metallurgical fields.

LEARNING OUTCOMES

1.Attitude

1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
1.6 Working together, having social sensitivity and caring for community and environment;
1.8 Internalizing values, norms and academic ethics;
1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
1.10 Internalizing spirit of independence, struggle and entrepreneurship;
1.11 Trying his/her best to achieve perfect results, and
1.12 Working together to be able to make the most of his/her potential.

2.General Skill

2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
2.2 Being able to demonstrate independent performance, quality, and measurable;
2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
2.10 Being able to develop themselves and compete in national and international level;
2.11 Being able to implement sustainability principles and develop knowledge: and
2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.

3. Knowledge

3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

Student is are able to calculate the changes of the thermodynamic properties in the field of materials and metallurgical engineering.

MAIN SUBJECT

1 Introduction to Materials Thermodynamics
2 The First Law of Thermodynamics
3 The Second Law of Thermodynamics
4 Thermodynamics of Combustion Engines
5 Gibb's Free Energy
6 Thermodynamics of Chemical Reaction Equilibrium

PREREQUISITE

Basic Chemistry, Materials Chemistry, Basic Physics 1, Basic Physics 2, Mathematics 1 and Mathematics 2

REFERENCE

1. Gaskel, D.R,"Introduction to Metallurgical Thermodynamics", McGraw Hill, Kogakusha, Ltd, Tokyo.

SUPPORTING REFERENCE

1. Swalin, R.A., "Thermodynamics of Solid", John Wiley & Sons, New York.
2. Ragone, D.V., "Thermodynamics of Material", Vol. I and II, John Wiley & Sons, New York.
3. Yunus A. Cengel and Michael A. Boles " Thermodynamics An Engineering Approach" 2nd ed. Mc Graw Hill , 1994
4. J.M Smith, H.C Van Ness and M.M Abbot "Introduction to Chemical Engineering Thermodynamics" 5th ed., 1996
5. T.D Eastop and A. Mc Conkey, "Applied Thermodynamics for Engineering Technologist" 5th ed., 1993

COURSE	**Course Name : Computer Programming**
	Course Code : TL184306
	Credit : 3 sks
	Semester : 3

DESCRIPTION OF COURSE

Mechanical behavior and material engineering can not be separated from mathematical formulation. Fundamentals of computer programming are required to facilitate the use of such mathematical formulation in understanding the mechanical properties and behavior of the material by numerical analysis. So it is expected after the end of the semester students are able to understand the basics of logic pemgrogaman computer or algorithm in making computer programs. In this course, students will learn about knowing and understanding basic computer programming using Pascal programming language and using it for simple calculation applications related to materials and metallurgy techniques. To achieve these objectives, the learning method used, among others, with class lectures, presentations, self-giving tasks and experiments in the form of basic computer laboratory.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understanding basic application of computer programming.
2. Student is able to explain about turbo pascal program and it's application.
3. Student is able to explaint the Turbo Pascal Standard Unit.
4. Student is able to explain about identifiers and variables
5. Student is able to explain the theory of reserved word and data type in pascal.
6. Student is able to decipher data types and bitwise operators.
7. Student is able to apply branching statement theory.
8. Student is able to explain operator priorities and type of declarations.
9. Student is able to explain looping theory .

MAIN SUBJECT

1. Definition and application of Basic Computer Programming
2. Installation of Turbo Pascal program.
3. Definition and application of Identifier and Variables.
4. Definition and application of data types.
5. Branching Statement Theory and its application.
6. Looping theory (repetition) along with its application

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Abdul Kadir, 2004, "Pemrograman Pascal".
2. Richard, S.F, 1982, "Pascal at Work and Play an Introduction to Computer Programming in Pascal", London
3. "Introduction to Computer Programming", Ozgur ZEYDAN BEU Dept. Of Enve. Eng.

SUPPORTING REFERENCE

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COURSE	**Course Name : Phase Diagram and Transformation**
	Course Code : TL184307
	Credit : 3 sks
	Semester : 3

DESCRIPTION OF COURSE

Phase Diagram and Transformation course provide an understanding of the basic concepts of phases and the principle of phase equilibrium according to the concept of thermodynamics. Phase Diagram and Transformation include the use of phase diagram materials to determine the possible phases of the material transformation process and to practice problem-solving phase problems and relative weights on a binary and ternary phase diagram.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex

engineering problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to know the concept of phase and phase diagram based on fundamental of thermodynamics
2. Student is able to know the concept of phase transformation
3. Student is able to calculate relative weight composition in unary, binary, and ternary phase diagrams
4. Student is able to presenting novelty of phase diagrams on metallic and nonmetallic materials
5. Student is able to draw a phase diagram of one component and two components

MAIN SUBJECT

1. Phase Diagram and Equilibrium
2. Phase Diagram : Thermodynamic Concept
3. Phase Transformation
4. Unary Phase Diagram
5. Binary Phase Diagram (eutectic, eutectoid, peritectic, peritectoid, monotectic, congruent transformation, complex binary diagram)
6. Ternary Phase Diagram
7. Case Study: metal and non-metal phase diagram

PREREQUISITES

Introduction to Materials and Metallurgical Engineering with minimum grade of C

REFERENCE

7. Raghavan, phase transformation, London, Prentice hall inc, 1987
8. Chadwick, metallography of phase transformation, London, Butter Worths & Co, 1972
9. Christian, The theory of tranfromation in metal and alloys, 2nd edition, Oxford, Pergamon Press, 1975
10. Porter, A. David and Eastering, E.Kenneth, Phase transformation in metal and alloys, Van Nostrand reinhold, UK. Co.ltd, 1980
11. Rhines, N.Frederick, Phase Diagram in Metallurgy, Their Development and application, McGraw-Hill, 1985
12. Callister, D.William, Material Science and Engineering, An introduction, John Wiley and son, Inc, 1994

SUPPORTING REFERENCE

Metal handbooks, vol 8 metallography, structure, dan phase diagram, ASM, 1973

COURSE	**Course Name : Machine Design**
	Course Code : TL184308
	Credit : 3 sks
	Semester : 3

DESCRIPTION OF COURSE

Element Machine is a course that discusses the work of machine / mechanical elements according to the principle of force and motion mainly related to material selection. Mechanical machine is one of the tools to facilitate human work. Mechanical machine are designed and manufactured based on a combination of design objectives, size, capacity and material selection. In this lecture, students are given provisions in designing a simple mechanical system and also evaluate the performance of a simple mechanical system that already exists. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.10 Trying his/her best to achieve perfect results, and

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

COURSE LEARNING OUTCOMES

1. Students are understand and be able to explain the concept of force and stress on mechanical elements
2. Students are able to calculate and analyze the strength of permanent and non permanent connections
3. Students understand and be able to explain the working principle of mechanical machine
4. Students are able to calculate and analyze the power of transmission system elements

MAIN SUBJECT

1. Load and stress on mechanical elements (failure theory)

2. Permanent and non permanent connections
3. Shaft and pegs
4. Coupling, clutch and brakes
5. Belt-pulley, chain-sprocket and Gear
6. Journal and Rolling contact Bearings (bearings)
7. Pressure vessel

PREREQUISITES

Engineering Mechanics-Static with minimum grade of D

REFERENCE

1. R.S. Khurmi, J.K. Gupta, S. Chandran, "Textbook of Machine Design", 2005
2. Budynas, Nisbett, "Shigley's Mechanical Engineering Design, 8th edition" McGraw Hill-Primis
3. Joseph E. Shigley "Standard Handbook of Machine Design, 3rd ed"
4. Robert L Mott, "Machine elements in Mechanical Design 4th ed", Pearson Prentice Hall

SUPPORTING REFERENCE

Journals

COURSE	**Course Name : Metallurgy 1 +P**
	Course Code : TL184309
	Credit : 3 sks
	Semester : 3

DESCRIPTION OF COURSE

Students are able to understand the physical structure of materials and phenomena related to physical structure

LEARNING OUTCOMES

1.Attitude

1.1 Believing in the oneness of God and able to demonstrate religious attitude;
1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
1.6 Working together, having social sensitivity and caring for community and environment;
1.7 Law abiding and disciplined in community and state life;
1.8 Internalizing values, norms and academic ethics;
1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
1.10 Internalizing spirit of independence, struggle and entrepreneurship;
1.11 Trying his/her best to achieve perfect results, and
1.12 Working together to be able to make the most of his/her potential.

2. General Skill

2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
2.2 Being able to demonstrate independent performance, quality, and measurable;
2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
2.10 Being able to develop themselves and compete in national and international level;
2.11 Being able to implement sustainability principles and develop knowledge: and
2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.

3. Knowledge

3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill

4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
4.2 Being able to find engineering problem source of material product or component, metallurgy product or

component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the mechanism of plastic deformation, recrystallization, fracture, alloy structure and micro structure
2. Student is able to apply various mechanisms of reinforcement on metal
3. Student is able to analyze the mechanism of various phase changes

MAIN SUBJECT

1. Introduction
2. Crystal structure, atomic bond, crystal, defect in crystal, crystallography
3. The Iron-Carbide phase and equilibrium diagram
4. Transformation diagram, Phase transformation Processing, austenite decomposition
5. Reinforcement of metal, general heat treatment
6. Hardening and tempering
7. Surface Hardening

PREREQUISITE

There is no prerequisite course

REFERENCE

5. Avner, Sidney H, Introduction to Physical Metallurgy, Second Edition, Tokyo: Mc Graw Hill, International Book Company, 1987
6. Schlenker B.R, Introduction to Material Science, SI Edition, Sidney: John Wiley & Sons, 1974
7. Dieter, George E, Mechanical Metallurgy, Second Edition, Tokyo: McGraw Hill International Book Company, 1981
8. Baret, Craig R, Nix William D, Tetelman, Alan S, The Principles of Engineering Materials, New Jersey: Prentice Hall Incorporation, Englewood Cliffs, 1973

SUPPORTING REFERENCE

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COURSE	**Course Name : Advanced Engineering Mathematics**
	Course Code : TL184310
	Credit : 3 sks
	Semester : 3

DESCRIPTION OF COURSE

Concepts and calculations in the engineering world cannot be separated from the understanding of differential equations. So the course of engineering mathematics will discuss about the concept and calculation of various kinds of differential equations, Laplace transformation, and the introduction of the use of Mat Lab or Mathematica program. It is expected that at the end of the lecture students are able to apply the concept of calculation in the related field of Materials Engineering and Metallurgy so as to be able to solve various problems that occur in engineering and design calculations. To achieve these objectives then the learning method used, among others, with class lectures and independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skills
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principle and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering

problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to calculate and show different methods of completion on first order ordinary differential equation and its application (single mixing, newton law of cooling, exponential growth-decay, torricelli's law)
2. Student is able to calculate and show different methods of completion on second order ordinary differential equation and its application (spring system)
3. Student is able to calculate and show different methods of completion on higher order ordinary differential equation and its application (double spring, double mixing, elastic beam)
4. Student is able to simplify the process of solving simple differential equations into the form of algebra and transformation and able to apply them in the world of materials and metallurgy techniques (mixing, damped vibration)
5. Student is able to use matrix to solve technical math problems
6. Student is able to analyze and evaluate partial differential equations
7. Student is able to translate and solve the problems / calculations of Math Engineering into programming languages (Mat Lab or Mathematica)

MAIN SUBJECT

1. First order ordinary differential equation and apllication
2. Second order ordinary differential equation and apllication
3. Higher order ordinary differential equation and apllication
4. Laplace Transformation
5. Matriks
6. Partial Differential Equation
7. MATLAB

PREREQUISITES

Mathematics 1 and Mathematics 2 with minimum grade of D

REFERENCE

1. Erwin Kreyzig, *"Advance Engineering Mathematics"*, 10th Edition, New York, John Wiley and Sons, 2011.

SUPPORTING REFERENCE

1. Desmond J. Higham, Nicholas J. Higham. MATLAB guide, 2nd edition, Society for Industrial and Applied Mathematic, 2005
2. Martha L. Abell et al.,Mathematic by Example, 4th edition,Elsevier, 2009

COURSE	**Course Name : Materials Characterization**
	Course Code : TL184411
	Credit : 3 sks
	Semester : 4

DESCRIPTIONOF COURSE

Material Characterization course provides an understanding of the basics of material characterization and equipment for material characterization, basic for equipment selecting to identify materials properties including physical / chemical properties, microstructure, crystal structure, phase identification and thermal properties. Material Characterization Course also provides concepts of grain size calculations, Miller indices, lattice parameters and Crystal structures as well as data analysis used in materials identification processes, material failures and material engineering.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.7 Law abiding and disciplined in community and state life;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development

4. Spesific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to knowledge the basics of material characterization and its application in material and metallurgical engineering
2. Student is able to knowledge the concept of physisorption and chemisorption and apply in physical properties of material
3. Student is able to knowledge the concept of microstructure analysis and being able to calculate grain size
4. Student is able to knowledge the concept of chemical composition analysis and apply in materials and metallurgy engineering
5. Student is able to knowledge the concept of material crystallography and apply in index miller, lattice parameter and crystal structure analysis
6. Student is able to knowledge of thermal analysis and apply in the determination of thermal properties

MAIN SUBJECT

1. Basic Consept of Material Characterization
2. Physical Properties Indentification (Physisorption, Chemisorption, Density, Porosity, Particle Size Analyzer)
3. Microstructure Analysis (Optical Microscope, SEM, TEM dan AFM)
4. Spectroscopy Analysis (FTIR, Raman Spectroscopy, XRF, EDX)
5. Crystallography Material and Crystal structure Analysis (Crystal Structure, Basic Consept Diffraction Analysis, XRD measurement, Phase Identification)
6. Thermal Analysis (DSC, TGA, DTA, TMA)

PREREQUISITES

Introduction to Materials and Metallurgical Engineering, Phase Diagram Transformation, and Metallurgy 1 +P with minimum grade of C

REFERENCE

1. Kehl, George L, The Principle of Metallographic Laboratory Practice, Mc Graw Hill Book Company, New York,1949
2. Cullity,B.D., Elements of X-Ray Diffraction, 2 edition, Addison Wesley Publishing Company Inc, Notre Dame, 1959
3. Dodd, W. James, dan Tonge, H.Kenneth, Analytical Chemistry by Open Learning, Termal Methods, John Wiley & sons, Inggris, 1987
4. Wiles, D.B., dan Young, R.A, A new Computer Program for Rietveld Analysis of X-Ray Diffraction Pattern, J. Apply.Cryst,1981

SUPPORTING REFERENCE

1. ASM Handbook volume 10, Material Characterization, USA, 1986

COURSE	**Course Name : Corrosion and Corrosion Control +P**
	Course Code : TL184412
	Credit : 3 sks
	Semester : 4

DESCRIPTION OF COURSE

This course teach definition and type of corrosion, corrosion energy, corrosion mechanisms and factors affecting rate of corrosion, polarization, method of corrosion control, material selection for certain corrosive media

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland , having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.7 Law abiding and disciplined in community and state life;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertsei Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge

3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the basic concept of corrosion
2. Student is able to identify the types of corrosion
3. Student is able to design / choose materials and structures for building safe techniques for certain environmental conditions
4. Student is able to design corrosion protection system
5. Student is able to choose treatment and method for metal coating

MAIN SUBJECT

1. Concept Of Energy And Thermodynamic
2. Kinetic Of Corrosion And Electrochemistry
3. Corrosion Classification
4. Corrosion On Metal And Corrosion Testing
5. Corrosion Control Methods

PREREQUISITE

Materials Chemistry with minimum grade of C

REFERENCE

1. McCafferty,E., INTRODUCTION TO CORROSION SCIENCE, Springer New York Dordrecht Heidelberg London, 2010

SUPPORTING REFERENCE

1. CORROSION ENGINEERING, Mars Guy Fontana, McGraw-Hill Book Company; 3rd edition (November 1, 1985)

2. CORROSION, METAL/ ENVIRONMENT REACTION, L.L. Shreir, R.A. Jarman, G.T. Burstein, Butterworth-Heinemann, 2000
3. UHLIG'S CORROSION HANDBOOK, R. Winston Revie, John Wiley and Sons, Canada, 2000
4. Principles of Corrosion Engineering and Corrosion Control, Zaki Ahmad, Elsevier Science and Technology Book, 2006
5. Handbook of Cathodic Corrosion Protection, W. von Baeckmann, W. Schwenk, W. Prinz, Gulf Professional Publishing, Houston, 1997
6. Corrosion Mechanisms in Theory and Practice, Philippe Marcus, Marcel Dekker, Inc. 270 Madison Avenue, New York, 2002

COURSE	**Coarse Name : Manufacturing Process +P**
	Coarse Code : TL184413
	Credit : 3 sks
	Semester : 4

DESCRIPTION OF COARSE

The processes of producing material in industrial field were connected with basic concept of manufacturing. In coarse of process of manufacture discuss about conventional and non conventional machining method, welding and variation types of welding, casting and variation types of casting, hot working and plastic production process. Students able to applied basic concept of manufacturing process to solve industrial problem after enter coarse are the goals of this course. Course strategy are classical study, individual work exercise, presentation and experiment should be done to ful full the goals.

LEARNING OUTCOMES

3. Attitude
   - 3.4 Believing in the oneness of God and able to demonstrate religious attitude;
   - 3.5 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 3.6 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

4. General Skill
   - 4.4 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 4.5 Being able to demonstrate independent performance, quality, and measurable;
   - 4.6 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and;
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work and
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship..

5. Knowledge
   - 5.4 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 5.5 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 5.6 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 5.7 Knowing principe and latest issue on general overall economic, social, ecology; and

5.8 Knowing communication technique and the newest and latest materials and metallurgy technology development.

6. Specific Skill
   6.4 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   6.5 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   6.6 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process;
   6.7 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   6.8 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   6.9 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to describe conventional and non conventional machining process
2. Student is able to explain OAW, SMAW and GTAW as welding processes
3. Student is able to explain sand casting, mold casting, centrifugal casting, die casting and investment casting as foundry processes
4. Student is able to describe hot working and cold working processes
5. Student is able to explain the processing of plastic and molding

MAIN SUBJECT

9. Conventional and non conventional machining
10. Welding and types of welding
11. Casting and types of casting
12. Hot working process and cold working process
13. Plastic and moulding

PREREQUISITES

There is no prerequisite course

REFERENCE

Kalpakjian, Manufacturing Process for Engineering Materials

SUPPORTING REFERENCE

3. John Schey
4. Amstead

COARSE	**Coarse Name : Metallurgy 2 +P**
	Coarse Code : TL184414
	Credit : 3 sks
	Semester : 4

COURSE DESCRIPTION

Metallurgy II studies about classification / types of steel alloys and cast iron, the effect of alloys elements and non ferrous alloys

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.7 Working together, having social sensitivity and caring for community and environment;
   - 1.13 Internalizing values, norms and academic ethics;
   - 1.14 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.15 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.16 Trying his/her best to achieve perfect results, and
   - 1.17 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - a. Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and;
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship..

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Students able to explain classification, properties and application of steels, understand relation between composition, microstructures and properties of steels
2. Students able to analysis stainless steel and cast iron, mechanical properties and applications
3. Students able to analysis non ferrous alloys
4. Students understand about specification of tools steel, classification and application
5. Students are able to anlayze the applications of non ferrous metals

MAIN SUBJECT

8. Metallurgical iron-steel, classification of steel, properties and applications. Effect of alloying element, standard code, specification and characteristic various steels
9. Cast iron : types, microstructures, mechanical properties and applications
10. Stainless steel : classification base on microstructures, standard specification, properties, applications and problem of manufacturing and working condition
11. Tools steel : classification, specification standard, types, properties and application
12. Non Ferrous metal

PREREQUISITE

Introduction of materials and metallurgical engineering and Metallurgy I with minimum score of D

REFFERENCE

1. Sidney H, Introduction to Physical Metallurgy, Second Edition, Tokyo: Mc Graw Hill, International Book Company, 1987
2. Thelning, Karl Erik, Steel and Its Heat Treatment, Second Edition, London: Butterworths, 1984.

SUPPORTING REFERENCE

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COURSE	**Course Name**	**: Numerical Analysis and Modeling**
	Course Code	: TL184415
	Credit	: 3 SKS
	Semester	: 4

DESCRIPTION OF COURSE

Study of algebraic operations and techniques to obtain numerical approximations for function, its derivatives and solution of equation/system of equations

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertsei Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Being able to arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principle on materials technology and manufacturing material product;
   - 3.3 Knowing principle and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principle and latest issue on general overall economic, social, ecology; and

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principles;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

7. Be able to understand basic concepts of error, taylor series and numerical approximation
8. Be able to implement algebraic operations for solving differential or integral of function numerically
9. Be able to implement algebraic operations for solving linear and non-linear equations or system of equations
10. Be able to implement numerical techniques for data fitting and optimization problems
11. Be able to implement useful numerical techniques and their programming for solving problems related to materials and metallurgical engineering

MAIN SUBJECT

9. Overview of engineering problems and mathematical modeling
10. Errors, taylor series and approximations
11. Roots of equation and root finding techniques (graphical, bisection and iterative/gradient based methods)
12. Matrix and matrix inverse, linear algebraic equations and solving techniques (gauss elimination, lu decomposition, and iterative methods)
13. Numerical differentiation (finite divided differences) and integration (trapezoidal rule, simpson's rule, newton-cotes, romberg integration, gauss quadrature)
14. Ordinary differential equations and solving techniques (euler's, runge-kutta, adaptive runge-kutta methods)
15. Data fitting and optimization problems
16. Classification of partial differential equations (elliptic, parabolic and hyperbolic equations)

PREREQUISITES

Computer programming course

REFERENCE

3. Steven C. Chapra And Raymond P. Canale. Numerical Methods For Engineers. Mc Graw Hill. 2010
4. G. Miller. Numerical Analysis For Engineers And Scientists. Cambridge University Press. 2014

SUPPORTING REFERENCE

COURSE	**Course Name**	**: Statistic and Design Experiments**
	Course Code	: TL184416
	Credit	: 3 sks
	Semester	: 4

COURSE DESCRIPTION

The good research plan is important factor that establishes the result of experiment. Knowledge to analysis experimental data is needed in statistic beside good research plan. In such away, Students have ability to analysis hypothesis correctly and choose the best method until optimum result occur by study in statistic and experimental design course. This course studies about basic concept of statistic, probability and application of probability in engineering field and give base of statistic for experiment. This course also studies about modelling, hypothesis, data analysis, and decide difference between mean treatment. To fulfil the target, learning method are classical studies and individual work exercise.

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LEARNING OUTCOME

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   a. Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   b. Being able to demonstrate independent performance, quality, and measurable;
   c. Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page i;
   d. Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   e. Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   f. Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   g. Being able to develop themselves and compete in national and international level;
   h. Being able to implement sustainability principles and develop knowledge: and;
   i. Being able to implement information and communication technology (ICT) in the context of implementation of his/her work
   j. Being able to implement information and communication technology (ICT) in the context of implementation of his/her work

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNNG OUTCOME

6. Student is able to explain concept of description data and concept of probability
7. Student is able to analysis and calculate estimation
8. Student is able to analysis hypothesis test and linier regression
9. Student is able to design research method and data analysis
10. Student is able to making decision base on result and research analysis

MAIN SUBJECT

1. NORMAL DISTRIBUTION
   1.1.Distribution Z and t
   1.2.Distribution Normal Standard
   1.3.Pooled Estimate s^2
   1.4.One tiled test
   1.5.Two Tiled Test
   1.6.Comparasion between two Mean and Distribution of t
2. INFERENSI TO VARIOUS NORMAL DISTRIBUTION DATA
   2.1.Distribution chi-square
   2.2.Distribution F
3. INFERENSI PROPORTION
   3.1. DistribUtion binomial
   3.2. approximation with normal distribution
   3.3. approximation with poisson distribution
4. TESTING DIFFERENCES BETWEEN K MEAN
   4.1 variance analysis
   4.2 steps to variance analysis
   4.3 table of anova
   4.5 95% multiply t confidence internal
5. RANDOMIZED BLOCK EXPERIMENT
   5.1. randomized block eksperiment
   5.2. two-way (factorial) design
6. LATIN SQUARE DESIGN
7. TWO LEVEL FACTORIAL DESIGN
   7.1 Method of YATES to calculate main effect and interaction
   7.2 Confidence Interval
   7.3 Blocking
8. ANALYSIS OF REGRESI
   8.1 Regresi Linear Equation

8.2. Inferensi Sudut β
8.3. Pure Error and Lack of Fit
8.4 Residual observation
8.5 Check Model linier line
8.6 Method of Matrix for regression analysis
8.7. Multiple Linier Regression
8.8 Analysis of Regresi for Two-level Factorial Design
8.9.Non Linear Regression

9. METHOD OF RESPONSE SURFACE
   9.1 Model Response
   9.2. Checking Model
   9.3. hiking steepest
   9.4. second design
   9.5 Applied two degree
   9.6. Estimating optimum condition in polynomial two degree equation
10. QUALITY CONTROL
   10.1. Diagram mean control
   10.2 Diagram control
   10.3. Diagram control Proportion (p)
   10.4. Diagram control defect (C)

PREREQUISITES

Mathemathics 1 and Mathematics 2 Courses with minimum score of D

REFFERENCE

6. Bhattacharya, Gouri and R.A. Johnsons, "Statistical Concept and Methods", John Willey & Sons, New York, 1977
7. Walpole, R.E. and R.H. Myers, "Probability and Statistical For Scientist and Engineer", Macmillan, New York, 1978
8. Fox E.P. Hunter, W.G., Hunter I.S., "Statistics for Experimenters", John Wiley & Sons, New York, 1984
9. Montgomery D.C. "Design and Analysis of Experiment", John Wiley & Sons, New York, 1984
10. Sudjana, "Desain dan Analisa Experimen", Tarsito, Jakarta,1991

SUPPORTING REFERENCE

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COURSE	Course Name : Ceramics and Glass Materials
	Course code : TL184517
	Credit : 3 sks
	Semester : 5

DESCRIPTION OF COURSE

Ceramics and glasses is one type of material which has a wide application. In addition, the ceramic material also has a complex type of crystal structure so it will opens wide opportunities in engineering and research. Ceramics and glass materials course learns about the properties and characteristics of ceramic and glass materials. In addition, it learns the process, manufacture and its application. It is expected that at the end of the course, students are able to understand the characteristics of ceramics and glasses materials and are able to develop this engineering field for further engineering applications. To achieve these objectives, then the learning methods used are class lectures, discussion and the provision of independent assignments.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.
3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the history of ceramic material development, ceramic types, and ceramic properties
2. Student is able to calculate, develop and analyze bonds between atoms of ceramics
3. Student is able to calculate and solve crystal system problems
4. Student is able to calculate and solve the problem of defects in the crystal
5. Student is able to calculate and solve manufacturing problems on ceramics and glasses
6. Student is able to explain the application of ceramic materials

MAIN SUBJECTS

1. Introduction to Ceramic and Glass Materials
2. The Atomic Bond in Ceramics and Glasses
3. Crystal system on ceramic and glass
4. Defects / Defects in Ceramics
5. Ceramics manufacturing process:
   - Raw Materials
   - Powders, Fibers, Platelets, and Composites
   - Shaping and forming
   - Coating process for structural and electronic ceramics
   - Sintering
6. Properties and ceramic applications

PREREQUISITES

There is no prerequisite course

REFERENCE

4. Kingery, W.D., et al., Introduction to Ceramic 2nd edition, New York : John Wiley and Sons, 1976.
5. Barsoum, M.W., Fundamentals of Ceramics,New York: McGraw-Hill Company, Inc, 1997.
6. Yet Ming Chiang et al, Physical Ceramics, New York John Wiley and Sons, Inc, 1997

SUPPORTING REFERENCE

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COURSE	**Course Name : Fracture Mechanics and Failure Analysis**
	Course code : TL184518
	Credit : 3 sks
	Semester : 5

DESCRIPTION OF COURSE

Failure on material occurs because of material released on workpiece material. A precise method is needed to analyze the failure of a material. Therefore, in this course we discuss about the factor of conductive concentration, stress of moment, torque, heat, crack opening mode, stress factor, causal factor, cause factor, extrusion intrusion factor, cleavage, failure analysis, failure analysis report. It is expected that at the end of the lecture students are able to explain the voltage that occurs as a result, moment and heat. In addition, students are also able to produce a dislocation stress. To achieve that goal it is the learning methods used are class lectures and self assignment.

LEARNING OUTCOMES

1. Attitude
   1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   1.6. Working together, having social sensitivity and caring for community and environment;
   1.8. Internalizing values, norms and academic ethics;
   1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   1.11. Trying his/her best to achieve perfect results
   1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   2.2 Being able to demonstrate independent performance, quality, and measurable;
   2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3. Knowledge
   3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

COURSE LEARNING OUTCOMES

1. Student is able to analyze stress and strain due to compression load, yield criterion, fracture criterion, fracture mechanism and its appearance, ductile and brittle fracture, and macroscopic aspects
2. Student is able to analyze mechanical behavior of material due to repetitive, microscopic and macrocospic load due to fatigue and crack propagation, fatigue life, cack initiation, crack growth, and total life, infinite life fatigue force, finite life fatigue force, practical steps
3. Student is able to analyze the stress intensity and residual stress factors due to the cracking of the toughness of the metal fracture
4. Student is able to analyze Linear elastic fracture mechanics, Griffith-Irwin theory, Indications and criteria Fracture, plasticity crack tip, ductile and brittle fracture, Plane strain fracture toughness

MAIN SUBJECTS

1. The concept of voltage at a point and voltage transformation
2. Linear elastic fracture mechanics
3. Elastic elastic fracture mechanics
4. Standard and crack parameter measurement
5. Mechanism of cracking
6. Life expectancy prediction and damage control
7. Analysis of failures and problems in practice

PREREQUISITES

Engineering Mechanics-Static and Machine Design Courses with minimum score of D

REFERENCE

3. Fracture Mechanics: Fundamental and Application, third ed,by TL Anderson, publ :Tailor and Francis, 2005
4. Failure Analysis of engineering structure, by AC Raghuram, Khrishnan, Bhaumik, publ: ASM Interl., 2005

SUPPORTING REFERENCES

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COURSE	**Course Name**	**: Health and Safety Environment**
	Course code	: TL184519
	Credit	: 3 sks
	Semester	: 5

DESCRIPTION OF COURSE

The health and safety course describes the importance of engineer's attention to good system and working methods. So, the workers who follow these system and methods can work healthy and safe in field. Every job have dangerous risks, especially in the industrial world. If the hazards are not handled with good regulation then it is likely to cause an accident. The accident harms many parties such as workers, workers' families, companies and the environment. After studying this course, students are expected to be able to analyze basic OSH concepts, OHS standard rules, types of hazards, hazard factors, how to cope with hazards, human roles in creating and preventing hazards and regulating safety and health procedures. To achieve these objectives learning strategies in the courses include face-to-face meetings, assignments, laboratory visits or industry visits for OSH analysis of a working system.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology

and manufacturing material product;

3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the introduction of health and safety
2. Student is able to explain the laws, regulations and health and safety standards
3. Student is able to analyze hazards and how to control hazards
4. Student is able to explain the human factor in the implementation of occupational health and safety
5. Student is able to analyze safety and health settings

MAIN SUBJECTS

1. Introduction of occupational health and safety
2. Laws, regulations and health and safety standards
3. Hazards and methods of hazard control
4. Human factors in the implementation of occupational health and safety
5. Occupational safety and health arrangements

PREREQUISITES

There is no prerequisite course

REFERENCE

Roger, (2006), safety and health for engineers, willey interscience, canada

SUPPORTING REFERENCE

COURSE	**Course Name**	**: Heat Treatment +P**
	Course code	: TL184520
	Credit	: 3 sks
	Semester	: 5

DESCRIPTION OF COURSE

The structural change of an alloy metal produced from machining / deformation will affect the propertiesof metals. The process of heat treatment can play an important role to change these structures, so it will expand the use of metal alloys due to variations in properties produced. Heat Treatment courses learn about diffusion and diffusionless transformation on heating / cooling (phase diagram, transformation diagram, martensite decomposition, recrystallization), hardenability, residual stress, various heat treatment processes (general and specific). After completing this course, students are able to explain and predict phase change on heating / cooling, measuring / calculating and using hardenability data, understanding the effect of alloy elements as well as the influence of process method variation in heat treatment (general heat treatment and specific heat treatment). To achieve these goals learning strategies in the course include: face to face meetings, assignments, practical projects, presentations, discussions and industry visits.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component

metallurgy;

3.4 Knowing principe and latest issue on general overall economic, social, ecology; and

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill

4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the interaction of alloys, microstructures, properties, heat treatment, manufacturing methods
2. Student is able to explain the phase transformation; equilibrium, non-equilibrium
3. Student is able to explain the alloying elements in steel
4. Student is able to calculate hardenability
5. Student is able to explain residual stress
6. Student is able to explain the process of heat treatment of steel; annealing
7. Student is able to explain the process of heat treatment of steel: hardening and tempering
8. Student is able to explain the surface hardening
9. Student is able to explain special heat treatment, among others: tool steel

MAIN SUBJECTS

1. Interaction of alloys, microstructures, properties, heat treatment, manufacturing methods
2. Phase transformation: equilibrium, non-equilibrium
3. Elements of alloys on steel
4. Hardenability
5. Residual Stress
6. Steel heat treatment process; annealing
7. Steel heat treatment process: hardening and tempering
8. Hardening of the surface
9. Special heat treatment include: tool steels

PREREQUISITES

Metallurgy 1, metallurgy 2 and phase diagram and transformation courses

REFERENCE

4. George E. Totten, “Steel Heat Treatment – Equipment and Process Design”, Tailor and Francis Group, 2007.
5. George E. Totten, “Steel Heat Treatment – Metallurgy and Technologies”, CRC, 2007.
6. Frank Czerwinski, “Heat Treatment Conventional and Novel Application”, InTech, 2012.

SUPPORTING REFERENCE

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OURSE	**Course Name**	**: Casting Technology +A**
	Course code	: TL184521
	Credit	: 3 sks
	Semester	: 5

COURSE DESCRIPTION

The casting process is a part of metallurgy manufacture to produce metal alloys into shape according to the required specifications. Casting technology course learn about foundry principle, casting type, molding component design (pattern, riser, channel system), sand mold treatment to meet good sand mold properties, non reactive system balance material to adjust target alloy composition, heat balance to predict heat requirements in melting, furnace types, cast-iron solidification, defects in casting and defective mechanisms. Upon completion of this course students are able to explain the technological needs for a casting process, designing all components of the mold, analyzing and recommending steps to minimize defects in casting products. To achieve these, the objectives learning strategies in this course are face-to-face meetings, assignments, practicum, presentations and industry visits.

LEARNING OUTCOMES

1. Attitude
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain casting technologies and types of casting
2. Student is able to explain the solidification mechanism
3. Student is able to calculate the pattern and core design
4. Student is able to calculate the riser design
5. Student is able to calculate the design of the inlet
6. Student is able to analyze the appropriate sand mold treatment
7. Student is able to calculate material and heat balance
8. Student is able to compare the melting process and the completion stage of the cast object
9. Student is able to analyze the cause of defects foundry
10. Student is able to analyze the handling of foundry defects
11. Student is able to analyze steel casting, aluminum casting and cooper casting

MAIN SUBJECTS

1. Casting technology and foundry types
2. Solidification mechanism
3. Design of patterns and cores
4. Raiser design
5. Design of the inlet
6. Treatment of sand molds
7. Material and heat balance
8. Melting and settlement process
9. Defect-defects foundry
10. Overcoming the defects foundry
11. steel casting, aluminum casting and cooper casting

PREREQUISITES

Metallurgy 1, metallurgy 2 and phase diagram and transformation courses

REFERENCE

4. Rao P. N. “Manufacture Technology
5. William D Callister “An Introduction : Material Science and Engineering. 8th Edition” US: John Willey and Sons, Inc. 2007
6. American Foundry Society

SECONDARY REFERENCE

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COURSE	Course Name	: Deformation and Forming Processes
	Course code	: TL184522
	Credit	: 3 sks
	Semester	: 5

DESCRIPTION OF COURSE

The Deformation and forming process course is a course which studies the deformation (change of shape) that occurs in solid. This course is also related to the technological progress of the forming process ,i.e the process of workpiece making in solid condition.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to reason mechanical behavior of material.
2. Student is able to reason the relationship between stress and material strain
3. Student is able to explain the technique of calculation analysis on solid deformation study to perform analysis on metal forming process cases
4. Student is able to explain technological progress of metal forming process
5. Student is able to explain reason using flow curve of the theory of pastisitas
6. Student is able to explain the stress-strain curve and the yield criteria of plasticity theory
7. Student is able to explain basic principles of Slab Analysis
8. Student is able to calculate using local stress-strain analysis
9. Student is able to use and analyze the Field Theory of Slip Lines
10. Student is able to formulate and analyze The theory of analysis of upper and lower limit
11. Student is able to identify and analyze the process of forming biocomposite
12. Student is able to identify and analyze the process of forming biopolymers
13. Student is able to identify and analyze the process of forming cellulose based nano composites

MAIN SUBJECTS

1. Tensor voltage
2. Compability
3. The yield criterion
4. Constitutive equations
5. Slab calculations
6. Slip line theory, Upper bound & Lower bound
7. The process of forming a composite made from natural fibers with extrusion technology
8. Technology forming process

PREREQUISITES

Engineering mechanic static and manufacture process courses

REFERENCE

7. Rowe, G.W, Principles of Industrial Metal Working Process, London: Edward Arnold.

SUPPORTING REFERENCE

4. Wagoner, R., H., Chenot, J., L., Fundamentals of Metal Forming, New York: John Wiley & Sons.
5. R. H. Wagoner and J.- L. Chenot, Metal Forming Analysis, Cambridge University Press, Cambridge.
6. Mohanty, Amar K., ed., Natural Fibers, Biopolymers, and Biocomposites, CRC Press, New York.

COURSE	**Course Name : Technopreneur**
	Course Code : UG184915
	Credit : 2 sks
	Semester : 6

DESCRIPTION OF COURSE

Technopreneur courses are used to define a business using technology. Technopreneur learns about business, technology, management, cost and finance. Teknopreneur is used to engineer and develop business in the field of materials and metallurgy.

LEARNING OUTCOMES

1. Attitude
   1.10 internalize the spirit of independence, striving, and entrepreneurship;

2. General Skill
   2.12 is able to implement information and communication technology in the context of the implementation of its work; and

COURSE LEARNING OUTCOMES

1. Student is able to remember the basic concept of teknopreneur
2. Student is able to understand the business principle
3. Student is able to explain Feasibility Study
4. Student is able to explain the business model
5. Student is able to implement the Business Plan
6. Student is able to apply business management
7. Student is able to analyze cost and financial analysis

MAIN SUBJECT

1. The basic concept of technopreneur
2. Business principles
3. Feasibility study
4. Business model
5. Business plan
6. Business management
7. Cost and financial analysis

PREREQUISITES

There is no prerequisite course

MAIN REFERENCE

Entrepreneurship
Business

SUPPORTING REFERENCES

COURSE	**Course Name : Polymer Material *enrichment services**
	Course Code : TL184623*
	Credit : 3 sks
	Semester : 6

DESCRIPTION OF COURSE

Polymeric materials are used for various engineering components. Polymer materials are used as car wheels, cable wrappers, bottles, electronic components and pipes. Polymer materials need to be designed and engineered. Subjects of polymer materials study the science and technology of structures, processing and properties of polymeric materials. The course material of polymer material has a discussion of the basic concepts of engineering materials, the classification of engineering materials, the selection of engineering materials, the basic concepts of polymer materials, the classification of polymer materials, the chemical structure of the polymer material, the molecular structure of the polymer material, the synthesis of polymer materials, the chemical properties of the polymeric material, polymers, mechanical properties of polymer materials, polymer material manufacturing processes, and application of polymeric materials.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials

technology and manufacturing material product;

3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.4 Knowing principe and latest issue on general overall economic, social, ecology; and

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill

4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to remember the basic concepts of engineering materials
14. Student is able to remember the classification and selection of engineering materials
15. Student is able to understand the basic concepts of polymer materials
16. Student is able to understand the classification of polymeric materials
17. Student is able to explain the chemical structure of polymer materials
18. Student is able to explain the molecular structure of polymer materials
19. Student is able to apply polymer material synthesis
20. Student is able to apply the chemical, physical and mechanical properties of polymer materials
21. Student is able to analyze the manufacturing process of polymer materials
22. Student is able to analyze the application of polymer materials

MAIN SUBJECTS

1. The basic concept of engineering materials
2. Classification and selection of engineering materials
3. The basic concept of polymeric material
4. Classification of polymeric materials
5. Chemical structure of polymer material
6. The molecular structure of polymeric materials
7. Synthesis of polymeric materials
8. Chemical, physical and mechanical properties of polymeric materials
9. The process of manufacturing polymeric materials
10. Application of polymeric materials

PREREQUISITES

Chemistry, Physics,and Mathematics Courses

REFERENCE

1. Fred W Billmeyer, Jr, Textbook of Polimer Science, John Wiley and Sons, New York, 1971

SUPPORTING REFERENCE

1. William D Callister “An introduction: Material science and Engineering. 8th edition”USA: John Wiley and Sons, Inc. 2007
2. L.H. Sperling, Introduction to physical polymer science, 4th Edition, New York, John Wiley and Sons, 2006.
3. John McMurry, Fundamentals of Organic Chemistry, Thomson Learning, California, 2003
4. A Brent Strong, Plastics: Materials and Processing, Prentice Hall, New Jersey, 2000
5. Manas Chanda, Salil K Roy, Plastics Fundamentals, Properties, and Testing, Taylor & Francis, Boca Raton, 2009
6. Richard G Griskey, Polymer Process Engineering, Chapman & Hall, New York, 1995
7. Ulf W Gedde, Polymer Physics, Chapman & Hall, London, 1995
8. Ger Challa, Polymer Chemistry An Introduction, Ellis Horwood, New York
9. Joel R Fried, Polymer Science and Technology, Prentice-Hall, New Jersey, 1995
10. Ralp J Fessenden, Joan S Fessenden, Aloysius Hadyana Pudjaatmaka, Kimia Organik, Erlangga, Jakarta, 1982
11. Michaeli, Greif, Kaufmann, Vosseburger, Training in Plastics Technology, Hanser, Munich, 1992
12. Walter Klopffer, Introduction to Polymer Spectroscopy, Springer-Verlag, Berlin, 1984
13. Serope kalpakjian, steven r schmid, Manufacturing Engineering and Technology, Addison wesley longman, India, 2000

COURSE	**Course Name : Iron and Steel Making**
	Course code : TL184624
	Credit : 3 sks
	Semester : 6

DESCRIPTION OF COURSE

This course studies the process of ironmaking and steelmaking equipments. The discussed topics starts from the preparation of raw materials until semi-finished products production. The process of ironmaking and steelmaking is a process of iron processing from its ore and followed by the processing of iron into steel that can be applied Iron processing begins with the preparation of raw materials of iron ore, ranging from crushing, grinding, screening, concentration, agglomeration. Then, in the next step is agglomeration process using two processing routes, either through Blast Furnace - Basic Oxygen Furnace (BF - BOF) or Direct Reduced Iron - Electric Arc Furnace (DRI - EAF). In the two routes the process is also explained about the fundamental theory to better understand the process in the reactor, ranging from thermodynamics, aerodynamics and reaction kinetics. After understanding the iron-making process of the two routes, this course also describes the alternative routes of iron processing. Then, in this course also discussed about the process of general steelmaking (billet, bloom and slab) and special steel, such as stainless steel and alloy steel.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials

technology and manufacturing material product;

3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.4 Knowing principe and latest issue on general overall economic, social, ecology; and

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

7. Specific Skill
   a. Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   b. Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   c. Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   d. Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   e. Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   f. Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOME

1. Student is able to remember the statistics of iron-steel and steel classification and steel development
2. Student is able to remember about all kinds of iron ore and agglomeration process
3. Student is able to understand thermodynamics and kinetics in the process of making iron and steel
4. Student is able to explain the process of making steel on blast furnace (Blast Furnace)
5. Student is able to explain the process of making steel in ladle and BOF (Basic Oxygen Furnace)
6. Student is able to explain the direct reduction process (Direct Reduction Iron)
7. Student is able to explain the making of steel in EAF (Electric Arc Furnace)
8. Student is able to analyze secondary metallurgical processes
9. Student is able to analyze the process of making stainless steels and alloy steel

DISCUSSED TOPICS

1. Iron Industry Statistics - Steel and Steel Classification and Steel Development
2. Iron Ore & Agglomeration Process
3. Thermodynamics and Kinetics in Iron and Steel Making Process
4. Blast Furnace
5. Steel Processing in Ladle and BOF (Basic Oxygen Furnace)
6. Direct Reduction Process (Direct Reduction Iron)
7. Steel Processing in EAF (Electric Arc Furnace)
8. Secondary Metallurgy Process
9. Fabrication Process Stainless steel and alloy steel

PREREQUISITE

Introduction to materials and metallurgy, Chemistry, Materials chemistry, Materials thermodynamics and Transport phenomena Courses

REFFERENCE

Babich dkk, Ironmaking Textbook, Aachen, 2008

SUPPORTING REFERENCE

Allain Vignes, Extractive Metallurgy 1 " Basic Thermodynamics and Kinetics ", Wiley, 2011.
Allain Vignes, Extractive Metallurgy 2 " Metallurgical Reaction Process ", Wiley, 2011.
Allain Vignes, Extractive Metallurgy 3 " Processing Operations and Routes ", Wiley, 2011.

COURSE	**Course Name : Welding Technology +A**
	Course Code : TL184625
	Credit : 3 sks
	Semester : 6

DESCRIPTION OF COURSE

This course teaching students about concept of welding and its classifications. The characteristics of welding heat input and welding process. Concept of heat transfer due to welding, welding metallurgy and its effect on the metal microstructure. Process of welding on ferrous metal, non ferrous and dissimilar metal. Quality of weldments and welding procedures and method of evaluating weldments

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology

development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand the basic principles and characteristics of welding
2. Student is able to analyze the concept of energy in welding
3. Student is able to apply the theory of metallurgy on welding
4. Student is able to design welding process of ferrous and non ferrous metal and dissimilar metal
5. Student is able to evaluate and analyze the quality of welded joints
6. Student is able to design a simple welding process and evaluate the results
7. Student is able to apply safety standards in the welding process

MAIN SUBJECT

1. Classification and Welding Characteristics
2. Concept of Input Heat Concepts on Welding
3. Welding Metallurgy
4. Welding of Ferous and Non Ferrous Materials, and Dissimilar Metal
5. Welding Quality Testing
6. Welding Defects
7. Design of Welding Procedure Spesifications and Procedure Qualification Record

PREREQUISITE

Metallurgy 1 and Manufacturing Process with minimum grade of C

REFERENCE

1. AWS, Welding Handbook, 9th ed, Volume 1, WELDING SCIENCE AND TECHNOLOGY, 9th ed., American Welding Society, Miami Florida

SUPPORTING REFERENCE

1. Lancaster J.F, Metallurgy of Welding, 6th ed, ABINGTON PUBLISHING, Woodhead Publishing Limited in association with The Welding Institute, Cambridge-England
2. Wiryosumarto, Harsono, Teknologi Pengelasan Logam, Jakarta: Pradnya Paramita
3. ASM Metal Handbook Committee, Metal Handbook Vol.6, ASM, Ohio:Metal Park

COURSE	**Course Name : Finite Element Method**
	Course Code : TL184626
	Credit : 3 SKS
	Semester : 6

DESCRIPTION OF COURSE

A numerical approximation technique based upon formulation of finite elements over continuum domain

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

6. Student is able to understand basic concepts of discretization and fem
7. Student is able to implement derivation techniques of stiffness matrices and perform assembly process
8. Student is able to implement methods of weighted residual
9. Student is able to understand and choose interpolation functions and element types in higher dimensional problems
10. Student is able to implement fem techniques for solving problems related to materials and metallurgical engineering

MAIN SUBJECT

7. Overview and basic concepts of fem
8. Derivations of stiffness matrices by direct approach
9. Methods of weighted residual
10. Interpolation functions and element types
11. Numerical solutions of fe equations
12. Applications of fem in heat transfer, composite and fluid mechanics analyses

PREREQUISITES

Numerical analysis and modelling

REFERENCE

5. O.C. Zienkiewicz. The Finite Element Method For Engineer. Mc Graw Hill. 1979
6. Klaus J. Bathe. Finite Element Procedures. Prentice Hall. 1996
7. David V. Hutton. Fundamentals Of Finite Element Analysis. 2004
8. Singiresu S. Rao. The Finite Element Method In Engineering. 2011

SUPPORTING REFERENCE

COURSE	**Course Name : Transport Phenomena**
	Course Code : TL184627
	Credit : 3 SKS
	Semester : 6

DESCRIPTION OF COURSE

The course of Transport Phenomena studies the basic concepts of transport phenomena (heat transfer, mass and momentum) and emphasizes momentum and heat transfer in material and metallurgical applications. In this course we will discuss the basic concepts of fluid, fluid flow, change equations to solve fluid flow problems, heat transfer mechanisms and equations to complete the heat transfer process. In addition, this course also studies mass transfer and analogies of heat transfer, mass and momentum in material and metallurgical applications. In this course will be discussed about diffusion in materials both metal and non-metal, mass transfer in laminair and turbulent flow, as well as the similarities and differences of the three transfer phenomena (momentum, mass and heat).

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalize the spirit of independence, striving, and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the basic concepts of fluid flow, including fluid definition, fluid flow classification, Newton viscosity law, streamline, momentum boundary layer and quantities in other momentum transfer coefficients.
2. Student is able to calculate simple mass balance.
3. Student is able to calculate the momentum balance and use the Navier-Stokes equation to solve the problem of momentum transfer in fluid flow.
4. Student is able to calculate the fluid flow rate changes in the turbulent flow.
5. Student is able to calculate the momentum transfer coefficients for external and internal flow.
6. Student is able to apply the Bernoulli equation for fluid flows.
7. Student is able to calculate heat transfer through conduction, convection and radiation mechanism.
8. Student is able to calculate the thermal property and temperature distribution by conduction rate equations
9. Student is able to calculate the conduction of 1 D steady state and temperature distribution in fluid flow
10. Student is able to calculate the diffusion coefficient in solid, liquid and gas.
11. Student is able to calculate mass transfer using mass transfer balance.
12. Student is able to calculate the diffusion in solid metal and non metal.
13. Student is able to calculate mass transfer in turbulent flow.
14. Student is able to explain the differences and equations of the three transfers

MAIN SUBJECT

1. Introduction Fluid Flow:
   Basic Concepts of Fluid Flow:
   • Definition of fluid
   • Fluid flow classification:
   - Compressible and Incompressible Flow, Introduction of Mach numbers - Laminar, Turbulent, and Transition Flows based on Reynold numbers - Viscous and Inviscid Flows
   - Steady and Unsteady stream
   - 1 phase and multi phase flow
   - External and internal flow
   • Newton's Viscosity Law
   • Streamline
   • Boundary momentum for external and internal flow
   • Coefficient of momentum transfer and other coefficients
2. Mass Balance Equation:
   • Overall Mass Balance and its decrease: the concept of control surface
   • Differential Mass Account and its decrease: the continuity equation
3. Balance of Momentum Equation:
   • Overall Momentum Momentum and its decrease: the concept of control surfaces

- Differential momentum and balance sheets: Navier-Stokes equations, dimensionless forms, boundary conditions
- Differential Balance Momentum Equations in flow and vortex functions and decreases

4. Turbulent Flow:
   - Time-smoothed variables
   - Time-smoothed governing equation
   - Flux momentum turbulent
5. Momentum Transfer Correlations:
   - External flow
   - Internal flow
6. Application of Energy Balance in Fluid Flow (Bernoulli Press):
   - Energy conservation, evaluation of kinetic energy, potential energy, mechanical energy, friction loss in a straight channel.
   - Bernoulli equations
   - Applications of the Bernoulli equation for fluid flows.
7. Introduction Heat Transfer:
   - Heat transfer through conduction mechanism: Fourier's Law
   - Heat transfer through convection mechanism
   - Heat transfer via radiation mechanism
   - Heat conservation
8. Conduction Introduction:
   - Conditional rate of conduction
   - Thermal property of conduction
   - Heat Diffusion Equation
   - Boundary conditions and initial conditions
9. 1-dimensional steady state conduction:
   - Flat Field
   - Radial system: cylinder and ball
   - Conduction with Heat Generation
   - Moving momentum along with heat transfer
10. Mass Transfer: Fick and Diffusivity Laws of Materials:
    - Definition of flux
    - Diffusion in solid
    - Diffusion in solid non-metal
    - Diffusion in liquid
    - Diffusion in gas
    - Diffusion in porous media
11. Mass Transfer Balance Equalization Overall:
    - decrease
    - example

    Distributed Mass Movement Diagram Balance:
    - decrease
    - example
12. Diffusion in Solid:
    - Steady state diffusion
    - Gas permeability through metal and non metal
13. Turbulence:
    - Time-smoothed variables
    - Time-smoothed governing equation
    - Flux mass turbulent
14. Equations and Differences of Tranfer Types:
    - Heat Transfer (Fourier Law)
    - Mass Transfer (Legal Fick)
    - Momentum Transfer (Newton's Law)
    - Form of Analogy
    - Diffusivity of heat, mass

PREREQUISITES

Chemistry and Physics 2 Courses with a minimum grade of C

REFERENCE

1. Kou, S "Transport Phenomena and Materials Processing", 1st edition, John Wiley and Sons, Inc. , 1996

SUPPORTING REFERENCE

1. Robert W. Fox & Alan T Mc Donald, "Introduction to Fluid Mechanics", Fourth Edition, New York: John Wiley & Sons, 1994
2. Bird R.B., Stewart W.E., and Lightfoot, E.N., “Transport Phenomena”, Wiley, New York, 1966
3. Geiger, G.H. and Poirier, D.R., “Transport Phenomena Metallurgy”, Addism Wesley Publishing Company, Reading, Massachussetts.
4. Brodkey, R.S. and Hershey H.C., “Transport Phenomena: A Unified Approach, Mc. Graw Hill Book, Co, Ltd., 1988

VIIth SEMESTER

COURSE	**Course Name : Knowledge and Application of Technology**
	Course Code : UG184916
	Credit : 3 sks
	Semester : 7

DESCRIPTION OF COURSE

The Knowledge and Application Technology courses are used to apply a technology. The Knowledge and Applications Technology studies the science of technology, competitiveness, potential, innovation and copyright. The Knowledge and Applications Technology is used to develop of material and metallurgical technology.

LEARNING OUTCOMES

2. General Skill
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

COURSE LEARNING OUTCOMES

1. Student is able to remember the technology concepts
2. Student is able to understand the sustainable development
3. Student is able to explain the competitive power
4. Student is able to expalin the concept of potential
5. Student is able to apply innovation
6. Student is able to apply creativity
7. Student is able to analyze information and communication technology
8. Student is able to analyze copyright and plagiarisme

MAIN SUBJECT

1. The technology Concepts
2. The Sustainable Development
3. The Competitive Power
4. The Concept of Potensial
5. The Concept of Innovation
6. The Concept of Creativity
7. Information and Communication Technology
8. Copyright and Plagiarisme

PREREQUISITES

There is no prerequisite course

REFERENCE

Technology and Innovation

SUPPORTING REFERENCE

COURSE	**Course Name : Extractive Metallurgy and Refining +P**
	Course code : TL184728
	Credits : 3 sks
	Semester : 7

COURSE CONTENT

This course studies many aspects related to extractive metallurgy and refining process. This includes basic of thermodynamic and kinetics, raw material preparation process starting from comminution, beneficiation until extraction and refining . Minerals discussed in this class include, copper, zinc, lead, tin, aluminum and gold. In addition, this course is also studies about the role of metallurgical engineers in the extractiive metallurgy and refining industry.

LEARNING OUTCOME

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOME

1. Student is able to remember the development of extraction process in Indonesia and the world and review of pre-extract process
2. Student is able to understand the basic principles of metallurgical extraction
3. Student is able to understand the concept and change of thermodynamic quantity; Ellingham Diagram and electrochemical principles
4. Student is able to explain extractive metallurgy of Cu
5. Student is able to explain extractive metallurgy of Pb and Zn
6. Student is able to explain extractive metallurgy of Ni
7. Student is able to explain extractive metallurgy of Al
8. Student is able to explain extractive metallurgy of Au
9. Student is able to analyze seconday extractive metallurgy

DISCUSSED TOPICS

1. Development of extractive metallurgy in Indonesia and the world, The flow of industrial process design as well as the review of pre-extraction process
2. Basic principle of metallurgical extraction
3. Concepts and changes in thermodynamic quantities; Ellingham Diagram and Electrochemical Principles
4. Extractive metallurgy of Cu
5. Extractive metallurgy of Pb and Zn
6. Extractive metallurgy of Ni
7. Extractive metallurgy of Mg
8. Extractive metallurgy of Al
9. Extractive metallurgy of Au
10. Secondary extractive metallurgy processing

PREREQUISITE

Materials thermodynamics, Materials chemistry, Iron and steelmaking and Transport phenomena courses

REFFERENCE

Habashi. Fathi, Handbook of Extractive Metallurgy, Canada, 1997

SUPPORTING REFFERENCE

Allain Vignes, Extractive Metallurgy 1 " Basic Thermodynamics and Kinetics ", Wiley, 2011.
Allain Vignes, Extractive Metallurgy 2 " Metallurgical Reaction Process ", Wiley, 2011.
Allain Vignes, Extractive Metallurgy 3 " Processing Operations and Routes ", Wiley, 2011.

COURSE	**Course Name : Production Management**
	Course Code : TL184729
	Credit : 4 sks
	Semester : 7

DESCRIPTION OF COURSE

The course of Production Management is a course that knowledge of optimization concepts that can be applied to industrial systems. Provide students with the ability of management, production systems, production planning and control, and be able to integrate various activities and processes to produce products and services that are of competitive value. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Students are able to identify and explain Productivity, decision making
2. Students are able to identify and explain the process structure in manufacturing and automation processes
3. Students are able to identify and explain Pareto chart, cause-effect diagram
4. Students are able to identify and explain Total Quality Management
5. Students are able to identify and explain linear program, transportation method
6. Students are able to identify and explain E-commerce and enterprise resource planning
7. Students are able to calculate with Forecasting models
8. Students are able to calculate with inventory models
9. Students are able to analyze by schedulling method
10. Students are able to analyze time value of money
11. Students are able to analyze Benefit cost and ratio
12. Students are able to analyze Breakeven analysis

MAIN SUBJECT

1. Productivity, decision making
2. Process structure in manufacture and otamation process
3. Pareto chart,
4. Total Quality Management
5. Linear Program, Transportation methods
6. E-commerce and enterprise resource planning
7. Forecasting model
8. Inventory model
9. Schedulling
10. Time value of money
11. Benefit and cost ratio
12. Breakeven analysis

PREREQUISITES

Engineering mechanics-statics and manufacture process courses

REFERENCE

Lee J. Krajewski, Larry P Ritzman, Operation Management: Process and Value Chains, 7rd Ed, New Jersey: Pearson Education, Inc., 2005.

SUPPORTING REFERENCE

1. Subir Chowdhury, Jay A. Conger, Edgar H. Shein, et.al., Organization 21C, Pearson Education, 2003
2. Hamdy A. Taha, Operation Research: An Introduction, 7rd Ed. New Jersey: Pearson Education, Inc., 2003

COURSE	**Course Name : Composite Materials *enrichment service**
	Course Code : TL184730*
	Credit : 3 sks
	Semester : 7

DESCRIPTION OF COURSE

In meeting the needs of technology and material innovation, composite material is one of the materials that are widely applied in various products in the material world. Thus, this subject will discuss about the basic concepts of composites, composite base material, composite making process, design and analyze failure and composite strength. It is expected that at the end of the lecture students are able to understand the concept of composite behavior and its application and able to design the composite material project for certain application. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to show application of composite materials
2. Student is able to show the classification of composite materials
3. Student is able to show components of composite materials
4. Student is able to compare and explain the process of making composite materials
5. Student is able to analyze and explain the influence of interfaces of composite materials
6. Student is able to analyze and predict micromechanical composite materials
7. Student is able to analyze failure on composite materials

MAIN SUBJECT

1. Introduction and overview of composite application
2. Classification of Composite Materials
3. Component of Composite Materials
4. Manufacture of Composite Materials
5. Interface of Composite Materials
6. Micromechanic of composite
7. Failure of Composite Materials

PREREQUISITES

There is no prerequisite course

REFERENCE

5. William D Callister “An introduction: Material science and Engineering. 8th edition”USA: John Wiley and Sons, Inc. 2007

SUPPORTING REFERENCE

1. Krishan K. Chawla, Composite Materials Science and Engineering, Springer-Verlag, New York, 1987.
2. Derek Hull, An Introduction to Composite Materials, Cambridge University Press, Cambridge, 1990
3. T J Pinnavaia, G W Beall, Polymer-Clay Nanocomposites, John Wiley & Sons, Chichester, 2000
4. L H Sperling, Polymeric Multicomponent Material An Introduction, John Wiley & Sons, New York, 1997

COURSE	**Course Name : Internship**
	Course Code : TL184731
	Credit : 2 sks
	Semester : 7

DESCRIPTION OF COURSE

Job Training Courses are used to determine materials and metallurgy in the industry. The course learn about the application of materials science and metallurgy. The course is used to manipulate and develop the application of materials and metallurgy.

LEARNING OUTCOMES

6. General Skill
   a. Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;

COURSE LEARNING OUTCOMES

1. Student is able to understand the Introduction of the problem
2. Student is able to explain the literature review
3. Student is able to apply Data collection
4. Student is able to apply Data processing
5. Student is able to analyze the Report of practical work

MAIN SUBJECT

1. Intoduction of Problem
2. The Literature Review
3. Data Collection
4. Data Processing
5. The Report of Practical Work

PREREQUISITES

There is no prerequisite course

REFERENCE

Sciencetific journals

SUPPORTING REFERENCE

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COURSE	**Course Name : Non Destructive and Risk Based Inspection**
	Course Code : TL184732
	Credit : 3 sks
	Semester : 7

DESCRIPTION OF COURSE

Non-Destructive and Risk-Based Inspection Courses are used to check the condition of component materials. Non-Destructive and Risk-Based Inspection studies the examination and testing of component material conditions. Non-Destructive and Risk-Based Inspections are used to manipulate and develop materials and metallurgy.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand Basic Concept of Inspection
2. Student is able to understand Basic Concept of Testing without Destructive
3. Student is able to explain Visual Testing
4. Student is able to explain about Penetran Testing
5. Student is able to apply Magnetic Testing
6. Student is able to apply Radiography Testing
7. Student is able to apply Ultrasonic Testing
8. Student is able to apply Eddy Current Testing
9. Student is able to apply the International Code of Examination Without Destructive
10. Student is able to analyze The Basic Concept of Risk-Based Inspection
11. Student is able to analyze The Risk
12. Student is able to analyze Possibility of Failure
13. Student is able to analyze Consequences of Failure

MAIN SUBJECT

1. Basic Concept of Inspection
2. Basic Concept of Testing without Destructive
3. Visual Testing
4. Penetran Testing
5. Magnetic Testing
6. Radiography Testing
7. Ultrasonic Testing
8. Eddy Current Testing
9. The International Code of Examination Without Destructive
10. The Basic Concept of Risk-Based Inspection
11. The Risk
12. Possibility of Failure
13. Consequences of Failure

PREREQUISITES

Chemistry, Physics, Mathematics, Metallurgy 1, Metallugy 2 and Material Characterization Courses

REFERENCE

ASM, Non Destructive Evaluation
ASME, Non Destructive Examination
AWS, Non Destructive Testing
ASNT, Non Destructive Testing

SUPPORTING REFERENCE

COURSE	**Course name : Industrial Process Design + A**
	Course code : TL184833
	Credit : 3 sks
	Semester : 8

COURSE DESCRIPTION

This course studies important aspects related to industrial process design especially preliminary stage design of an industry. This includes the determination of design concepts, design basis determination, the creation of possible design concepts, compatibility testing, economic evaluation, optimization and selection, design of block diagrams, manufacturing process flow diagram, industrial layout, industrial organization, detailed design and selection of equipment, procurement, construction and operation. The students are thus expected to be able to apply industrial process design concepts in industrial design in the field of materials engineering and metallurgy. To achieve these objectives, the learning strategies are classroom lectures, group assignments and final report presentations.

LEARNING OUTCOME

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.4. Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5. Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOME

1. Student is able to remember the introduction of industrial process design and its application in the field of materials and metallurgy
2. Student is able to understand the process design flow of the industry
3. Student is able to understand the background of determining industrial development
4. Student is able to create Block Diagram
5. Student is able to calculate mass and energy balance in industrial process design
6. Student is able to make Process Flow Diagram (PFD)
7. Student is able to determine supporting equipment in the process industry
8. Student is able to determine the specification of the equipment quantitatively
9. Student is able to analyze the utilities of process industries
10. Student is able to analyze the SHE in industry
11. Student is able to analyze the economics of the process industry

MAIN SUBJECTS

1. Introduction to industrial process design and its application in the field of Materials and Metallurgy
2. The flow of industrial design process
3. The background of determining industrial development
4. Block Diagram
5. The use of mass and energy balance in industrial process design
6. Process Flow Diagram (PFD)
7. Determination of supporting equipment
8. Determination of device specifications quantitatively
9. Utilities in industrial processes
10. SHE industry process
11. Economic analysis in process industry

PREREQUISITES
Iron and steelmaking, Production management (already completed or still in progress), Extractive metallurgy and refining (already completed or still in progress)
REFFERENCE
1. Gavin Towler, Ray Sinnott, Chemical Engineering Design-Principles, Practice and Economics of Plant and Process Design 2nd Ed, El Sevier, 2013
SUPPORTING REFFERENCE
1. Sean Moran, An Applied Guide to Process and Plant Design, El Sevier, 2015 (Pustaka Utama) 2. William D. Baasel, Preliminary Chemical Engineering Plant Design, El Sevier, 1974 3. Nayef Ghasem, Principles of Chemical Engineering Processes-Material and Energy Balances 2nd edition, CRC Press, 2015 4. Max S. Peters, Plant Design and Economics for Chemical Engineers 4th ed, McGraw-Hill, 1991

COURSE	**Course Name : Final Project**
	Course Code : TL184834
	Credit : 6 sks
	Semester : 8

COURSE DESCRIPTION

The final project course is used to study and analyze the properties and technologies of materials and metallurgy. The final project course studies materials and metallurgy. Final Project in the form of research activities, hypothesis observation and design. Final Project is used to engineer and develop materials and metallurgy.

LEARNING OUTCOME

3. Attitudes
   1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;

4. General Skill
   2.1. Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   2.2. Being able to demonstrate independent performance, quality, and measurable;

COURSE LEARNING OUTCOME

6. Student is able to understand the Introduction of the problem
7. Student is able to explain the literature review
8. Student is able to apply the Methodology
9. Student is able to apply the Final Proposal
10. Student is able to analyze Final Report

MAIN SUBJECTS

6. Introduction of problems
7. Literature review
8. Methodology
9. Final project proposal
10. Final report

PREREQUISITES

There is no prerequisite course

REFERENCE

4. Rules of preparation of the final project of Institut Teknologi Sepuluh Nopember
5. Research methodology
6. Research procedure

SUPPORTING REFERENCE

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COURSE	**Course Name : Elective 3 enrichment**
	Course Code : TL184835
	Credit : 3 sks
	Semester : 8

COURSE DESCRIPTION

This course is used to study science and technology. This course learns the science of engineering from diverse disciplines and increases the wealth of knowledge. This course is used to enrich engineering and material and metallurgical development.

LEARNING OUTCOME

2. General Skills
   - 2.1. Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2. Being able to demonstrate independent performance, quality, and measurable;
   - 2.5. Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.8. Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9. Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10. Being able to develop themselves and compete in national and international level;
   - 2.11. Being able to implement sustainability principles and develop knowledge;

COURSE LEARNING OUTCOME

4. Student is able to explain the basic concept of engineering science
5. Student is able to apply the structure of science
6. Student is able to analyze the mechanism of science

MAIN SUBJECTS

4. The concept of engineering science
5. The structure of science
6. The mechanism of science

PREREQUISITES

There is no prerequisite course

REFERENCE

Engineering sciences

SUPPORTING REFERENCE

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COURSE	**Course Name : Elective 1**
	Course Code : TL18483X
	Credit : 3 sks
	Semester : 8

COURSE DESCRIPTION

This course is used to study science and technology of specific materials and metallurgy. Elective 1 is used to study science and technology of specific materials and metallurgy on the elective courses. Elective 1 is used to engineer and develop specific materials and metallurgy.

LEARNING OUTCOME

1. Attitude
2. General Skills
3. Knowledge
4. Specific Skills

COURSE LEARNING OUTCOME

1. Student is able to explain the basic concept engineering of specific material and metallurgy
2. Student is able to apply the structure engineering of specific material and metallurgy
3. Student is able to analyze the mechanism engineering of specific material and metallurgy

MAIN SUBJECTS

1. The basic concept engineering of specific material and metallurgy science
2. The structure engineering of specific material and metallurgy
3. The mechanism engineering of specific material and metallurgy

PREREQUISITES

There is no prerequisite course

REFERENCE

Engineering of specific material and metallurgy

SUPPORTING REFERENCE

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COURSE	**Course Name : Elective 2**
	Course Code : TL18483X
	Credit : 3 sks
	Semester : 8

COURSE DESCRIPTION

This course is used to study science and technology of specific materials and metallurgy. Elective 2 is used to study science and technology of specific materials and metallurgy on the elective courses. Elective 2 is used to engineer and develop specific materials and metallurgy.

LEARNING OUTCOME

1. Attitude
2. General Skills
3. Knowledge
4. Specific Skills

COURSE LEARNING OUTCOME

1. Student is able to explain the basic concept engineering of specific material and metallurgy
2. Student is able to apply the structure engineering of specific material and metallurgy
3. Student is able to analyze the mechanism engineering of specific material and metallurgy

MAIN SUBJECTS

1. The basic concept engineering of specific material and metallurgy science
2. The structure engineering of specific material and metallurgy
3. The mechanism engineering of specific material and metallurgy

PREREQUISITES

There is no prerequisite course

REFERENCE

Engineering of specific material and metallurgy

SUPPORTING REFERENCE

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COURSE	**Course Name : Advanced Strength of Materials**
	Course Code : TL184836
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Study of strength of materials in relation with deformation, strain and stress experienced by a material or body of structure/component due to external forces, temperature, or other internal/external excitations according to certain strength criteria

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.7 Law abiding and disciplined in community and state life;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;

3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific skill
4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand basic concepts of stress at a point
2. Student is able to implement 3D stress transformation
3. Student is able to compute deviatoric stress components and implement failure theories
4. Student is able to compute or measure strain and implement strain transformation
5. Student is able to understand and implement experimental stress analysis
6. Student is able to understand and implement residual stress and it's measurement techniques

MAIN SUBJECT

1. Concept of stress at a point
2. 3D stress transformation
3. Deviatoric stress components and failure theories
4. Strain and strain transformation
5. Experimental stress analysis
6. Residual stress and it's measurement techniques

PREREQUISITES

Engineering mechanics and machine design Courses

REFERENCE

1. Bickford, W.B., Advanced Mechanics Of Materials, Addison-Wesley, 1998.
2. Boresi, A.P. And Chong, K.P., Elasticity In Engineering Mechanics, 1987.
3. Budynas, R.G., Advanced Strength And Applied Stress Analysis, 2nd Edition, Mcgraw-Hill, 1999.
4. Cook, R.D., Advanced Mechanics Of Materials, Macmillan, 1985.
5. Fertis, D.G., Advanced Mechanics Of Structures, Marcel Dekker, 1996.
6. Popov, E.P., Engineering Mechanics Of Solids, Prentice Hall 1990.
7. Timoshenko, S.P., History Of Strength Of Materials, Mcgraw-Hill, 1953.
8. Timoshenko, S.P., Theory Of Elasticity, Mcgraw-Hill, 1951.
9. Ugural, A.C. And S.K. Fenster, Advanced Strength And Applied Elasticity, 3rd Edition, Prentice Hall, 1995

SUPPORTING REFERENCE

COURSE	**Course Name : Computational Fluid Dynamics**
	Course Code : TL184837
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Computational Fluid Dynamics has become an indispensable tool for engineers. CFD simulations can provide an overview of the details of the phenomena of a process, and allow new products / processes to be evaluated on the computer even before prototypes are made. Therefore this course is taught to to solve more complex problems involving modeling turbulence, mixing, combustion reactions and multiphase flow. It is expected that students are able to apply CFD concepts in industrial design in material and metallurgical engineering. To achieve these objectives, the learning strategies are classroom lectures, group assignments and large task presentations.

LEARNING OUTCOMES

1.Attitude

1.1 Believing in the oneness of God and able to demonstrate religious attitude;
1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
1.6 Working together, having social sensitivity and caring for community and environment;
1.7 Law abiding and disciplined in community and state life;
1.8 Internalizing values, norms and academic ethics;
1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
1.10 Internalizing spirit of independence, struggle and entrepreneurship;
1.11 Trying his/her best to achieve perfect results, and
1.12 Working together to be able to make the most of his/her potential.

2.General skill

2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
2.2 Being able to demonstrate independent performance, quality, and measurable;
2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
2.10 Being able to develop themselves and compete in national and international level;
2.11 Being able to implement sustainability principles and develop knowledge: and
2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3.Knowledge

3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4.Specific skill
4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to remember the introduction of CFD and its application in the field of materials and metallurgy
2. Student is able to understand the similarities of CFDs such as continuity, momentum, energy and species
3. Student is able to understand choosing a suitable method for CFD simulation
4. Student is able to model turbulent flow with several models of turbulence
5. Student is able to describe the physical phenomena of turbulence stirring that is influenced by chemical reactions
6. Student is able to model the multiphase flow
7. Student is able to implement CFD techniques to solve fluid flow problems for two / three dimensions

MAIN SUBJECT

1. Introduction of Fluid Dynamics Computing (CFD) and its Application in the field of Materials and Metallurgy
2. Modeling
3. Numerical aspects of CFDs
4. Turbulent-flow modeling
5. Turbulent mixing and chemical reactions
6. Multiphase flow modeling
7. Best-practice guidelines

PREREQUISITES

Numerical Analysis and Modelling and Transport Phenomena Courses

REFERENCE

1. Computational Fluid Dynamics for Engineers, by BENGT ANDERSSON Chalmers University, Sweden, RONNIE ANDERSSON Chalmers University, Sweden LOVE H, AKANSSON Engineering Data Resources – EDR, Norway MIKAEL MORTENSEN Norwegian Defence Research Establishment, Norway RAHMAN SUDIYO, University of Gadjah Mada, Indonesia, BEREND VAN WACHEM, Imperial College London, University. 2012

2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, by H. Versteeg , W. Malalasekera. 1995

SUPPORTING REFERENCE

1. Computational Methods for Fluid Dynamics 3rd Edition, by Joel H. Ferziger, Milovan Peric.
2. Introduction to Simulation with ANSYS Mechanical APDL, 2016, by Hussien M. Al-Khafaji, Al-Khafaji Ali J. Dawood.

COURSE	**Course Name : Wood Composites**
	Course Code : TL184838
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

This course provides students with understanding of the principles of mechanics based on rigid body mechanics and composite materials. The content of knowledge are about the strength of the material especially relating to non-isotropic and non-homogeneous wood materials. Furthermore it also provides a basic knowledge of how to determine the mechanical properties and characteristics of wooden beam structures, laminated wood, and wood-based composite materials

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to identify the characteristics of wood and it's composite
2. Student is able to analyze the mechanical properties and rheological properties of wood-based composite materials
3. Student is able to analyze failure on wood composite.
4. Student is able to apply analysis and design, and to evaluate the strength of wood-based composite material
5. Student is able to design innovative materials based on wood waste including WPC (Wood Polymer Composite)

MAIN SUBJECT

1. Wood Composite Characteristics (Wood as a Renewable Material, Wood Chemical Composition, Cell Wall Organization, Wood Cellular Structure, Wood Composite, Specific Gravity and Moisture Content)
2. Stress, Strain, and Transformation
3. Orthrotopic Elasticity
4. Application of Elasticity Theory in Simple System
5. Rheological Characteristics
6. Failure analysis
7. Lamination System
8. Material organitiation

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Bodig, J., Jayne A., B., Mechanics of Wood and Wood Composites, Van Nostrand Reinhold Company, New York, 1992

SUPPORTING REFERENCE

1. Gibson, R., Cellular Solid, John Wiley & Sons, New York, 1989
2. Wagner, B., Wood Structure, Spring-Verlag, 1999
3. Kollmann, F.P., Kuenzi, E.W., Stamm, A.J., Principles of Wood Science and Technology, Spring-Verlag, 1975

COURSE	**Course Name : Biomaterials**
	Course Code : TL184839
	Credit : 3 sks
	Semester :8

DESCRIPTION OF COURSE

Knowledge of Biomaterials for Biomedial Applications are important to assist in the selection of potential materials for medical applications. This biomaterial course studies a wide range of materials (metals, polymers, bioglass, bioceramics, biocomposites, degradable) that have potential for biomedical applications, charaterization and testing methods (in-vivo and in-vitro), tissue response due to implantation, tribology biomaterials, tissue engineering, scaffolding materials and manufacturing techniques, as well as the application and techniques of manufacturing for medical Materials. At the end of this course, students will be able to explain and analyze basic material selection for medical applications, characterization and testing methods performed, post-implantation reaction process, tribology role and various application of biomaterials. In order to achieve these targets, several learning strategies are implemented such as face-to-face lecture, assignment, industry visit, guest lecture, and idea design on "development of biomedical devices".

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology

development.

4. Specific skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand and explain the classification of biomaterials
2. Student is ble to understand and explain again about the concept of cells, tissues and organ systems
3. Student is able to show the relationship between network response due to implantation process
4. Student is able to demonstrate and classify biocompatibility levels as well as biocompatibility testing techniques
5. Student is able to show the influence of tribology biomaterials
6. Student is able to show the type of scaffold material and network technique
7. Student is able to analyse material selection for certain medical applications as well as compare several types of material manufacturing process and medical equipment

MAIN SUBJECT

1. Overview Biomaterials Classification
2. Cell, Tissue, and System organ
3. Tissues response to implant
4. Biocompatibility and Its Characterization Method
5. Tribology of Biomaterials (Surface engineering, friction and shear)
6. Scaffold and Tissue Engineering
7. Application and Manufacture of Biomaterials and Medical devices

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Joon B. Park, Joseph D. Bronzino, Biomaterials Principles and Applications", CRC Press,2003.
2. Joon Park, "Biomaterials An introduction", springer, 2007.
3. Robert Lanza "Principles of Tissue Engineering" Academic Press, 2007

SUPPORTING REFERENCE

1. Glen S. Kwon, "Polymetric Drg Delivery Systems", Taylor and Fraciss, 2005.
2. Kay C. Dee, David A. Puleo. Rena Bizios," Tissue-Biomaterial Interactions", Wiley-Liss, 2002.
3. J Paulo Davim,"Biomaterials and Medical Tribology" Woodhead publishing, 2013

COURSE	**Course Name : Electronic Materials**
	Course Code : TL184840
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

This course deals with electrical properties of material, material classification based on electrical properties including conductor, semiconductor, and insulator materials, and the application of material for electronic device.

LEARNING OUTCOMES

1. Attitude
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

Student is able to understand the electrical properties of materials, material classification based on electrical properties and the application of materials for electronic device.

MAIN SUBJECT

1. Introduction to Electronic Materials
2. Electrical Conduction
3. Conductor Material
4. Semiconductor Material
5. Insulator Material
6. Electronic Material Applications

PREREQUISITES

Basic Chemistry, Materials Chemistry, Basic Physics 1, Basic Physics 2, and Materials Characterization Courses

MAIN REFERENCE

1. Callister Jr, W. D., & Rethwisch, D. G. (2012). Fundamentals of materials science and engineering: an integrated approach. John Wiley & Sons.
2. Kasap, S. O. (2006). Principles of electronic materials and devices (Vol. 2). New York: McGraw-Hill.

SUPPORTING REFERENCE

COURSE	Course Name : Convertion and Energy Storage Material
	Course Code : TL184841
	Credit : 3 sks
	Semester : 8

COURSE DESCRIPTION

The energy crisis due to the increasing scarcity of petroleum fuels requires an alternative source of energy. Energy conversion materials are one of the alternative energy generators that use electrochemical principles that convert chemical processes into electrical energy. In addition it is also necessary material that is storing energy as a place to store energy reserves produced by energy conversion materials. So this course provides an understanding of the background, fundamental science and analysis of energy materials based on electrochemical processes as materials for energy conversion and energy storage. It is expected that at the end of the lecture students are able to understand the electrochemical concept to synthesize the right materials used in energy conversion and energy storage applications. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOME

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.4. Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

COURSE LEARNING OUTCOME

5. Student is able to explain the basic principles of energy conversion process through photosynthesis process and how its application in solar cell

6. Student is able to explain the various types of solar cells and mechanisms of how they work, describe the materials used and the morphological changes
7. Student is able to perform measurements and calculate the efficiency of different types of solar cells
8. Student is able to explain the electrochemical process as the basis for materials for batteries, capacitor and fuel cell applications
9. Student is able to explain the difference of function and application of baterei, superkapasitor and fuel cell, chemical process in material during energy conversion process
10. Student is able to provide solutions and report on problems related to the process of energy conversion and energy storage for solar cell materials, batteries, super-capacitors and fuel cells
11. Student is able to express ideas and ideas related to basic concepts of material physics both orally and in writing
12. Student is able to have good moral and good responsibility in completing their tasks

MAIN SUBJECT

5. Basic concept of solar energy conversion process into electrical energy
6. Basic concept of calculating efficiency of solar cell
7. Classification of solar cell technology, dye sensitized solar cell, organic material solar cell, charge separation and transport
8. Electrochemical process on various types of battery, material for battery and super capacitor
9. Characterization and chemical reaction on fuel cell, safety and reliability of battery and fuel cell

PREREQUISITES

Electrochemistry course with minimum grade of D

MAIN REFFERENCES

David S. Ginley, David Cahen,'Fundamentals of Materials for Energy and Environmental Sustainability
Allen J. Bard, Larry R. Faulkner, Electrochemical Methods: Fundamentals and Applications. Augustin McEvoy, L. Casyaner, Tom Markvart,'Solar Cells, Second Edition: Materials, Manufacture and Operation
Augustin McEvoy, L. Casyaner, Tom Markvart,'Solar Cells, Second Edition: Materials, Manufacture and Operation
Linden's Handbook of Batteries, 4th Edition, James Larminie, Andrew Dicks, Fuel Cell Systems Explained (Second Edition). Materials for Electrochemical Energy Storage and Conversion II-Batteries, Capacitors and Fuel Cells: Volume 496 (MRS Proceedings)

SUPPORTING REFFERENCE

Journals

COURSE	**Course Name**	**:Mechanical Behavior of Engineering Materials**
	Course Code	: TL184842
	Credit	: 3 sks
	Semester	: 8

DESCRIPTION OF COURSE

Selection of materials for various applications requires the analysis of appropriate mechanical properties of the application. To obtain mechanical properties, it takes knowledge of mechanical properties and mechanical testing so that it can be analyzed the properties of the material. This material mechanical behavior course will discuss material on the mechanical properties of the material and its testing methods, to understand the behavior of the mechanical properties of various materials and to analyze the causes of material failure. It is expected that at the end of the lecture students are able to understand the properties and mechanical testing of various materials and their behavior, so that they are able to select material suitable with the required application and minimize the failure of the product. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General skills
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill

4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

COURSE LEARNING OUTCOMES

1. Student is able to understand and explain the material classification
2. Student is able to calculate and analyze the mechanical properties of the test results
3. Student is able to calculate and analyze the mechanics of material failure
4. Student is able to analyze the mechanical behavior of some engineering materials

MAIN SUBJECT

1. Materials Classification, Types of materials (metal, ferrousmetal, non ferrous metal, ceramics, polymer, composite) and its applications
2. Mechanical properties and Testing : Tensile test, compresive test, bending test, hardness test
3. Materials failure (Fracture, fatigue, creep)
4. Mechanical properties of some materials: Mechanical behavior of polymer, ceramics and composites

PREREQUISITES

There is no prerequisite course

REFERENCE

4. Thomas H. Courtney “Mechanical behavior of materials” Singapore: McGraw-Hill Publishing Company. 1990
5. William D Callister “An introduction: Material science and Engineering. 8th edition”USA: John Wiley and Sons, Inc. 2007

SUPPORTING REFERENCE

1. Norman E Dowling “Mechanical Behavior of Materials”

COURSE	**Course Name : Magnetic Materials**
	Course Code : TL184843
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Magnetic materials has a very wide application for example superconductor for maglev train applications. Topics covered in magnetic courses include Development of Magnetic Properties and Materials, Application Development. Magnetic Dimension, Magnetic Field, Magnetic Moment and Magnetization, Quantum Theory of Magnetic Properties, Magnetic Electronic Moment, Magnetic Properties, Magnetic Domain, Curve of Hysteresis, Magnetism Measurement Method, Magnetism Measure (VSM, Squid), Magnetic Material, and Superconductivity. It is expected that at the end of the lecture students are able to understand the properties and applications of magnetic materials so that they can be used for further application of magnetic material. To achieve these objectives then the learning method used, among others, with class lectures, practicum and providing independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;

3.Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;

4.Specific skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

COURSE LEARNING OUTCOMES

1. Student is able to understand, explain, analyze and solve problems related to the basic concept of magnetism
2. Student is able to understand, explain, analyze and solve problems related to magnetism
3. Student is able to understand, explain, analyze and solve problems related to magnetic domains
4. Student is able to understand, explain, analyze and solve problems related to the hysteresis curve and measurement of magnetic properties
5. Student is able to understand, explain, analyze and solve problems related to magnetic material
6. Student is able to understand, explain, analyze and solve problems related to superconductivity
7. Students is able to understand, explain, analyze and solve problems related to the application of magnetic properties and materials

MAIN SUBJECT

1. Introduction
2. The basic concept of magnetism
3. The properties of magnetism
4. Magnetic domain
5. Hysteresis curve and magnetic properties measurement
6. Magnetic materials
7. Superconductivity
8. Application of magnetic properties and materials

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Spaldin, Nicola A.A.2013.Magnetic Materials Fundamental and Application,Second Ed.Cambridge : Cambridge Unversity Press
2. Jiles, David.1989. Introduction to Magnetism and Magnetic Materials . London.Chapman and Hall
3. Cullity, B.D, Graham C.D.2009. Introduction To Magnetic Materials. Piscataway : IEEE Press
4. Charles Kittel, 2004, "Introduction to Solid State Physics" 8 edition, Wiley WD Callister . 2012. Introduction of Material Science & Engineering. John Wiley and Son

SUPPORTING REFERENCE

COURSE	**Course Name : Optic Materials**
	Course Code : TL184844
	Credit : 3 sks
	Semester : 8

COURSE DESCRIPTION

Fiber optics is one of the optical materials underlying the development of the internet today. So an understanding of the mechanism of optical properties in materials is needed.
This course covers the basic concepts of optical phenomena in the form of waves, Interaction of light with materials, optical materials and colors, lasers and optical fibers as well as optical properties test equipment Materials and test equipment using optical properties.
It is expected that at the end of the lecture students are able to understand the properties and applications of optical materials so that they can be used for further application of optical materials.
To achieve these objectives then the learning method used, among others, with class lectures, practicum and providing independent tasks.

LEARNING OUTCOME

1. Attitude
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;

3 .Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;

4. Specific skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

COARSE LEARNING OUTCOME

7. Student is able to explain concept of wave
8. Student is able to explain concept of atomic-electron interaction and polarization electronic concept of light (Newton & Huygens), Light quantum theory
9. Student is able to explain concept of interaction between light and material
10. Student is able to explain optical material and colour
11. Student is able to explain concept of laser and fiber optic
12. Student is able to explain testing method optical properties of material and testing apparatus using optical properties

POKOK BAHASAN

1. Basic concept optical phenomena
    a. Wave (wave, wave, amplitude, frequency, period, wave type (transverse and longitudinal), wave velocity, intensity) Electromagnetic Waves, Atomic-Electronic Interactions and Electronic Polarization Light Concepts (Newton & Huygens), Light Quantum Theory (Dualism Waves Particle, Compton Effect, Electric Photo Effect, Photoconductivity and Photoelasticity)
2. Light interaction with material
    a. Reflection, Refraction and Dispersion, Absorption, Transmission, Interference, Diffraction
3. Optical and Color Materials
    a. Optical Properties In Metals, Optical Properties In Non-Metals, Opacity & Translusen on Insulator Materials Luminescence, Absorbance, Phosphorency and Fluorency
4. Laser and Optical Fiber
    a. Laser, Laser and Its Properties, Laser Basic Principles (Threshold), Laser Pumping, Types, Materials and Laser-making Processes Definition, Types and Principles of Optical Fiber Work, Optical Fiber Making Materials and Processes, Current Optical Material Research
5. Test Equipment of Optical Properties of Materials and Test Equipments using Optical Properties

a. Spectrometer, Optical Microscope, Photoelasticity, VNA (Vector Network Analyzer)

6. Optical Materials Manufacturing Process
7. Latest Technology in Optical material field

PREREQUISITES

There is no prerequisite course

REFFERENCE

Wooten, F., Optical Properties of Solids, Academic Press, New York, 1972.

SUPPORTING REFERENCE

4. Amon Yariv, "Optical Electronics in Modern Communications",
5. W. Greiner, “Quantum Mechanics: An introduction”
6. Charles Kittel, "Introduction to Solid State Physics"

COURSE	**Course Name : Refractory Materials**
	Course Code : TL184845
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Refractory materials is one type of material that can survive at high temperatures. This material is required for application on the structure or as a component on the system that must be exposed to temperatures above 5380C. Usually used as a lining for wall furnace, kiln, incinerator and reactor. So in this Course will discuss the material about the manufacture of refractory brick and the installation of smelting furnace, phase diagram of phase equilibrium slag and refractory brick. It is expected that at the end of the lecture students are able to understand the characteristics of various refractories, able to design and choose refractory that suits the working conditions of the melting kitchen. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.11 Trying his/her best to achieve perfect results, and

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand, explain, and solve problems related to the classification of refractory materials based on chemical composition

2. Student is able to understand, explain, and solve problems related to the classification of refractory materials based on manufacturing methods
3. Student is able to understand, explain, and solve problems related to the classification of refractory materials based on fusion temperature
4. Student is able to understand, explain, and solve problems related to insulation refractories
5. Student is able to understand, explain, and solve problems related to the selection of refractories
6. Student is able to understand, explain, and solve problems related to refractory manufacturing process
7. Student is able to understand, explain, and solve problems related to energy conservation and heat loss
8. Student is able to understand, explain, and solve problems related to the application of steel industry refractories

MAIN SUBJECT

1. Introduction
2. Classification of refractory materials based on chemical composition
3. Classification of refractory materials based on manufacturing methods
4. Classification of refractory materials based on fusion temperature
5. Insulation refractories
6. Selection of refractories
7. Refractory manufacturing process
8. Energy conservation and heat loss
9. Application of refractory materials in steel industry

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Spaldin, Nicola A.A.2013.Magnetic Materials Fundamental and Application,Second Ed.Cambridge : Cambridge Unversity Press
2. Jiles, David.1989. Introduction to Magnetism and Magnetic Materials . London.Chapman and Hall
3. Cullity, B.D, Graham C.D.2009. Introduction To Magnetic Materials. Piscataway : IEEE Press
4. Charles Kittel, 2004, "Introduction to Solid State Physics" 8 edition, Wiley WD Callister . 2012. Introduction of Material Science & Engineering. John Wiley and Son

SUPPORTING REFERENCE

COURSE	**Course Name : Engineering Economy**
	Course Code : TL184846
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

The course teach about the time value of money for economic considerations regarding investments, asset utilization, income, taxation, depreciation analysis, in order to achieve the maximum benefit.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4. Knowing principle and latest issue on general overall economic, social, ecology; and
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to apply the concept of Time Value of Money
2. Student is able to perform capital analysis using time value of money
3. Student is able to analyze economic considerations in technical decision making
4. Student is able to plan an investment based on Rate of Return consideration
5. Student is able to understand concept of taxes and calculate investments that affected by taxes and depreciation
6. Student is able to understand the concept of breakeven point and able to analyse the investment age to break even

MAIN SUBJECT

1. Time Value of Money
2. Concept of Capital And Breakeven Point
3. Concept of Maintenance and Replacement Analysis of Assets
4. Tax and After Tax Analysis

PREREQUISITES

There is no prerequisite course

REFERENCES

1. Leland Blank , P. E., Anthony Tarquin , P. E., ENGINEERING ECONOMY 7th edition, McGraw-Hill Companies, Inc., New York, NY 10020
2. Collier, Courtland A. And william B. Ledbetter, Engineering Cost Analysis, New York: Harper & Row Publishers, 1982
3. Grant, Eugene L.at. Al., Principles of Engineering Economy, New York: John Wiley & Sons,1976
4. Ostwald Philip F, Cost Estimating for Engineering and Management, Englewood Cliffs, N.J. Prentice-Hall, Inc, 1974

SUPPORTING REFERENCE

COURSE	**Course Name : Mechanics of Composites**
	Course Code : TL184847
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Composite as a material consisting of two or more components which has different properties or structures with homogeneous structure and heterogeneously structure. The mixed material will produce a new material that has the superior properties of the constituent material. by combining two or more different materials, one can select and develop the mechanical and physical properties of the materials.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the c ontext of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the definition and process of composite mechanics
2. Student is able to explain the process of micro-mechanics of the lamina
3. Student is able to explain the short-fiber composite process
4. Students is able to explain the process of laminated macro-mechanics
5. Student is able to explain the process of laminate mechanics

MAIN SUBJECT

1. Introduction of Composite Materials
2. Mechanica-micro Lamina
3. The short-fiber composite process
4. Lamina Power
5. The process of laminated macro-mechanics
2. The process of laminate mechanics

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Prof. Dr. Ir. Sulistijono, Mekanika Material Komposit

SUPPORTING REFERENCE

1. Jones, Mechanics of composite materials
2. Gibson R.F, Principle of Composite Material Mechanics

COURSE	**Course Name : Manufacturing Metallurgy**
	Course Code : TL184848
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

To give understanding about basic design and concrete reinforcement structure. Understand metallurgical transformation occurs on manufacture process and able to design manufacture process base on metallurgical constrain

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4. Knowing principle and latest issue on general overall economic, social, ecology; and
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and

public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOME

1. Student is able to know the metallurgy manufacture of casting product
2. Student is able to explain the metallurgy manufacture of welding product
3. Student is able to explain the metallurgy manufacture of heat treatment
4. Student is able to explain the metallurgy manufacture of forming

MAIN SUBJECT

1. Metallurgy manufacture of casting product
2. Metallurgy manufacture of welding product
3. Metallurgy manufacture of heat treatment
4. Metallurgy manufacture of forming

PREREQUESITES

There is no prerequisite course

REFFERENCE

3. Flemings, Merton Chapter, “Solidification Processing”, New York: Mc Graw Hill Book Company, 1974
4. Avner, Sidney H, Introduction to Physical Metallurgy, Second edition, Tokyo: Mc Graw Hill International Book Company, 1987

SUPPORTING REFFERENCE

5. Welding Handbook Vol. 1 : Fundamental of Welding, America Welding Society, Miami, Florida 33125, 1976
6. Dieter, George E.,”Mechanical Metallurgy”, Mc Graw Hill International Book Company, Singapore, 1981
7. Dodd, W. James, dan Tonge, H.Kenneth, Analytical Chemistry by Open Learning, Termal Methods, John Wiley & sons, Inggris, 1987

COURSE	**Course Name : Powder Metallurgy**
	Course Code : TL184849
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Powder metallurgy is one of the manufacturing processes in metals. Powder metallurgy can be used to produce metal products with high precision.
The topics of discussion in this course are the process of making metal powders, the process of preparing the components with powder metallurgy, the advantages and disadvantages of powder metallurgy technology, powder characterization, mixing process, mixing type (wet and dry), factors affecting the quality of mixing, sintering and Final Work such as lathe, forging, rolling.
It is expected that at the end of the lecture students are able to manufacture with powder metallurgy and be able to make products with powder metallurgy process. To achieve these objectives then the learning method used, among others, with class lectures, practicum and providing independent tasks.

LEARNING OUTCOMES

1. Attitudes
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;

2. General Skill
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

COURSE LEARNING OUTCOMES

1. Student is able to explain the historical development of powder metallurgy technology
2. Student is able to calculate, develop and analyze the characterization process on the powder
3. Student is able to calculate and solve the problem of powder making process and process variables
4. Student is able to calculate and resolve mixing problems, mixing types and mixing process variables
5. Student is able to calculate and resolve compaction issues on the powder, the force used, holding time during compaction
6. Student is able to calculate and solve sintering problems on powder products, the influence of temperature and sintering time.
7. Student is are able to calculate and solve final processing problems on powder metallurgy products

MAIN SUBJECT

1. Preliminary
   Introduction to the development of powder metaluurgy, trends in development of powder metallurgy, applications of powder metallurgy
2. Powder characterization
   Definition of powder characterization, the reason of powder met. Process, the characteristics of powder met, methods of characterization of powder
3. Powder making
   Powder making process, powder making process variables, powder characterization based on its making process
4. Mixing
   Types of mixture (Wet and dry), factors which affect quality
5. Compaction
   The measurement of compaction force, types of compaction (cold, hot, single punch, double punch, lubrication)
6. Sintering
   Types of sintering, the variable process sintering
7. Final Working
   Forging, rolling

PREREQUISITES

There is no prerequisite course

REFERENCE

5. Randal M. German, Powder Metallurgy Science, Metal powder Industries Federation, 1984
6. "Frizt V. Lenel, Powder Metallurgy Principles and Application, Metal Powder Industries Federation Princenton, 1980 "
7. "Joel S. Hirschron, Indroction to powder Metallurgi, America Powder Mellurgy Institute, Princenton, 1976"

SUPPORTING REFERENCE

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COURSE	**Course Name : Super Alloy**
	Course Code : TL184850
	Credit : 3 credits
	Semester : 8

DESCRIPTION OF COURSE

Super Alloy course discusses about super alloy classification such as Fe, Ni, Co and its applications. Strengthen mechanism of supper alloy, phase influences, microstructure, composition and super alloy characterization are discussed. Material selection for some applications are also studied so that student will be able to analysis and choose the proper material.

LEARNING OUTCOMES

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand basic concepts of super alloy such as strengthen mechanism, phase and super alloy clasification.
2. Student is able to understand super alloy characterizations
3. Student is able to understand super alloy material selection

MAIN SUBJECT

1. Super alloy based on elements and its application such as Fe, Ni and Co
2. Phase, microstructure, composition and strengthen mechanism of super alloy
3. Paduan super characterizations
4. Material selection and its applicationnya

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Blaine Geddes Hugo Leon Xiao Huang , ''Superalloys Alloying and Performance'', ASM International, 2010

SUPPORTING REFERENCE

1. Frederik E. Wang, ''Bonding Theory for Metals and Alloys'', Elsevier Science, 2005
2. Jean-Marie Dubois, Ester, Urban, ''Complex Metallic Alloys'', Willey, 2011

COURSE	**Course Name : Quality Control and Reliability**
	Course Code : TL184851
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

The quality and reliability of a product can not be separated from the process of controlling the quality. So in this Course will discuss the material about the concept of reliability and quality management. It is expected that at the end of the lecture students are able to apply the scheduling method for a product, measure the quality of a product based on its criteria and its ways. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalize the spirit of independence, striving, and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to analyze process performance and quality control
2. Student is able to apply quality management
3. Student is able to analyze the reliability process

MAIN SUBJECT

1. Acceptance sampling: single double sampling plan, OC curve, military standard 105 D
2. SPC: p-Chart, c-Chart, np-Chart
3. The concept of reliability
4. Quality management
2. ISO Standards

PREREQUISITES

Mathematics 1 and Mathematics 2 Courses

REFERENCE

2. Introduction to Quality Control and Industrial Statistic, Montgomery, 1974

SUPPORTING REFERENCE

COURSE	**Course Name : Coating Technology**
	Course Code : TL184852
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

This course discusses about basic theory of coating technology from reaction between substrate surface and coating material, microstructure of the coating, adhesion strength concepts and types of coating technology to increase corrosion resistance and wear resistance. The technologies are electroplating, electroless, Hot-dip Galvanizing, Anodizing, organic coating, and Thermal Spray. In addition, this course also discusses about thin film technology deposition such as chemical vapor deposition (CVD), atomic layer deposition (ALD) and physical vapor deposition (PVD) for surface engineering biomedical applications, cutting tool, and microelectronics mechanical system (MEMS).

LEARNING OUTCOMES

2. General Skill
   - 2.1. Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2. Being able to demonstrate independent performance, quality, and measurable;
   - 2.3. Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4. Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5. Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;

3. Knowledge
   - 3.1. Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2. Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.4. Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5. Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1. Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2. Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3. Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.5. Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6. Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand basic concepts of coating technology

2. Student is able to understand surface pretretment before coating process
3. Student is able to understand and analyse coating technologies such as electroplating, electroless, Hot-dip Galvanizing, Oxidizing, organic coating and Thermal Spray
4. Student is able to understand and analyse thin film coating such as CVD, PVD, ALD and its applications

MAIN SUBJECT

1. Introduction to Coating Technolgy
2. Surface preparation
3. Electroplating and Electroless
4. Hot-dip Galvanizing
5. Organic Coating
6. Thermal Spray
7. Thin Film

PREREQUISITES

There is no prerequisite course

REFERENCE

1. ASM Handbook 5: Surface Engineering, ASM International, 1994
2. Arthur A. Tracton, Coatings Materials And Surface Coatings, CRC Press, 2007
3. Arthur A. Tracton, Coatings Technology Fundamentals, Testing, And Processing Techniques , CRC Press, 2007

SUPPORTING REFERENCE

1. Peter Maaß and Peter Peißker, Handbook of Hot-dip Galvanization, Wiley-VCH Verlag GmbH & Co. KgaA, 2011
2. Lech Pawlowski, The Science and Engineering of Thermal Spray Coatings, Second Edition, John Wiley & Sons, 2008
3. J.F.H. Van Eijnsbergen, Duplex Systems Hot-dip Galvanzing Plus Painting, Elsevier, 1994
4. M. Ohring, The Materials Science of Thin Films The Materials Science of Thin Films, Academic Press, 1992
5. Hugh O. Pierson, Handbook Of Chemical Vapor Deposition (CVD), Second Edition, Noyes Publications, 1999

COURSE	**Course Name : Operational Research**
	Course Code : TL84853
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

The course of Operational Research is a course on the knowledge of optimization concepts that can be applied to industrial systems. Provide students with the ability of management, production systems, production planning and control, and be able to integrate various activities and processes to produce products and services that are of competitive value. To achieve these objectives then the learning method used, among others, with class lectures and the provision of independent tasks.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently
   - 1.10 Internalize the spirit of independence, striving, and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - a. Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - b. Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - c. Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to identify the challenges faced in operations and production management "
2. Student is able to identify and explain the operation strategy
3. Student is able to identify and reason the design process strategy
4. Student is able to analyze the process including performance evaluation, redesigning process
5. Student is able to analyze process performance and quality
6. Student is able to apply aggregate planning process and production planning by using mathematical technique from Operational Research
7. Student is able to explain the role of information technology and Value Chains
8. Student is able to choose forecasting techniques as part of Operational Research techniques for certain situations
9. Student is able to apply inventory management as part of the implementation of Operational Research
10. Student is able to create a scheduling system (scheduling)

MAIN SUBJECT

1. Corporate strategy, market analysis, operating strategy relationships and decision-making patterns.
2. Process design, process structure in manufacturing, manufacturing automation process, capital intensity.
3. Pareto charts, cause-effect diagrams, process simulations, benchmarking.
4. Total Quality Managing, Statistical Process Control, ISO, process capability.
5. Linear program, transportation method.
6. Information technology components, e-commerce, electronic data interchange, Enterprise Resource Planning,
7. Forecasting models: moving average technique, exponential smoothing, regression.
8. Inventory models: EOQ, inventory control system.
9. Demand scheduling, workforce scheduling, operations scheduling Process Flow Diagram (PFD).

PREREQUISITES

Mathematics 1 and Mathematics 2 Courses

REFERENCE

1. Lee J. Krajewski, Larry P Ritzman, Operation Management: Process and Value Chains, 7rd Ed, New Jersey: Pearson Education, Inc., 2005.
2. Hamdy A. Taha, Operation Research: An Introduction, 7rd Ed. New Jersey: Pearson Education, Inc., 2003

SUPPORTING REFERENCE

1. Subir Chowdhury, Jay A. Conger, Edgar H. Shein, et.al., Organization 21C, Pearson Education, 2003

COURSE	**Course name : Energy Conversion Machine**
	Course code : TL184854
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

This course discusses several energy conversion machines used in industry. Energy conversion machines covered in this class include pump, compressor, Otto engine, Diesel engine, gas turbine and vapor turbine. Students are introduced to basics of these machines, working principle, basic application of these machines in industry. Additionally, students learn also on how to analyse piping and ducting system which will be used simultaneously with pump and compressor. For Otto engine, Diesel engine, gas turbine and vapor engine, students learn also to investigate and analyse the thermal efficiency and strategy to increase it.

LEARNING OUTCOME

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalize the spirit of independence, striving, and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;

3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOME

1. Student is able to understand types of energy conversion machines
2. Student is able to understand application of each energy conversion machines
3. Student is able to analyse and design the piping system
4. Student is able to analyse and design the ducting system
5. Student is able to understand working principle and application of Otto and diesel engine
6. Student is able to understand working principle and application of gas and vapour turbine
7. Student is able to analyse thermal efficiency of Otto and Diesel engine as well as vapour and gas turbine

DISCUSSED TOPIC

12. Introduction to energy conversion machines and their industrial application
13. Basic of pump
14. Types of pump, application and system design
15. Basic of compressor
16. Types of compressor, application and system design
17. Types of combustion engine and its industrial application
18. Basic of Otto engine and working principle
19. Otto engine 2 and 4 strokes
20. Basic of Diesel engine and working principle
21. Gas turbine for aircraft and industry
22. Vapour turbine and Carnot cycle

PREREQUISITE

Materials thermodynamics, Machine element, Transport phenomena Courses

REFFERENCE

Khan, Kaleem Mohammad, Fluids mechanics and machinery, Oxford University Press, 2015

SUPPORTING REFFERENCE

5. C.P. Kothandaraman, R. Rudramoorthy, Fluid mechanics and machinery, New Age Publications (Academic), 2009
6. Meinhard Scobeiri, Gas turbine design, components, and system design integration, Springer, 2018

7. Michael J. Moran, Howard N. Shapiro, Fundamentals of engineering thermodynamics, 8ed, Springer, 2014
8. Tanuma, Tadashi, Advances in steam turbines for modern power plants, Woodhead Publishing is an imprint of Elsevier, 2017

COURSE	**Course Name : Electronics and Instrumentation**
	Course Code : TL184855
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Electronics and Instrumentation is an indispensable supporting course in order to understanding the working principles of equipment and industry, particularly in the field of material and metallurgical process industries. This lecture consists of two main parts of discussion, namely Basic Electronics and basic measurement and control instruments. In the basic electronics, students are expected to be able to understand, perform calculations and apply the basic concept of the current voltage, basic components of electronics RLC. While on the instrumentation of measurement and control, students are expected to be able to understand the working principle of measurement and control system, and the working principle of the elements of the system compiler; sensor / transducer, signal conditioning, ADC-DAC, display / storage, controller, and final control. The learning methods applied in this course are lectures, discussions, and study presentations of various industrial instrumentation systems.

LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.4 Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation;
   - 1.5 Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.7 Law abiding and disciplined in community and state life;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalize the spirit of independence, striving, and entrepreneurship;

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;

3. Knowledge

4.7 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
4.8 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
4.9 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skill
4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

COURSE LEARNING OUTCOMES

1. Student is able to understand and apply in daily life the basic concepts of current and voltage (AC / DC) and laws related to electricity, as well as safety factors in electronics (ohmic losses)
2. Student is able to recognize and describe the basic components in the electronic circuit and the technology of making the basic components of electronics
3. Studen is able to calculate, measure and analyze Resistance, Capacitance, Inductance, Reactance of basic electronics components either individually or in series
4. Student is able to understand the concept of Electrical Measurement: Amperemeter, Voltmeter, Ohmmeter, etc.
5. Student is able to understand the basic concepts of the instrumentation system
6. Student is able to understand the working principle of Sensor / Transducer
7. Student is able to understand the concept of power supply
8. Student is able to understand the concept of digital data communication, interfacing, controlling, and data conversion (ADC / DAC)

MAIN SUBJECT

1. Concept of Electronics and Electrical
2. Electric current: Low Voltage, High Voltage, One Phase, Three Phases, Power
3. Electronic and Electrical Components: Resistors, Inductors, Capacitors, Diodes, Transistors, Circuit Diagrams, Electric Symbols, etc.
4. Electrical measurements: Amperemeter, Voltmeter, Ohmmeter, etc.
5. Electric motor
6. The basic concept of instrumentation
7. Sensor and Transducer
8. Power Supply
9. Operational Amplifier
10. Data communication (digital and analog)
11. Data conversion (ADC / DAC)

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Physics, vol 2, Wolfson, Pearson Pub. 2007. Chapter 24 pp 398-408
2. Horowitz and Hill, The Art of Electronics, Cambridge University Press, 1989.
3. Physics, vol 2, Wolfson, Pearson Pub. 2007. Chapter 25 pp 398-408
4. Rizzoni, G. Principles and Applications of Electrical Engineering, McGraw Hill, 2007
5. Prinsip Dasar Instrumentasi Elektronika dan Industri, FISIKA FMIPA
6. C.A Grimes, E. C. Dickey and M.V Pishko, Encyclopedia of Sensors, American Scientific Publishers, 2006
7. G.E. tobey, J.G Graeme, and L.P. Huelsman, Operational amplifiers-Design and Applications, Publisher Mc Graw Hill, 1971. 2. Walden, R.H, Analog to digital converter survey and analysis, IEEE Journal on Selected Areas in Communications 17, 539-550, 1999
8. H.M Berlin (Book 1 &2), Howard W, Introductory Experiments in Digital Electronics, Sams & Co, Inc Publisher

SAMS
SUPPORTING REFERENCE
-

COURSE	**Course Name : Recycling Technology**
	Course Code : TL184856
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Polymer products are indispensible to humans because of their several advantages, such as easy processability into various shapes, low cost, lightweight, and durability, over conventional products. But the irony is that some of these advantages make polymeric materials a threat to life on Earth through widespread and irreparable damage to environment. This comes mainly because some of us still believe that polymer products are of the "use and throw" type. Because of this, our soil, water, and air are catastrophically affected. Therefore, it is high time to think and work on alleviating the serious ill effects of polymers and attempt to regenerate our environment for future generations. One of the possible remedies that is being considered and debated by the general public, scientists, and academicians is polymer recycling. This is because all other alternatives are either extremely dangerous or economically unviable. One can see that the two common substitutes for polymer recycling are (i) the simple burning of used polymers in open air, which is more dangerous to the environment, and (ii) the use of biodegradable polymers, which is uneconomical. Therefore, "recycle and reuse" is considered the best option for a sustainable environment. Secondly, recycling minimizes the need for raw materials so that the rainforests can be preserved. Great amounts of energy are used when making products from raw materials. Recycling requires much less energy and therefore helps us preserve natural resources. This course, *The Recycling Technology of Polymers* is presented to provide the knowledge and technology of the methods of recycling, followed by applications and, finally, the merits and demerits of recycled polymer products including almost all categories of polymers, namely plastics, elastomers, and fibers, and, in addition, also blends, composites, and resins

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LEARNING OUTCOMES

1. Attitude
   - 1.1 Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2 Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3 Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila;
   - 1.6 Working together, having social sensitivity and caring for community and environment;
   - 1.8 Internalizing values, norms and academic ethics;
   - 1.9 Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10 Internalizing spirit of independence, struggle and entrepreneurship;
   - 1.11 Trying his/her best to achieve perfect results, and
   - 1.12 Working together to be able to make the most of his/her potential.

2. General skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge

3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific skill
4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

7. The student is able to understand the urgency of polymer recycling processes based on the products and the energy and environmentall issues
8. The student is able to understand the types of polymer waste
9. The student is able to understand the additives used in recycling processes
10. The student is able to understand the methods of polymer waste recycling
11. The student is able to understand and handling the procedures of each type of polymer recycling
12. The student is able to design the recycling process of polymer waste

MAIN SUBJECT

11. Introduction (3R, sources of polymer waste, the urgency and \
procedure of recycling)
12. Ecoprofiles of Recycled Polymers at a Glance (based on the products and the energy and environmental issues)
13. Common Additives/agents used in Recycling of Polymers
14. Methods of Recycling
15. Recycling of Plastic
16. Recyciling of Rubber
17. Recycling of Other Layered Mixed Plastics or Resins: Polyurethanes
18. Recycling of Polymer Blends and Composites (Epoxy Blends)
19. Design and implementation of recycling process of polymer products
20. Design and implementation of recycling process of ceramic products

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Dr. Raju Francis, “Recycling of Polymers: Methods, Characterization and Applications”, Wiley-VCH Verlag GmbH & Co, Germany, 2017

SUPPORTING REFERENCE

COURSE	**Course Name : Materials for Marine Application**
	Course Code : TL184857
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

The Materials for Marine Application discusses about the application of material and metallurgical science disciplines in the shipping. After following this course, students are able to know the types of ships and their uses, ship parts, ship components, material selection for ship construction, ship corrosion, anti-fouling, boat painting, dry-docking, inspection, maintenance and security in a ship environment. The lectures gives the exams and discussion about marine materials.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

COURSE LEARNING OUTCOMES

1. Student is able to explain the types of ships and their uses
2. Student is able to explain ship parts and components
3. Student is able to explain the material construction for ships
4. Student is able to explain the corrosion on the ship
5. Student is able to explain the body painting of the ship
6. Student is able to explain anti decay of hull (anti fouling)
7. Student is able to explain cathodic protection on ships
8. Student is able to explain dry docking and inspection
9. Student is able to explain maintenance and safety

MAIN SUBJECT

1. the types of ships and their uses
2. ship parts and components
3. the material construction for ships
4. the corrosion on the ship
5. the body painting of the ship
6. anti decay of hull (anti fouling
7. cathodic protection on ships
8. dry docking and inspection
9. The maintenance and safety

PREREQUISITES

Corrosion and Corrosion Control, Machine Design, Fracture Mechanics and Failure Analysis Courses with minimum score of D

REFERENCE

1. Rudolf das, 2001, ship knowledge, third edition

SUPPORTING REFERENCE

COURSE	**Course Name : Mineral Dressing**
	Course Code : TL184858
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

This course will studied all matters relating to mineral processing after the mineral is obtained from the mine. Minerals processing includes mineral handling, comminution, size classification, concentration process, dewatering. The process of concentration studied in this course is concentration through the gravity principle, concentration through magnetic principle, concentration through electrical principle.

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.7. Law abiding and disciplined in community and state life;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.6 Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge: and
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to remember the introduction to mineral processing
2. Student is able to understand ore handling
3. Student is able to understand particle size analysis
4. Student is able to explain comminution process
5. Student is able to explain classification process
6. Student is able to explain the process of mineral concentration through gravity principle
7. Student is able to explain flotation process
8. Student is able to explain the process of magnetic and electrical separation
9. Student is able to analyze dewatering process

MAIN SUBJECT

1. Introduction to mineral processing
2. Ore handling
3. Particle size analysis
4. Comminution process
5. Classification process
6. Mineral concentration through gravity principle
7. Flotation process
8. Magnetic and electrical separation
9. Dewatering process

PREREQUISITE

Introduction to Materials and Metallurgical Engineering Course with minimum score of D

REFFERENCE

1. Minerals Processing Technology, Barry A. Wills, 2006.

SUPPORTING REFFERENCE

1. Introduction to Mineral Processing Desgn and Operation, Gupta, A., 2006
2. Speciality Chemicals in Mineral Processing, Skuse, D.R., 2002

COURSE	**Course Name : Electrochemistry**
	Course Code : TL184859
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Electrochemistry is the study of the relationship between chemical (chemical) change and electrical work, which usually involves electrochemical cells that apply the principle of redox reactions in their applications. The electrochemical reaction involves the transfer of free electrons from a metal to a component in the solution. The equilibrium of electrochemical reactions is important in the galvanic cell (which produces an electric current) and the electrolysis cell (which uses an electric current). The measurement of the electric motion (DGL) of an electrochemical cell within a certain temperature range can be used to determine the thermodynamic values of the reaction as well as the activity coefficients of the involved electrolyte

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology

development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;
   - 4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and
   - 4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the definition and process of electrochemistry
2. Student is able to explain and calculate the electrical conduction and ionic solution
3. Student is able to explain and calculate electrochemical cells and electrodes
4. Student is able to explain and calculate polarization and Pourbaix diagrams
5. Student is able to explain and analyze electrochemical applications in corrosion and metal coating

MAIN SUBJECT

1. Introduction of electrochemistry
2. the electrical conduction
3. electrochemical cells
4. electrodes
5. polarization and Pourbaix diagrams
6. electrochemical applications in corrosion and metal coating

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Thomas F. Fuller Electrochemical Engineering Principles
2. Geoffrey A. Prentice Electrochemical Engineering Principles.

SUPPORTING REFERENCE

COURSE	**Course Name : High Temperature Corrosion**
	Course Code : TL184860
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

High temperature corrosion is the process of degradation material quality, including degradation of mechanical properties caused by the influence of the atmosphere at high temperatures

LEARNING OUTCOMES

1. Attitude
   - 1.1. Believing in the oneness of God and able to demonstrate religious attitude;
   - 1.2. Upholding the value of humanity in undertaking the task based on religion, morality and ethics;
   - 1.3. Contributing to improve the quality of life of society, nation, state, and progress of civilization based on Pancasila;
   - 1.6. Working together, having social sensitivity and caring for community and environment;
   - 1.8. Internalizing values, norms and academic ethics;
   - 1.9. Demonstrating attitude of responsibility on work in his/her field of expertise Independently;
   - 1.10. Internalizing spirit of independence, struggle and entrepreneurship;2. Mastery of Knowledge
   - 1.11. Trying his/her best to achieve perfect results
   - 1.12. Working together to be able to make the most of his/her potential.

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.
   - 2.13 Being able to apply entrepreneurship and understand technology-based Entrepreneurship.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering

problem on material and metallurgy product or component manufacturing process;

4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;

4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;

4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to explain the definition and process of high temperature corrosion
2. Student is able to explain the corrosion process of high temperature by oxygen
3. Student is able to explain the corrosion process of high temperature by carbon
4. Student is able to explain the corrosion process of high temperature by nitrogen
5. Student is able to explain the process of high temperature corrosion by sulfur

MAIN SUBJECT

1. Introduction of high temperature corrosion
2. The corrosion process of high temperature by oxygen
3. The corrosion process of high temperature by carbon
4. The corrosion process of high temperature by nitrogen
5. The process of high temperature corrosion by sulfur
6. Application of high temperature corrosion in industry

PREREQUISITES

There is no prerequisite course

REFERENCE

1. MG Fontana, ND Green, Corrosion Engineering, Tokyo : Mc Graw Hill International Book Company
2. Thretewey, KR, and J. Chamberlain, Corrosion for Students and Engineers

SUPPORTING REFERENCE

COURSE	**Course Name : Specific Topic**
	Course Code : TL184861
	Credit : 3 sks
	Semester : 8

DESCRIPTION OF COURSE

Special topics is courses that learn about various technologies, including engineering principles, material design and material manufacturing processes. This course is expected to help students in doing the final project and can add insight in the industrial world.

LEARNING OUTCOMES

2. General Skill
   - 2.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
   - 2.2 Being able to demonstrate independent performance, quality, and measurable;
   - 2.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page;
   - 2.4 Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page;
   - 2.5 Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis;
   - 2.7 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
   - 2.8 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
   - 2.9 Being able to document, store, secure and recover data to ensure validity and prevent Plagiarism;
   - 2.10 Being able to develop themselves and compete in national and international level;
   - 2.11 Being able to implement sustainability principles and develop knowledge
   - 2.12 Being able to implement information and communication technology (ICT) in the context of implementation of his/her work.

3. Knowledge
   - 3.1 Knowing theoretical concept of engineering sciences, engineering principles, and engineering design for analyzing and designing materials and metallurgy and manufacturing process of materials and metallurgy product or component;
   - 3.2 Knowing basic science concept and engineering mathematical application principe on materials technology and manufacturing material product;
   - 3.3 Knowing principe and engineering design of system, process or material manufacturing and component metallurgy;
   - 3.4 Knowing principe and latest issue on general overall economic, social, ecology; and
   - 3.5 Knowing communication technique and the newest and latest materials and metallurgy technology development.

4. Specific Skill
   - 4.1 Being able to apply mathematic, basic science, and engineering principles for solving complex engineering problem on material and metallurgy product or component manufacturing process;
   - 4.2 Being able to find engineering problem source of material product or component, metallurgy product or component and manufacturing process by research process, analysis, data interpretation and information based on engineering principes;
   - 4.3 Being able to perform research on identification, formulation, and analysis of engineering problem for materials, metallurgy and product or component material manufacturing process ;
   - 4.4 Being able to formulate alternative solution for solving complex engineering problem on material, metallurgy and product or component material manufacturing process based on economic, health and

public safety, cultural, social and environment factor;

4.5 Being able to design product or component material and metallurgy manufacturing process based on analytical and technical standard, working aspect, reliability, versatility, continuity based on economic, health and public safety, cultural, social and environment factor; and

4.6 Being able to select resources and apply tool design and engineering analysis based on appropriate information and computation technology to perform engineering on product or component material manufacturing process

COURSE LEARNING OUTCOMES

1. Student is able to understand specific topics
2. Student is able to explain the concept and theory of specific topics
3. Student is able to applicate the mechanism of specific topics
4. Student is able to analize the application of specific topics

MAIN SUBJECT

1. Introduction of Specific Topic.
2. Concepts and theories of Specific Topic.
3. Specific Topic Mechanism.
4. Specific Topic Applications

PREREQUISITES

There is no prerequisite course

REFERENCE

1. Joon B. Park, Joseph D. Bronzino, Biomaterials Principles and Applications", CRC Press,2003.
2. Joon Park, "Biomaterials An introduction", springer, 2007.
3. Robert Lanza "Principles of Tissue Engineering" Academic Press, 2007

SUPPORTING REFERENCE

1. Glen S. Kwon, "Polymetric Drg Delivery Systems", Taylor and Fraciss, 2005.
2. Kay C. Dee, David A. Puleo. Rena Bizios," Tissue-Biomaterial Interactions", Wiley-Liss, 2002.
3. J Paulo Davim,"Biomaterials and Medical Tribology**"** Woodhead publishing, 2013