STRUKTUR KURIKULUM PROGRAM STUDI TEKNIK METALURGI DAN MATERIAL S1

KODE	MATA AJARAN	SUBJECT	SKS
	Semester 1	**1st Semester**	
UIGE 6 0 0002	MPKT B	Integrated Character Building Subject B	6
UIGE 6 0 0003	Bahasa Inggris	English	3
ENGE 6 0 0001	Kalkulus 1	Calculus 1	3
ENGE 6 0 0009	Kimia Dasar	Basic Chemistry	2
ENMT 6 0 1 001	Menggambar Teknik	Engineering Drawing	2
ENMT 6 0 1 002	Pengantar Material Teknik	Introduction to Engineering Materials	2
ENMT 6 0 1 003	Praktikum Kimia Dasar	Basic Chemistry Laboratory	1
		Sub Total	**19**
	Semester 2	**2nd Semester**	
UIGE 6 0 0001	MPKT A	Integrated Character Building Subject A	6
UIGE 6 0 00010-15	Agama	Religious Studies	2
UIGE 6 0 00020-48	Olah Raga / Seni	Sport & Art	1
ENGE 6 0 0004	Aljabar Linier	Linear Algebra	4
ENGE 6 0 0002	Kalkulus 2	Calculus 2	3
ENGE 6 0 0005	Fisika Mekanika dan Panas	Physics (Mechanic & Heat)	3
ENGE 6 0 0006	Praktikum Fisika Mekanika dan Panas	Physics (Mechanic & Heat) Laboratory	1
		Sub Total	**20**
	Semester 3	3rd Semester	
ENGE 6 0 0007	Fisika Listrik, Magnet, Gelombang dan Optik	Physics (Electric, Magnet, Wave & Optic)	3
ENGE 6 0 0008	Praktikum Fisika Listrik, Magnet, Gelombang dan Optik	Physics (Electric, Magnet, Wave & Optic) Laboratory	1
ENGE 6 0 0010	Statistik & Probabilitas	Statistics & Probability	2
ENMT 6 0 3 004	Elektro Kimia	Electro-Chemistry	3
ENMT 6 0 3 005	Karakterisasi Kimia Material	Chemical Characterization of Materials	2
ENMT 6 0 3 006	Metalurgi Fisik 1	Physical Metallurgy 1	4
ENMT 6 0 3 007	Statika & Mekanika Material	Static & Mechanic of Materials	3
ENMT 6 0 3 008	Termodinamika Material	Thermodynamics of Materials	3
		Sub Total	**21**
	Semester 4	4th Semester	
ENMT 6 0 4 009	Analisis Struktur Material	Tech. of Microstructural Analysis	2
ENMT 6 0 4 010	Kimia Polimer	Polymer Chemistry	4
ENMT 6 0 4 011	Komputasi Numerik	Numerical Computation	2
ENMT 6 0 4 012	Metalurgi Fisik 2	Physical Metallurgy 2	3
ENMT 6 0 4 013	Pengolahan Mineral	Mineral Processing	4
ENMT 6 0 4 014	Pengujian Material	Testing of Materials	2
ENMT 6 0 4 015	Peristiwa Perpindahan	Transport Phenomenon	3
ENMT 6 0 4 016	Praktikum Karakterisasi Kimia Material	Chemical Characterization of Materials Laboratory	1
		Sub Total	**21**
	Semester 5	5th Semester	
ENGE 6 0 0012	K3LL	Health, Safety & Environment	2
ENMT 6 0 5 017	Manajemen Industri	Industrial Management	2
ENMT 6 0 5 018	Metalurgi Ekstraksi Non Ferrous	Non Ferrous Extractive Metallurgy	3
ENMT 6 0 5 019	Perlakuan Panas & Rek. Permukaan	Heat Treatment & Surface Engineering	3

ENMT 6 0 5 020	Proses Manufaktur Logam	Metal Manufacturing Process	4
ENMT 6 0 5 021	Teknologi Polimer	Polymer Technology	3
ENMT 6 0 5 022	Praktikum Analisis Struktur Material	Tech. of Microstructural Analysis Laboratory	1
ENMT 6 0 5 023	Praktikum Pengujian Material	Testing of Materials Laboratory	1
		Sub Total	**19**
	Semester 6	**6th Semester**	
ENMT 6 0 6 024	Korosi & Proteksi Logam	Corrosion & Protection of Metals	3
ENMT 6 0 6 025	Penyambungan Material	Materials Joining	3
ENMT 6 0 6 026	Proses Pembuatan Besi Baja	Iron & Steel Making Process	2
ENMT 6 0 6 027	Teknologi Keramik	Ceramic Technology	3
ENMT 6 0 6 028	Teknologi Komposit	Composite Technology	3
ENMT 6 0 6 029	Praktikum Korosi & Proteksi Logam	Corrosion & Protection of Metals Laboratory	1
ENMT 6 0 6 030	Praktikum Metalurgi Ekstraksi	Extractive Metallurgy Laboratory	1
ENMT 6 0 6 031	Praktikum Proses Manufaktur Logam	Metal Manufacturing Process Laboratory	2
		Sub Total	**18**
	Semester 7	**7th Semester**	
ENMT 6 0 7 032	Disain Rekayasa Produk	Engineering Design of Products	3
ENMT 6 0 7 033	Kapita Selekta	Capita Selecta	2
ENMT 6 0 7 034	Mekanika Perpatahan & Analisis Kegagalan	Fracture Mechanics & Failure Analysis	4
ENMT 6 0 0 035	Kerja Praktek	Internship	2
ENMT 6 0 0 036	Seminar	Seminar of Final Project Proposal	1
	Pilihan 1	Elective 1	2
	Pilihan 2	Elective 2	2
		Sub Total	**16**
	Semester 8	8th Semester	
ENMT 6 0 0 037	Skripsi	Final Project	4
	Pilihan 3	Elective 3	2
	Pilihan 4	Elective 4	2
	Pilihan 5	Elective 5	2
		Sub Total	**10**
		TOTAL	**144**

MATA KULIAH PILIHAN

KODE	MATA AJAR	SUBJECT	SKS
ENMT 6 0 7 938	Aditif Polimer	Polymer Additives	2
ENMT 6 0 7 939	Baja Khusus & Paduan Super	Special Steels & Super Alloys	2
ENMT 6 0 7 940	Bio Material	Bio Material	2
ENMT 6 0 7 941	Desain Pabrik Metalurgi	Metallurgical Plant Design	2
ENMT 6 0 7 942	Korosi Temperatur Tinggi	High Temperature Corrosion	2
ENMT 6 0 7 943	Material Elektronik	Electronic Materials	2
ENMT 6 0 7 944	Metodologi Penelitian	Research Methodology	2
ENMT 6 0 7 945	Pemrosesan Plastik	Plastic Processing	2
ENMT 6 0 7 946	Refraktori Material	Refractory Materials	2
ENMT 6 0 7 947	Sistem Manajemen Mutu	Quality Management Systems	2
ENMT 6 0 8 948	Analisis Pembentukan Logam	Analysis of Deformation	2
ENMT 6 0 8 949	Ekologi Industri	Industrial Ecology	2
ENMT 6 0 8 950	Korosi Pada Beton	Concrete Corrosion	2
ENMT 6 0 8 951	Material Energi	Energy Materials	2
ENMT 6 0 8 952	Metalurgi Ekstraksi Lanjut	Advanced Extractive Metallurgy	2
ENMT 6 0 8 953	Peralatan Mekanika Industri	Industrial Mechanic Equipment	2
ENMT 6 0 8 954	Rekayasa Permukaan Material Lanjut	Advanced Surface Engineering	2
ENMT 6 0 8 955	Standardisasi Material	Material Standardization	2
ENMT 6 0 8 956	Teknologi Daur Ulang Polimer	Polymer Recycling Technology	2
ENMT 6 0 8 957	Teknologi Karet	Rubber Technology	2
ENMT 6 0 8 958	Teknologi Nano	Nano Technology	2

Silabus Mata Kuliah – Kurikulum 2016
Jenjang Sarjana – Dept. Teknik Metalurgi & Material

ENMT 601001 – MENGGAMBAR TEKNIK – (2 SKS)
(1)Illustrasi: Fungsi dan Manfaat Gambar Teknik; SAP; Pengukuran dan Evaluasi; Pengenalan Peralatan Menggambar. (2) Pengertian dasar geometri, format kertas & aturan gambar; garis, bidang, & konfigurasi garis; bentuk-bentuk geometri dasar; test kemampuan awal. (3) visualisasi Geometri 3D: Proyeksi Miring dan Isometri; Fungsi dan jenis garis, Konfiurasi Bentuk
Geometri. (4) Proyeksi Orthogonal: Standar proyeksi; Konsep Pandangan; Prinsip Penyajian Ukuran. (5)Proyeksi Orthogonal Lanjut: Konsep penampang putar; Konsep tampak khusus; konsep Potongan; Penyajian Ukuran; Pembiasaan.
Prasyarat: -

ENMT 601002 – PENGANTAR MATERIAL TEKNIK – (2 SKS)
Teknik Metalurgi dan Material dan ruang lingkupnya, teori atom dan ikatan atom, klasifiasi
dan karakteristik material teknik: logam (ferrous dan non-ferrous), keramik, gelas, polimer dan
komposit.
Prasyarat: -

ENMT 601003 – PRAKTIKUM KIMIA DASAR – (1 SKS)
Sifat fisika dan sifat kimia; Pemisahan dan pemurnian zat; Identifikasi ion logam alkali, alkali tanah, amonium, sulfat, iodid, bromide dan nitrat; Titrasi asam basa; Reaksi logam dan asam; Air kristal.
Prasyarat: -

ENMT 603004 - ELEKTROKIMIA – (3 SKS)
Konsep dasar elektrokimia dan aplikasi, larutan dan konduktivitasnya, Hukum Faraday, sel elektrokimia dan aplikasinya. Elektroda (definisi, potensial, persamaan Nerst, lapis ganda listrik, polarisasi, pengukuran potensial,energi bebas dan potensial elektroda, potensial kesetimbangan), elektroda acuan.Konstruksi diagram Pourbaix dan aplikasinya. Kinetika elektrokimia, kecepatan reaksi elektroda, teori potensial campuran, evans-diagram, mixed-potential diagram
Prasyarat: -

ENMT 603005 – KARAKTERISASI KIMIA MATERIAL – (2 SKS)
Tinjauan ulang struktur dan sifat fisiokimia material, konsep analisis material (kualitatif dan kualitatif, prinsip analisis intrument (teori, prinsip alat dan kerja, interpretasi keluaran dan pemanfaatannya) dari metode spektroskopi (massa, UV/VIS, infra merah-FTIR, emisi, XRF dan *Spark Emission*) dan termal (TGA, DTA/DSC, MFI dan *Vicat*), dan strategi melakukan karakterisasi material
Prasyarat: -

ENMT 603006 – METALURGI FISIK 1 – (4 SKS)
Pendahuluan, pengertian kristal, kisi kristal, sel satuan, kisi Bravais, index Miller untuk bidang dan arah, proyeksi kristal/stereografi, simetri kristal, teori atom, cacat-cacat logam (crystal defects), teori dislokasi: sisi dan ulir (edge and screw), larutan padat subtitusi dan interstisi: pengotor dan paduan. Teori deformasi elastis & plastis, sifat mekanik dan fisik logam: kekuatan, kekerasan, ketangguhan, keausan, kelelahan dan pemuluran (creep). Studi Kasus
Prasyarat: -

ENMT 603007 – STATIKA MEKANIKA MATERIAL – (3 SKS)
Vektor gaya, resultan gaya, kesetimbangan partikel dan benda tegar, analisis struktur, sifat-sifat geometri dan beban terdistribusi, beban-beban internal. Tegangan dan regangan, diagram tegangan dan regangan material ulet dan getas, teori elastis dan plastis material, beban-beban aksial, torsi, tekuk, geser dan beban-beban campuran, transformasi tegangan dan regangan, disain balok, kolom dan poros
Prasyarat: -

ENMT 603008 – TERMODINAMIKA MATERIAL – (3 SKS)
Definisi termodinamika, hukum pertama, kedua dan ketiga termodinamika, intepretasi statistik dari entropi, fungsi-fungsi tambahan (auxiliarry functions), kapasitas panas, entalpi dan entropi, keseimbangan fasa pada satu komponen, perilaku gas dan larutan, energi bebas, komposisi dari system biner, reaksi fasa kondensasi murni dan fasa gas, reaksi

keseimbangan dalam sistem pada komponen larutan.
Prasyarat: -

ENMT 604009 – ANALISIS STRUKTUR MATERIAL – (2 SKS)
Teknik analisis mikro, pembentukan fase dan karakteristik umum struktur material, struktur mikro baja; fase stabil dan metastabil, pembentukan dan mekanisme, paduan mikro non-ferrous; aluminium, tembaga, titanium, macrostructure, teknik persiapan sampel, teknik pengamatan dengan optik dan mikroskop elektron, pengukuran khusus sampling; mikro-kekerasan, ketebalan lapisan, kekasaran, metalografi kuantitatif; ukuran butir, fraksi volume fase dan endapan.
Prasyarat: Metalurgi Fisik 1

ENMT 604010 – KIMIA POLIMER – (4 SKS)
Prinsip dasar kimia organik (ikatan atom & molekul, klasifikasi dan penamaan senyawa organik, isomer, konjugasi, gugus reaktif dan penata-ulangannya). Jenis reaksi organik (substitusi, radikal bebas, adisi dan eliminasi). Pengantar polimer (struktur, asal, polimerisasi, berat molekul). Prilaku molekul polimer (pembelitan, pelipatan, kristalisasi, opasitas, morpologi, transisi gelas, pelelehan, visko-elastisitas). Jenis polimer (termoplastik, termoset dan karet –hubung silang). Hubungan struktur dan prilaku molekul polimer.
Prasyarat: -

ENMT 604011 – KOMPUTASI NUMERIK – (2 SKS)
Pengantar terhadap model, jenis jenis model, pembuatan model, dasar-dasar Matlab, susunan (array) dalam matlab, seleksi if dan switch, loop dalam matlab, fungsi dan m-file dalam matlab, persamaan linear, metoda ekspansi Taylor, Euler, persamaan diferensial biasa, pengantar solidworks, pemodelan padat (solid modelling), dasar simulink, simulik orde pertama dan kedua
Prasyarat: -

ENMT 604012 – METALURGI FISIK 2 – (3 SKS)
Aturan fasa, diagram fasa biner, diagram energi bebas, pengantar diagram fasa terner, pengantar transformasi fasa dan antarmuka (interface) dan tegangan permukaan, efek Gibbs-Thomson, proses pembekuan, nukleasi homogen dan heterogen, laju nukleasi, proses pembekuan paduan, transformasi difusi, pertumbuhan dan kristalisasi, mekanisme penguatan: penguatan regangan, endapan dan penuaan (age hardening).
Prasyarat: Termodinamika Material

ENMT 604013 – PENGOLAHAN MINERAL – (4 SKS)
Terminologi dan konsep dasar pengolahan mineral/bijih, potensi sumber-sumber mineral/bijih yang dapat diolah secara teknis dan ekonomis, proses-proses size reduction (comminution): Proses crushing, Proses screening, Proses grinding, Proses klasifikasi, Proses separasi/konsentrasi: Gravity concentration:Jigging Flowing Film Concentration Heavy,Media Separation, Proses Flotasi, Magnetic Separation, High Tension Separation, Proses Dewatering dan Thickening.
Prasyarat: Metalurgi Fisik 1

ENMT 604014 – PENGUJIAN MATERIAL – (2 SKS)
Pengantar pengujian material, ulasan perilaku mekanik material, analisis data dan penyajian hasil tes, prosedur pengujian, mesin pengujian dan instrumen, standardisasi pengujian bahan, pengujian merusak (tarik, kompresi, geser, kelelahan, relaksasi stres, dan keausan) , non-destruktif (visual, penetran, ultrasonik, radiografi, arus eddy dan partikel magnetik)
Prasyarat: Metalurgi Fisik 1

ENMT 604015 – FENOMENA PERPINDAHAN – (3 SKS)
Satuan teknik dan tekanan dalam fluida statik, transpor momentum dan aliran laminar, persamaan kontinuitas dan konservasi momentum, aliran turbulen, neraca energi mekanik dan aplikasi aliran fluida, panas konduksi, panas konveksi, aliran panas transien, radiasi, transport massa melalui diffusi padat dan cairan
Prasyarat: Termodinamika Material

ENMT 604016 – PRAKTIKUM KARAKTERISASI KIMIA MATERIAL – (1 SKS)
Analisa kualitatif an organik, analisa kuantitatif zat an organik dengan menggunakan metode titrimetri
Prasyarat: Karakterisasi Kimia Material

ENMT 605017 – MANAJEMEN INDUSTRI – (2 SKS)
Pengantar manajemen industri, organisasi dan fungsi manajemen, teori dan teknik pengambilan keputusan, manajemen produksi/operasi, keputusan stratejik produk dan proses, lokasi dan tata letak, manajemen dan pengendalian sediaan (inventory), R&D, manajemen proyek, manajemen QC dan produktivitas, manajemen produksi dalam praktek, manajemen pemasaran dan industri, manajemen SDM, TI dan industri manufaktur, Industri manufaktur di Indonesia.
Prasyarat: -

ENMT 605018 – METALURGI EKSTRAKSI NON FERROUS – (3 SKS)
Prinsip dasar metalurgi ekstraksi (pirometalurgi, hidrometalurgi dan elektrometalurgi). Tahapan proses / perlakuan bijih untuk ekstraksi; Metode pelindian bijih oksida dan sulfida, proses Bayer, Al, pelindihan Au/emas secara sianidasi (Leaching; precipitation techniques; ion exchange; solvent extraction; reverse osmosis). Elektro-metalurgi (Elektrowining dan elektrorefining); Elektrowining Lelehan garam. Hall proses. Elektrowining Mg, Ti. Secondary metals. Perolehan logam dari scrap dan secondary sources secara piro-, hidro- dan elektrometalurgi. Pirometalurgi, separasi mineralterak, tanur tinggi, bahan baku, reaksi, material balance, iron ore, roasting, smelting refining of Sn Ni, Cu, Zn, Pb
Prasyarat: Elektrokimia, Pengolahan Mineral

ENMT 605019 – PERLAKUAN PANAS & REKAYASA PERMUKAAN – (3 SKS)
Pengertian pelakuan panas, transformasi fasa dan struktur mikro, diagram TTT dan CCT, pengaruh laju pemanasan dan pendinginan pada struktur material, struktur mikro stabil dan metastabil, kemampu kerasan, pengaruh unsur paduan, pengerasan, pelunakan, kerapuhan temper, distorsi dan pencegahannya, karburisasi, nitro-karburising, nitriding, boronizing, perlakuan panas non-ferrous, berbagai jenis dapur perlakuan panas dan atmosfirnya. Penyimpangan pada proses perlakuan panas. perlakuan panas khusus. Studi kasus perlakuan panas dan rekayasa permukaan
Prasyarat: Metalurgi Fisik 1

ENMT 605020 – PROSES MANUFAKTUR LOGAM – (4 SKS)
Pembentukan logam sebagai bagian dari proses disain dan manufaktur; prinsip umum pengecoran logam (cetakan, logam cair, pembekuan), cetakan (pasir, keramik, logam), sistem tuang (pola, riser, pressure and unpressure, chill) dan simulasinya, proses pembekuan besi tuang dan aluminium, liquid treatment untuk logam ferrous (inokulasi, Mg treatment) dan non- ferrous (modifier, grain refiner), berbagai metode pengecoran, cacat cor (casting defect); prinsip umum pembentukan padat logam, teknik – teknik pembentukan logam melalui: pressing, forging, rolling, extrusion, wire drawing, sheet metal forming; thermo-mechanical-processing (TMP). Prinsip umum metalurgi serbuk, fabrikasi serbuk logam dan mekanisme pembentukan serbuk, karakteristik dan karakterisasi serbuk, mechanical alloying, Proses pra-kompaksi, kompaksi, karakteristik bakalan, proses sinter dan konsolidasi serbuk, pemrosesan densitas penuh, jenis peralatan sinter dan aspek terkait, aplikasi dan penggunaan produk metalurgi serbuk
Prasyarat: Metalurgi Fisik 1

ENMT 605021 – TEKNOLOGI POLIMER – (3 SKS)
Review hubungan struktur dan prilaku molekul polimer. Sifat material polimer (termal, kimia, mekanik, optik dan listrik). Tahapan proses fabrikasi (formulasi, pembentukan -kontinu & diskontinu- dan finalisasi produk) pada produk termoplastik, termoset dan karet. Formulasi bahan baku polimer. Material polimer dalam pembentukan produk polimer. Jenis & penentuan proses pembentukan suatu produk polimer. Studi kasus teknologi produk polimer pada aplikasi kemasan (kaku dan fleksibel), automotif, peralatan elektronik dan konstruksi.
Prasyarat: Kimia Polimer

ENMT 605022 – PRAKTIKUM ANALISIS STRUKTUR MATERIAL – (1 SKS)
Persiapan sampel metalografi (teknik pemotongan, pengamplasan, pemolesan dan etsa), teknik analisis struktur mikro logam (ferrous dan non-ferrous) dengan mikroskop optis.
Prasyarat: Analisis Struktur Material

ENMT 605023 – PRAKTIKUM PENGUJIAN MATERIAL – (1 SKS)
Pengujian tarik, kekerasan, keausan dan impak untuk beberapa material teknik.

Prasyarat: Pengujian Material

ENMT 606024 – KOROSI & PROTEKSI LOGAM – (3 SKS)
Prinsip korosi, kinetika korosi, polarisasi, pasivasi, pengukuran kecepatan korosi, aspek metalurgi, pengujian korosi, bentuk – bentuk korosi, korosi temperatur tinggi, proteksi katodik,proteksi anodik, coating, inhibitor, pemilihan material dan disain, monitoring dan inspeksi, analisa kerusakan korosi, standar yang terkait pada bidang korosi.
Prasyarat: Elektrokimia

ENMT 606025 – PENYAMBUNGAN MATERIAL – (3 SKS)
Prinsip Penyambungan berbagai material serta klasifikasinya, Adhesive Bonding, Mechanical Joining, Metoda Pengelasan: Las Fusi (busur listrik), Las Resistansi Listrik, las tekan (Solid State Welding), Proses las lainya (EBW, Laser Welding, Thermit Welding, Underwater Welding), Soldering dan Brazing, disain sambungan dan Simbol Las, Metalurgi Las: baja karbon, baja paduan rendah, baja tahan karat,besi tulang, non ferrous, WPS serta standard dan kode las, Cacat las dan pencegahannya, Kontrol Hasil Sambungan serta Pengujiannya.
Prasyarat: Metalurgi Fisik 1, Pengujian Material

ENMT 606026 – PROSES PEMBUATAN BESI BAJA – (2 SKS)
Klasifikasi dan pengembangan baja, bahan baku (bijih besi, reduktor, dll) dan proses-proses persiapannya, termodinamik dan kinetik pembuatan besi baja, proses reduksi bijih besi pada tanur tinggi, reduksi langsung (hylsa, midrex, rotary kiln SL-RN, rotary hearth), smelting reduction, desulfurisasi, deoksidasi, deposforisasi, degassing, pembuatan baja pada EAF (Electric Arc Furnace) dan BOF (Basic Oxygen Furnace), proses sekunder metalurgi, continous casting, proses hot dan cold rolling, Pembuatan baja khusus
Prasyarat: Pengolahan Mineral

ENMT 606027 – TEKNOLOGI KERAMIK – (3 SKS)
Pengantar keramik (umum), struktur kristal, struktur gelas, diagram fasa, transformasi fasa. Sifat keramik: thermal, optik, mekanis,listrik dan magnet, serta sifat dielektris. Teknologi pembuatan dan aplikasi keramik:keramik konvensional (aluminium-silikat; clay, glaze); semen dan beton; gelas dan keramik lanjut (advanced ceramics). Proses-proses untuk keramik modern, keramik lapisan tipis, keramik untuk aplikasi bidang mekanik, elektronik, optik dan magnetik. Komposit berbasis matriks keramik. Keramik refraktori. Bahan baku refraktori, jenis refraktori: refraktori system alumininum – silika, refraktori silika, refraktori magnesit, refraktori kromit, refraktori karbon, refraktori spesial. Pembuatan refraktori, penggunaan refraktori pada industri logam dan lainnya, serta mekanisme kerusakan refraktori.
Prasyarat: Metalurgi Fisik 2

ENMT 606028 – TEKNOLOGI KOMPOSIT – (3 SKS)
Konsep, definisi dan klarifikasi komposit, tipe matrix dan penguat untuk komposit, metal matrix composite, polymer matrix composite, ceramic matrix composite, nature fiber komposit. Reinforced fibers dan Whiskers, rule of mixture, interface dalam bahan komposit, interfacial area, Interfacial Wettability, interfacial bonding
Prasyarat: Teknologi Polimer

ENMT 606029 – PRAKTIKUM KOROSI & PROTEKSI LOGAM – (1 SKS)
(1) Sel – sel korosi, (2) Pengukuran Potensial Korosi Beberapa Jenis Logam, (3) Polarisasi Stainless steel, (4) Proteksi Katodik, (5) Rekayasa Permukaan.
Prasyarat: -

ENMT 606030 – PRAKTIKUM METALURGI EKSTRAKSI – (1 SKS)
Pengujian ekstraksi logam dan elektrometalurgi (e.g. Electroplating, froth flotation)
Prasyarat: Metalurgi Ekstraksi Non Ferrous

ENMT 606031 – PRAKTIKUM PROSES MANUFAKTUR LOGAM – (2 SKS)
(1) Distribusi ukuran pasir, perhitungan kadar air, kadar zat aditif (bentonit) dalam cetakan, mampu alir pasir, hubungan kadar air dan zat aditif dalam pasir dengan permaebilitas, kekuatan geser dan kekuatan tekanan pasir (2) Penggunaan perangkat lunak simulasi untuk perhitungan dan desain pengecoran (3) Desain pembuatan sistem saluran masuk dan penambah, pembuatan cetakan pasir dari pola, pembuatan inti cetakan, proses peleburan dan penuangan logam cair ke dalam cetakan, analisis cacat–cacat hasil pengecoran, analisis produk pengecoran berkaitan dengan unsur paduan dan proses pengecoran. Modul Pengubahan Bentuk Logam: (1) Penekanan logam silinder pejal (2) Pencanaian logam lembaran, (3) Pembentukan logam lembaran meliputi pengujian non simulatif lembaran (pengujian tarik untuk nilai

n dan r) dan pengujian simulatif lembaran (perentangan dan penarikan lembaran, batas tinggi kubah (LDH) dan batas rasio penarikan (LDR).
Prasyarat: Proses Manufaktur Logam

ENMT 607032 – DESAIN REKAYASA PRODUK – (3 SKS)
Pengantar Desain Rekayasa, Aktivitas Desain secara Menyeluruh, Dinamika Kelompok dan Manajemen Desain, Penelusuran Informasi dan Analisis Kebutuhan, Identifikasi Masalah dan Spesifikasi Desain, Kreativitas dan Pembuatan Konsep-konsep Desain, Pemodelan, Optimasi, Pemilihan Material dan Proses, Komunikasi dan Presentasi Desain.
Prasyarat: Teknologi Polimer, Teknologi Keramik, Teknologi Komposit, Proses Pembuatan Besi Baja

ENMT 607033 – KAPITA SELEKTA – (2 SKS)
Topik–topik khusus yang belum tercakup dalam mata ajaran dan diberikan oleh nara sumber eksternal yang berpengalaman di dunia kerja.
Prasyarat: Proses Manufaktur Logam, Korosi & Proteksi Logam

ENMT 607034 – MEKANIKA PERPATAHAN & ANALISIS KEGAGALAN – (4 SKS)
Aspek–aspek rekayasa kegagalan dan analisanya, sumber/faktor kegagalan material penjabaran faktor kegagalan, teknik analisis kegagalan, penjabaran analisis kegagalan, jenis perpatahan, sistem tegangan dan residual stress (tegangan sisa), teori Mekanika perpatahan dan pengantar inspeksi berbasis resiko, perpatahan akibat: fatik, creep (mulur), keausan, kerapuhan, perlakuan panas, tegangan sisa, korosi dan lingkungan, beserta studi kasusnya.
Prasyarat: Metalurgi Fisik 1, Pengujian Material, Analisa Struktur Material, Korosi & Proteksi Logam

ENMT 600035 – KERJA PRAKTEK – (2 SKS)
Kerja Praktek di industri selama minimal 1 bulan. Studi dan menggambarkan proses pekerjaan teknis, kontrol kualitas, manajemen proyek, spesifikasi proyek, gambar teknik dan aspek lainnya; Mengidentifikasi masalah yang berkaitan dengan pekerjaan teknis, kontrol kualitas, manajemen proyek, Specifiations proyek, gambar teknik dan aspek lainnya; Melakukan masalah yang terjadi pada setiap tahap proyek; Menentukan cara atau solusi untuk mengatasi masalah yang terkait dengan proyek belajar; Menyiapkan laporan akhir termasuk deskripsi proyek, permasalahan yang ada dan pemecahan masalah. Hasil Kerja Praktek disajikan dalam bentuk laporan dan di presentasikan di hadapan sidang kerja praktek (KP)
Prasyarat: Telah memperoleh minimal 100 SKS

ENMT 600036 – SEMINAR – (1 SKS)
Cara penulisan tugas akhir termasuk penelitian awal, cara penulisan abstraksi, metodologi penelitian, jenis rujukan, pembahasan, serta kesimpulan. Membuat tulisan ilmiah daritugas akhir yang kemudian dipresentasikan sesuai dengan persyaratan jurnal tertentu atau presentasi proposal tugas akhir
Prasyarat: Telah memperoleh minimal 105 SKS

ENMT 600037 – TUGAS AKHIR – (4 SKS)
Penerapan/pelaksanaan berbagai mata kuliah yang diikuti secara integrasi dalam suatu penelitian guna memecahkan suatu permasalahan dibidang teknik metalurgi dan material. Hasil penelitian disajikan dalam bentuk laporan ilmiah dan dipresentasikan didepan tim dosen penguji.
Prasyarat: Telah memperoleh minimal 125 SKS

MATA KULIAH PILIHAN

ENMT 607938 – ADITIF POLIMER – (2 SKS)
Peranan strategis industri polymer compounding. Jenis, fungsi aditif dan pemodifikasian sifat produk polimer sesuai tuntutan pasar. Teori pencampuran pada basis polimer. Jenis metode proses fabrikasi polymer compounding (dry dan hot-melt mixing) pada termoplastik dan karet. Evaluasi keberhasilan polymer compounding. Teknik pengamatan/ pengujian dispersi dan distribusi aditif pada produk bijih plastik.
Prasyarat: Teknologi Polimer

ENMT 607939 – BAJA KHUSUS & PADUAN SUPER – (2 SKS)
Klasifikasi serta penggunaan baja khusus dan paduan super, unsur paduan dan mikrostruktur baja paduan dan paduan super, baja tahan karat (feritik, austenitik, duplex, martensitik, precipitation hardening stainless steel), Baja tahan panas (heat resistant steel), Baja tahan aus/abrasi (wear resistant steel) , Baja perkakas (tool steel), Baja paduan lainnya, paduan super (paduan berbasis Ni dan Co).

Prasyarat: Proses Pembuatan Besi Baja

ENMT 607940 - BIOMATERIALS – (2 SKS)
Tinjauan biomaterial dan penggunaannya dalam alat kesehatan, persyaratan fisik dan teknik untuk bahan alat kesehatan, bahan logam, korosi dari implan logam dan prosthetic devices, analisis kegagalan metallic implant ortopedic, bahan keramik, bahan polimer, perekat, coatings, biomaterial untuk aplikasi dental, noda dan korosi gigi paduan, gesekan dan keausan bahan dental
Prasyarat: Statika Mekanika Material, Korosi & Proteksi Logam

ENMT 907941 – DESAIN PABRIK METALURGI – (2 SKS)
Pendekatan berbasis resiko untuk merencanakan desain, proses ekonomi dan seleksi, kasus bisnis, pemilihan lokasi, pengembangan proyek, mengelola risiko teknologi, custom designed equipment, keberlanjutan dalam desain pabrik, desain untuk keamanan, tata letak tanaman dan logistik, pelaksanaan proyek
Prasyarat: Metalurgi Ekstraksi Non Ferrous, Proses Pembuatan Besi Baja

ENMT 607942 – KOROSI TEMPERATUR TINGGI – (2 SKS)
Thermodinamika reaksi oksidasi logam, Diagram Ellingham, Struktur oksida (produk korosi) : stoikhiometri dan non-stoikhiometri, Oksida type-n dan type-p, Rasio Pilling-Bedworth, Mekanisme pertumbuhan oksida : difusi dan migrasi, Laju kinetika pertumbuhan oksida : Wagner- parabolik, logaritmik, linier, Aspek morfologi lapisan oksida (produk korosi), Korosi temperatur tinggi pada lingkungan spesifik : garam lebur (hot corrosion), boiler, karburisasi/metal dusting, sulfidisasi dan siklus termal, Metoda perlindungan korosi temperatur tinggi : pemilihan material, logam paduan tahan temperatur tinggi, coating/perlakuan permukaan
Prasyarat: Korosi & Proteksi Logam

ENMT 607943 – MATERIAL ELEKTRONIK – (2 SKS)
Konsep dasar teori elektron (dualitas gelombang - partikel, elektron bebas, elektron hampir bebas, struktur pita, isolator - konduktor - semikonduktor). teori modern padatan (teori band padatan, kepadatan materi, statistik Boltzmann dan Fermi-Dirac, elektron massa efektif dan energi Fermi). konduksi listrik dalam bahan (teori elektron klasik, pertimbangan kuantum mekanik, magnet, superkonduktivitas, dielektrik dan isolator, fenomena termoelektrik). Semikonduktor (intrinsik dan ekstrinsik semikonduktor, semikonduktor merosot, recombination and minority carrier junction, persimpangan Schottky dan kontak ohmik, perangkat semikonduktor)
Prasyarat: Fenomena Perpindahan

ENMT 607944 – METODOLOGI PENELITIAN – (2 SKS)
Pengertian ilmiah, metodologi penelitian, perumusan masalah, hipotesa, penelaahan pustaka, pengumpulan dan pengolahan data, penyusunan usulan penelitian serta penyajian karya ilmiah
Prasyarat: -

ENMT 607945 – PEMROSESAN PLASTIK – (2 SKS)
Pengantar polimer dan produknya. Sifat-sifat polimer yang terkait pemrosesan. Teori reologi polimer. Tahapan dan jenis mesin prosessan produk polimer. Injection molding. Ekstrusi (blown film, callendering, blow molding dan thermoforming). Komposit (Reinforcing process. Laminating process)
Prasyarat: Teknologi Polimer

ENMT 607946 – REFRAKTORI MATERIAL – (2 SKS)
Pendahuluan, Jenis Refraktori (asam, basa, netral), Bentuk Refraktori, Aplikasi Refraktori di Industri
Prasyarat: Teknologi Keramik

ENMT 607947 – SISTEM MANAJEMEN MUTU – (2 SKS)
Umum, pendekatan proses, hubungan dengan ISO 9004, persesuaian dengan sistim lainnya seperti manajemen lingkungan dan K3. Persyaratan sistim manajemen mutu termasuk lingkup penerapan, acuan yang mengatur, istilah dan definisi, persyaratan dokumentasi, tanggung jawab manajemen, pengelolaan sumber daya, produk realisasi, pengukuran kinerja, analisis dan pemantauan serta peningkatan sistim yang berkelanjutan termasuk internal audit, tindakan koreksi dan pencegahan.
Prasyarat: Statistik & Probabilitas

ENMT 608948 – ANALISIS PEMBENTUKAN LOGAM – (2 SKS)
Tinjauan tegangan regangan, analisis kesetimbangan energi, analisis kesetimbangan gaya, upper bound analysis, slip

line field analysis, finite element analysis, circle grid analysis, distortion and deformations analysis
Prasyarat: Statika Mekanika Material, Proses Manufaktur Logam, Desain Rekayasa Produk

ENMT 608949 – EKOLOGI INDUSTRI – (2 SKS)
Pandangan pada Ekologi Industri, Life-Cycle Assessment: Metode Dasar, Evaluasi Lingkungan dan Advanced Method, Aggregate Materials Flows, Strategi Kebijakan Lingkungan
Prasyarat: Metalurgi Ekstraksi Non Ferrous, Proses Pembuatan Besi Baja

ENMT 608950 – KOROSI PADA BETON – (2 SKS)
Sifat Material Semen : Jenis-jenis semen, water/semen ratio, porositas, permeabilitas. Proses transport pada semen : komposisi larutan pori dan kandungan air. Proses transport dan kandungan air, difusi, migrasi, parameter dan mekanisme transport. Degradasi semen : serangan asam, serangan air laut. Mekanisme korosi dalam semen, Aspek Elektrokimia, Korosi yang dipicu oleh Karbonasi, Korosi yang dipicu oleh ion Khlorida, Korosi yang dipicu 'stray-current',Korosi retak tegangn retakan yang dipicu oleh Hydrogen. Pencegahan Korosi pada baja dalam semen : Inhibitor, Perlakuan permukaan, Material selection, Proteksi Katodik, Inspeksi dan Monitoring, Repair.
Prasyarat: Korosi & Proteksi Logam

ENMT 608951 – MATERIAL ENERGI – (2 SKS)
Pengantar material energi, bahan fotovoltaik, sel surya dye-sensitized, baterai lithium ion, nanopartikel tembaga, nanotube karbon, aplikasi dan proses manufaktur
Prasyarat: Teknologi Polimer, Teknologi Komposit, Teknologi Keramik

ENMT 608952 – METALURGI EKSTRAKSI LANJUT – (2 SKS)
Karakterisasi Limbah untuk bahan baku proses. Inovasi proses metalurgi basah (hydrometallurgy) dan metalurgi panas (pyrometallurgy)untuk bahan baku kadar rendah dan efisiensi energi: mekanisme reaksi dan aplikasi, seperti esktraksi logam dengan plasma, gelombang mikro. Proses daur ulang logam. Pemrosesan terak, debu dan partikel abu metalurgi. Pemrosesan dan pemanfaatan produk sampingan (by product): pemanfaatan terak, pemrosesan dross, pemrosesan abu terbang. Perolehan logam dari limbah proses (seperti tailing, residue, sludges): pemrosesan mineral dari tailing, perolehan logam dari red mud, perolehan logam dari waste sludge. Teknologi baru proses daur ulang logam.
Prasyarat: Metalurgi Ekstraksi Non Ferrous

ENMT 608953 – PERALATAN MEKANIKA INDUSTRI – (2 SKS)
kode dan standar, pipa dan fittings pipa, katup, pipa sambungan untuk peralatan proses (tank, pressure vessels, heat exchanger, pompa, kompresor), sistem pipa minyak, gas, lng, panas bumi, air, kimia, sistem pipa untuk instrumentasi, pipa dan diagram instrumen (p & id), rencana plot, isometrik, cross section, gambar pipa fabrikasi, pipa proses, pipa utility, onshore dan lepas pantai
Prasyarat: Proses Manufaktur Logam, Korosi & Proteksi Logam

ENMT 608954 – REKAYASA PERMUKAAN MATERIAL LANJUT – (2 SKS)
Dasar rekayasa permukaan, rekayasa permukaan konvensional, rekayasa permukaan lanjut, pelapisan permukaan, modifikasi permukaan, karakterisasi thin film.
Prasyarat: Perlakuan Panas & Rekayasa Permukaan

ENMT 608955 – STANDARDISASI MATERIAL – (2 SKS)
Pengantar aturan standar material, jenis standar material, standar material di industri.
Prasyarat: -

ENMT 608956 - PLASTIC RECYCLING TECHNOLOGY – (2 SKS)
Peraturan nasional dan internasional tentang daur ulang polimer. Siklus material polimer. Klasifikasi industri polimer di Indonesia. Produk polimer dan ekologi. Prinsip dasar pendaur ulangan. Tahapan dan jenis proses/permesinan daur ulang produk polimer. Pemilihan metode proses pendaur ulangan produk polimer. Rekayasa secara kimia dan fisika produk daur ulang polimer. Studi kasus pendaur ulangan produk polimer (polietilentereptalat-PET, PE & PP, polistirena-styrofoam, PVC, poliakrilat, termoplastik enjineering-ABS, karet dan thermoset) Prasyarat: Teknologi Polimer

ENMT 608957 – TEKNOLOGI KARET – (2 SKS)
Pendahuluan, jenis dan sifat dasar pada bahan baku dan produk karet, aditif-aditif pada produk karet, proses dan

peralatan manufaktur produk karet, metode pengujian bahan baku dan produk karet, aplikasi dan pengembangan produk karet
Prasyarat: Teknologi Polimer

ENMT 608958 – TEKNOLOGI NANO – (2 SKS)
Definisi dan ruang lingkup, kimia fisik permukaan padatan, struktur-struktur nano (zero, one and two-dimensional: 0D, 1D, 2D), material-material nano khusus, proses-proses fabrikasi (lithography, nanolithography, soft-lithography, assembly), karakterisasi (struktural, fisika dan kimia) dan aplikasi (sensor kimia, biosensor, MEMS/Microelectromechanical system, DNA chips, photonic crystals).
Prasyarat: Teknologi Polimer, Teknologi Komposit, Teknologi Keramik

Curriculum of 2016 – Subjects Syllabus
Bachelor Degree – Dept. of Metallurgy & Materials Engineering

ENMT 601001 - ENGINEERING DRAWING – (2 Credit Points)
Illustration: Function and benefit of Engineering Drawing; SAP; Measurement and Evaluation; Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, fild, line confiuration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, confiuration geometric form; Orthogonal Projection: Projection standard, viewing concept, width display principle; Advanced orthogonal projection: Circle region concept, special region concept, trimming concept, display width, refraction.
Prerequisite: -

ENMT 601002 - INTRODUCTION TO ENGINEERING MATERIALS – (2 Credit Points)
(1) Types of engineering materials and their applications; (2) Structures of engineering materials; (3) Properties of material; (4) Manufacturing and Processing of Metallic Materials; (5) Steel and iron: production and properties; (6) Aluminium: production and properties;(7) Other non-ferrous alloys: production and properties; (8) Polymer: processing and properties; (9) Ceramic: processing and properties; (10) Composite: processing and properties
Prerequisite: -

ENMT 601003 - BASIC CHEMISTRY LABORATORY – (1 Credit Point)
Physical and chemical properties; Separation and purification of the substance; Identification of alkali metal ions, alkaline earth, ammonium, sulfate, iodid, bromide and nitrate; acid-base titration; metal and acid reaction; Water crystals
Prerequisite: -

ENMT 603004 - ELECTRO-CHEMISTRY – (3 Credit Points)
Basic concepts and applications of electrochemistry, and conductivity solution, Faraday's law, and their application.Elektrode electrochemical cell (definition, potential, equation Nerst, electrical double layer, the polarization, the measurement of potential, free energy and electrode potential, equilibrium potential), the reference electrode,Construction Pourbaix diagram and its application. Electrochemical kinetics, electrode reaction speed, mixed potential theory, Evans-diagram, the mixed-potential diagram
Prerequisite: -

ENMT 603005 - CHEMICAL CHARACTERIZATION OF MATERIAL – (2 Credit Points)
Review of structure and physiochemical characteristics of materials, concept of material analysis (qualitative and quantitative), principal of analysis instrument from spectroscopy method (UV/VIS, FTIR, XRF, Spark Emission) and thermal method (TGA, DSC/DTA, MFI and Vicat), material characterization strategy.
Prerequisite: -

ENMT 603006 - PHYSICAL METALLURGY 1 – (4 Credit Points)
(1) Definition of crystal; (2) Crystal lattice(3) Unit cell; (4) Bravais lattice; (5) Miller index for planes and direction; (6) Stereographic projection; (7) Crystal symmetry; (8) Formation of crystal; (9) Identification of crystal; (10) Crystal defects: point defects, line defects (dislocations), edge dislocations, screw dislocations, burgers vector, movement of dislocations, energy of dislocation, dislocations in FCC, BCC and HCP structures, planar defects; (11) Fatigue and Fracture of Materials; (12) Creep of Materials; (13) Strengthening Mechanism: strain (work) hardening, grain boundary strengthening, solid solution strengthening, precipitation (two-phase) strengthening, steel alloys strengthening, composite strengthening, study case in materials strengthening.
Prerequisite: -

ENMT 603007 - STATIC & MECHANIC OF MATERIALS – (3 Credit Points)
General principle of mechanics, Vector and forces, Equilibrium points, Resultant of forces, Structure analysis, Center of gravity and centroid, Moment inertia, Internal forces, Friction. The concept of stress strain, Relation of stress and strain in axial loading, Twisting, Buckling, Transversals loading, Stress analysis, Design of shaft and beam, Beam deflection, Structural joints, Column and thick cylinder, Energy method.
Prerequisite: -

ENMT 603008 - THERMODYNAMICS OF MATERIALS – (3 Credit Points)
Definition of thermodynamics, first, second, and third law of thermodynamics, statistical interpretation of entropy, auxiliary functions, heat capacity, enthalpy and entropy, phase equilibrium in a component, gas and solution behavior, free energy, binary system composition, reaction of pure condensation phase and gas phase, equilibrium reaction of a system in a solution component
Prerequisite: -

ENMT 604009 - TECH. OF MICROSTRUCTURAL ANALYSIS – (2 Credit Points)
Techniques of microstructure analysis, Phase formation and general characteristic of material structures, Microstructure of steel; stable and metastable phases and the formation and mechanism, Microstructure of non-ferrous alloys; aluminum, copper, titanium, Macrostructure, Sampling techniques, Samples preparation, Observation techniques with optical and electron microscopes, Special measurements; micro-hardness, coating thickness, roughness, Quantitative metallography; grain size, volume fraction of phases and precipitates.
Prerequisite: Physical Metallurgy 1

ENMT 604010 - POLYMER CHEMISTRY – (4 Credit Points)
Fundamentals of organic chemistry (bonding atom and molecule, polar molecules, free radicals, the nomenclature of organic compounds, isomer,

conjugation and resonance). Reaction types of organic compounds, addition reactions, nucleophilic and electrophilic substitution, elimination, rearrangement, and radical reaction mechanism. Basic Properties of Polymer Chemistry
Prerequisite: -

ENMT 604011 - NUMERICAL COMPUTATION – (2 Credit Points)
Introduction to models, types of models, basics of Matlab, array in Matlab, if and switch selection, loop in Matlab, function and m-file in Matlab, linear equation, Taylor expansion method, Euler, differential equation, basic of solid works, solid modeling, basics of simulink, first and second order simulink
Prerequisite: -

ENMT 604012 - PHYSICAL METALLURGY 2 – (3 Credit Points)
(1) Concept of Equilibrium: single component system, binary component system, the phase rule, binary phase diagrams; (2) Fe-Fe3C Phase Diagram; (3) Ternary Equilibrium: ternary system representation, ternary system containing 2 phase, ternary system containing 3 phase; (4) Diffusion in Materials: atomic mechanism of diffusion, interstitial diffusion, substitutional diffusion; (5) Crystal Interfaces and Microstructure: interfacial free energy, grain boundary, interphase interfaces in solids, interface migration; (6) Solidification: nucleation in pure metals, growth of a pure solid, solidification of alloy, solidification of ingots and castings, solidification of fusion welds, rapid solidification; (7) Diffusional Transformation in Solids: homogeneous and heterogeneous nucleation in solids, precipitate growth, transformation kinetics, eutectoid transformation, ordering transformation; (8) Diffusionless Transformation in Solids: theories of martensite nucleation, martensite growth, tempering of ferrous martensite, martensite transformation in nonferrous metals, case study in diffusionless transformation
Prerequisite: Thermodynamics of Materials

ENMT 604013 - MINERAL PROCESSING – (4 Credit Points)
Understanding mineralogy, classification of minerals, mineral properties, mineral that has economic value. Terminology and basic concepts of processing mineral / ore, potential sources of mineral / ore that can be processed in a technically and economically, the processes of size reduction (comminution): The process of crushing, screening process, grinding process, the classification process, process of separation/concentration: Gravity concentration: Concentration Heavy Jigging Flowing Film, Media Separation, Flotation process, Magnetic Separation, High Tension Separation, Dewatering and Thickening process
Prerequisite: Physical Metallurgy 1

ENMT 604014 - TESTING OF MATERIALS – (2 Credit Points)
Introduction to material testing, Review of mechanical behavior of materials, Data analysis and presentation of test results, Testing procedures, Testing machine and instruments, Standardization of materials testing, Destructive testing (tensile, compression, shear, fatigue, stress relaxation, and wear), Non-destructive (visual, penetrant, ultrasonic, radiography, eddy current and magnetic particle)
Prerequisite: Physical Metallurgy 1

ENMT 604015 - TRANSPORT PHENOMENON – (3 Credit Points)
Mass transfer, Fluid flow concept, Laminar flow, momentum conservation, Turbulent flow, Enthalpy & heat transfer, Solid & liquid diffusion mass transport
Prerequisite: Thermodynamics of Materials

ENMT 604016 - CHEMICAL CHARACTERIZATION OF MATERIAL LABORATORY – (1 Credit Point)
Quantitative analysis of organic and anorganic matter using titrimetry method
Prerequisite: Chemical Characterization of Material

ENMT 605017 - INDUSTRIAL MANAGEMENT – (2 Credit Points)
Introduction to industrial management, organization and management functions, theories and techniques of decision-making, management of production / operations, the strategic decisions of products and processes, location and layout, management and control of stocks (inventory), R & D, project management, QC and productivity, management production practices, marketing and industrial management, HR management, IT and manufacturing industry, manufacturing industry in Indonesia
Prerequisite: -

ENMT 605018 - NON-FERROUS EXTRACTIVE METALLURGY – (3 Credit Points)
Basic principles of extractive metallurgy (pyrometallurgy, hydrometallurgy and electrometallurgy). Process/treatment process of ore to be extracted. Leaching method of oxide and sulfide ores, Bayer process, Al, Au leaching by cyanidation (Leaching; precipitation techniques; ion exchange; solvent extraction; reverse osmosis). Electrometallurgy (Electro winning and electro refining). Molten salt electro winning. Hall process. Electro winning of Mg, Ti. Secondary metals. Obtaining metals from scrap and secondary sources by using pyro, hydro, and electrometallurgy. Pyrometallurgy, mineral separation, slag, blast furnace, raw materials, reactions, material balance, iron ore, roasting, smelting, refining of Sn, Ni, Cu, Zn, Pb.
Prerequisite: Electro-chemistry, Mineral Processing

ENMT 605019 - HEAT TREATMENT & SURFACE ENGINEERING – (3 Credit Points)
Definition of heat treatment, phase transformation and microstructure, TTT and CCT diagram, the influence of heating and cooling rate, stable and metastable microstructure, hardenability, the influence of alloying element, hardening, softening, temper brittleness, distortion and its prevention, carburization, nitro-carburizing, nitriding, boronizing, non-ferrous heat treatment, various heat-treating furnace and its atmosphere, deviation in heat treatment process, special heat treatment, case study of heat treatment and surface engineering
Prerequisite: Physical Metallurgy 1

ENMT 605020 - METAL MANUFACTURING PROCESS – (4 Credit Points)

The forming of metals as a part of design process and manufacture; fundamentals of metal casting (mould, molten metal, solidification), mould (sand, ceramic, metal), pouring system (pattern, riser, pressure and unpressure, chill) and its simulation, solidification of cast iron and aluminum, liquid treatment for ferrous metals (inoculation, Mg treatment) and non-ferrous (modifier, grain refiner), various methods of casting, casting defect; common principle of solid forming of a metal, techniques of metal forming through: pressing, forging, rolling, extrusion, wire drawing, sheet metal forming; thermo-mechanical processing (TMP). General principle of powder metallurgy, powder fabrication and mechanism of powder forming, powder characteristics and characterization, mechanical alloying, pre-compaction process, compaction, precursor characteristic, sintering and powder consolidation, full density processing, sintering equipment and related aspects, application of powder metallurgy products
Prerequisite: Physical Metallurgy 1

ENMT 605021 - POLYMER TECHNOLOGY – (3 Credit Points)
Relationship of structure and behaviour of polymer molecule, polimer material characteristics (thermal, chemical, mechanic, optic and electrical), fabrication process stages (formulation, continuous & discontinuous manufacturing, product finalization) on thermoplastic, thermosetting and rubber product, polimer raw material formulation, case study of polymer product in packaging, automotive, electronic and construction application
Prerequisite: Polymer Chemistry

ENMT 605022 - TECH. OF MICROSTRUCTURAL ANALYSIS LABORATORY – (1 Credit Point)
Metallographic sample preparation (techniques of cutting, grinding, polishing and etching), micro-structural analysis techniques of metal (ferrous and non-ferrous) with an optical microscope
Prerequisite: Tech. of Microstructural Analysis

ENMT 605023 - TESTING OF MATERIALS LABORATORY – (1 Credit Points)
Tensile test, Compressive test, Micro and Macro Hardness test, Impact Test, Wear Test
Prerequisite: Testing of Materials

ENMT 606024 - CORROSION & PROTECTION OF METALS – (3 Credit Points)
Principles of corrosion, kinetics of corrosion, polarization, passivation, measurement of corrosion rate, metallurgical aspects, corrosion tests, forms of corrosion, high temperature corrosion, cathodic protection, anodic protection, coating, inhibition, materials selection and design, monitoring and inspection, analysis of corrosion driven-damage, standards related to corrosion
Prerequisite: Electro-Chemistry

ENMT 606025 - MATERIALS JOINING – (3 Credit Points)
Principles of various material joining and its classification, adhesive bonding, mechanical joining, methods of welding: fusion welding (electric arc), electrical resistance welding, pressure welding (solid state welding), other welding process (EBW, laser welding, thermit welding, underwater welding), soldering and brazing, design of joint and welding symbol, welding metallurgy: carbon steel, low alloy steel, stainless steel, concrete steel, non ferrous, WPS and welding standards and code, weld defect and its prevention, control of joint and its testing
Prerequisite: Physical Metallurgy 1, Testing of Materials

ENMT 606026 - IRON & STEEL MAKING PROCESS – (2 Credit Points)
Classification and the development of steel (iron ores, reductor, etc.) and their preparatory process, thermodynamics and kinetics of iron and steel making process, blast furnace reduction of iron ores, direct reduction (hylsa, midrex, rotary kiln SL-RN, rotary hearth), smelting reduction, desulfurization, deoxidation, dephosphorisation, degassing, steel making in EAF (Electric Arc Furnace) and BOF (Basic Oxygen Furnace), secondary metallurgy process, continuous casting, hot and cold rolling, special steel making
Prerequisite: Mineral Processing

ENMT 606027 - CERAMIC TECHNOLOGY – (3 Credit Points)
Introduction to ceramics (general), crystal structure, glass structure, phase diagrams, phase transformations. Properties of ceramics: thermal, optical, mechanical, electrical and magnetic fields, as well as the nature dielektris. Manufacture of ceramic technology and applications: conventional ceramic (aluminum-silicate; clay, glaze); cement and concrete; glass and advanced ceramics (advanced ceramics). The processes for modern ceramics, ceramic thin film, ceramic for field application of mechanical, electronic, optical and magnetic. -Based ceramic matrix composites. Refractory ceramics. Refractory raw materials, types of refractories: refractory system Alumininum - silica, silica refractories, refractory magnesite, chromite refractories, refractory carbon, special refractories. Manufacture of refractories, the use of refractory metals in the industry and others, as well as the failure mechanism of refractory.
Prerequisite: Physical Metallurgy 2

ENMT 606028 - COMPOSITE TECHNOLOGY – (3 Credit Points)
The concept, definition and clarification of the composite, matrix and reinforcement type for composites, metal matrix composite, polymer matrix composite, ceramic matrix composite, fiber composite nature. Reinforced fibers and Whiskers, the rule of mixtures, the interface in composite materials, interfacial area, Interfacial Wettability, interfacial bonding
Prerequisite: Polymer Technology

ENMT 606029 - CORROSION & PROTECTION OF METALS LABORATORY – (1 Credit Point)
Corrosion cells, corrosion potential measurement of selected metals, polarization of stainless steel, cathodic protection, surface treatment.
Prerequisite: -

ENMT 606030 - EXTRACTIVE METALLURGY LABORATORY – (1 Credit Point)
Metals extraction test and electrometallurgy (e.g. Electroplating, froth flotation)
Prerequisite: Non Ferrous Extractive Metallurgy

ENMT 606031 - METAL MANUFACTURING PROCESS LABORATORY – (2 Credit Points)
(1) Sand particle size distribution, water content calculation, additive substance (bentonite) content in mould, sand flowablity, relation of water and additive content in sand with permeability, shear and compressive strength of sand, (2) utilization of simulation software in calculation and design of casting, (3) Design of inlet and riser, mould making from patterns, making of the core of the mould, melting and pouring of molten metal to the mould, analysis of casting defect, analysis of casting product related to the alloying element and casting process. (4) Solid silinder forging, (5) Sheet metal rolling, (6) Sheet metal forming which includes non-simulative testing (tensile testing for n and r value), and simulative testing (strecthing and deep-drawing, LDH and LDR)
Prerequisite: Metal Manufacturing Process

ENMT 607032 - ENGINEERING DESIGN OF PRODUCT – (3 Credit Points)
Introduction to Engineering Design, total design activity, group dynamics and design management, problem identification and design specification, creativity and the conception of design, modeling, optimallisation, materials and process selection, design communication and presentation.
Prerequisite: Polymer Technology, Composite Technology, Ceramic Technology, Iron & Steel Making Process

ENMT 607033 - CAPITA SELECTA – (2 Credit Points)
Specific topics that have not been included in Subjects and supplied by external resource persons which is experienced in industry
Prerequisite: Metal Manufacturing Process, Corrosion & Protection of Metals

ENMT 607034 - FRACTURE MECHANICS & FAILURE ANALYSIS – (4 Credit Points)
Aspects of failure engineering and its analysis, sources/factors contributing the material's failure, explanation of failure factors, types of fractures, stress system and residual stress, theories of fracture mechanics and introduction to the risk-based inspection, failure due to: fatigue, creep, wear, brittleness, heat behavior, residual stress, corrosion and environment, case study.
Prerequisite: Physical Metallurgy 1, Testing of Materials, Tech. of Microstructural Analysis, Corroson & Protection of Metals

ENMT 600035 - INTERNSHIP – (2 Credit Points)
Specify the job objectives in the proposal; Implement an internship at a site that has been approved and in accordance with its specifiity; Study and describe the process of technical work, quality control, project management, project specifications, engineering drawings and other aspects; Identify the problem related to the technical work, quality control, project management, project specifiations, engineering drawings and other aspects; Conduct problems that occur at each stage of the project; Determine ways or solutions to overcome the problems associated with the project learned; Prepare a final report includes project description, existing problems and problem solving
Prerequisite: Student has obtained minimum of 100 credits

ENMT 600036 - SEMINAR OF FINAL PROJECT PROPOSAL – (1 Credit Points)
Final assignment writing guide including initial research, abstract writing guide, research methodology, type of references, discussion, also conclusion. To make scientific paper from existing final report which then be presented according to certain journal term or final assignment proposal presentation.
Prerequisite: Student has obtained minimum of 105 credits

ENMT 600037 - FINAL PROJECT – (4 Credit Points)
Implementation/application of various lectures taken by students on integration in a research to solve a problem in metallurgy and material engineering field. The research result is presented in a form of scientific report and presented in front of the judging lecturers.
Prerequisite: Student has obtained minimum of 125 credits

ELECTIVES

ENMT 607938 - POLYMER ADDITIVES – (2 Credit Points)
Strategic role of polymer compounding industries, additives type and functions, modification of polymer product according to market, mixing theory in polymer base material, polymer compounding fabrication process for thermoplastic and rubber, success evaluation for polymer compounding, dispersion test / observation and additives distribution in plastic pellet product
Prerequisite: Polymer Technology

ENMT 607939 - SPECIAL STEELS & SUPER ALLOYS – (2 Credit Points)
Classification, alloying elements and microstructures of special steels and super alloys which include: stainless steels (ferritic, austenitic, duplex, martensitic, and precipitation hardened), heat resistant steels, wear resistant steels, tool steels, Ni and Co based steels.
Prerequisite: Iron & Steel Making Process

ENMT 607940 - BIOMATERIALS – (2 Credit Points)
Overview of Biomaterials and Their Use in Medical Devices, Physical and Mechanical Requirements for Medical Device Materials, Metallic Materials, Corrosion of Metallic Implants and Prosthetic Devices, Failure Analysis of Metallic Orthopedic Implants, Ceramic Materials, Polymeric Materials, Adhesives, Coatings, Biomaterials for Dental Applications, Tarnish and Corrosion of Dental Alloys, Friction and Wear of Dental Materials
Prerequisite: Statics & Mechanics of Materials, Corrosion & Protection of Metals

ENMT 907941 - METALLURGICAL PLANT DESIGN – (2 Credit Points)
Risk-based approach to plan design, process economic and selection, business case, site selection, project development, managing technology risk, costum designed equipment, sustainability in plant design, design for safety, plant layout and logistics, project implementation
Prerequisite: Non Ferrous Extractive Metallurgy, Iron & Steel Making Process

ENMT 607942 - HIGH TEMPERATURE CORROSION – (2 Credit Points)
Metal oxidation reaction thermodynamics, Ellingham diagram, oxide structure, type-n and type-p oxidation, Pilling-Bedworth ratio, oxide growth

mechanism and rate, high temperature corrosion in specific environment (hot corrosion, boiler, carburization, thermal cycle), protection method (material selection, high temperature resistant alloy, coating / surface engineering)
Prerequisite: Corrosion & Protection of Metals

ENMT 607943 - ELECTRONIC MATERIALS - (2 Credit points)
Elementary concepts of electron theory (wave – particle duality, free electrons, nearly free electrons, band structure, insulators – conductors – semiconductors). Modern theory of solids (band theory of solids, density of states, Boltzmann and Fermi-Dirac statistics, electron effective mass and Fermi energy). Electrical conduction in materials (classical electron theory, quantum mechanical considerations, magnetism, superconductivity, dielectrics and insulator, thermoelectric phenomena). Semiconductors (intrinsic and extrinsic semiconductors, degenerate semiconductors, recombination ad minority carrier junction, Schottky junctions and Ohmic contacts, semiconductor devices)
Prerequisite: Transport Phenomenon

ENMT 607944 - RESEARCH METHODOLOGY - (2 Credit Points)
Scientific understanding, research method, problem specifiation, hypothesis, literature study, data collection and processing, elaboration of research proposal and scientific work presentation
Prerequisite: -

ENMT 607945 - PLASTIC PROCESSING - (2 Credit Points)
Introduction of polymer and its product, polymer characteristics related to process, polymer rheology, polymer equipment (injection molding, blow molding, calendaring, thermoforming), polymer composites (reinforcing process, laminating process)
Prerequisite: Polymer Technology

ENMT 607946 - REFRACTORY MATERIALS - (2 Credit Points)
Introduction to refraktory materials. Types of refractory materials (acid, basic, neutral refractory). Shape of refractory materials. Industrial application.
Prerequisite: Ceramic Technology

ENMT 607947 - QUALITY MANAGEMENT SYSTEMS - (2 Credit Points)
General introduction, ISO 9004 system approach and its connection with environment and safety, quality management system requirement, internal audit, correction and preventive procedure
Prerequisite: Statistic & Probability

ENMT 608948 - ANALYSIS OF DEFORMATION - (2 Credit Points)
Review of Stress and Strain, Energy-Balance Analysis, Force-Balance Analysis, Upper Bound Analysis, Slip Line Field Analysis, Finite Element Analysis, Circle Grid Analysis, Distortion and Deformations Analysis
Prerequisite: Statics & Mechanics of Materials, Metal Manufacturing Process, Engineering Design of Products

ENMT 608949 - INDUSTRIAL ECOLOGY - (2 Credit Points)
Views on Industrial Ecology, Life-Cycle Assessment: Method Basics, Environmental Evaluation and Advanced Methods, Aggregate Materials Flows, Environmental Policy Strategies
Prerequisite: Non Ferrous Extractive Metallurgy, Iron & Steel Making Process

ENMT 608950 - CONCRETE CORROSION - (2 Credit Points)
Cement material characteristics (types, water ratio, porosity, permeability), transport process of cement (water content and diffusion), cement degradation (sea water attack, acid attack), corrosion mechanism in cement, electrochemistry aspects, carbonated corrosion, chloride corrosion, stray current corrosion, hydrogen corrosion, corrosion protection (inhibitor, surface engineering, cathodic protection, inspection, monitoring, repair)
Prerequisite: Corrosion & Protection of Metals

ENMT 608951 - ENERGY MATERIAL - (2 Credit Points)
Introduction to energy material, photovoltaic material, dye-sensitized solar cell, lithium ion battery, copper nanoparticles, carbon nanotubes, applications and manufacturing process
Prerequisite: Polymer Technology, Composite Technology, Ceramic Technology

ENMT 608952 - ADVANCED EXTRACTIVE METALLURGY - (2 Credit Points)
Waste characterization for raw material, innovation in hydrometallurgy and pyrometallurgy for energy efficient process, metal recycle process, by-product process and utilization, mineral processing from tailing, metal recovery from red mud and water sludge, updated technology for metal recycle process.
Prerequisite: Non Ferrous Extractive Metallurgy

ENMT 608953 - INDUSTRIAL MECHANIC EQUIPMENTS - (2 Credit Points)
Code and Standard, Pipes and Pipe Fittings, Special Items, Valves, Pipe Connection to Process Equipments (Tanks, Pressure Vessels, Heat Exchangers, Columns, Pumps, Compressors), Piping System for Oil, Gas, LNG, Geothermal, Water, Chemical, Piping System for Instrumentation, Piping and Instrument Diagram (P & ID), Plot Plan, Isometric, Cross Section, Pipe Fabrication Drawings, Process Pipes, Utility Pipes, Onshore and Offshore
Prerequisite: Metal Manufacturing Process, Corrosion & Protection of Metals

ENMT 608954 - ADVANCED SURFACE ENGINEERING - (2 Credit Points)
Fundamental of surface engineering, conventional surface engineering, advanced surface engineering practices, surface coatings and surface modifications, advanced topics on characterizations for thin film
Prerequisite: Heat Treatment & Surface Engineering

ENMT 608955 – MATERIAL STANDARDIZATION – (2 Credit points)
Introduction to material standard. Types of material standard. Industrial standard of materials.
Prerequisite: -

ENMT 608956 - PLASTIC RECYCLING TECHNOLOGY – (2 Credit Points)
National and international regulation on polymer recycling, polymer material cycle, classification of polymer industry in Indonesia, ecology and polymer product, basic principal for recycling, selection of polymer recycle methods, physical and chemical engineering of polymer recycle product, case study of polymer recycle (PET, PP, PE, PS, Styrofoam, PVC, polyacrylate, thermoplastic, ABS, rubber, thermoset)
Prerequisite: Polymer Technology

ENMT 608957 - RUBBER TECHNOLOGY – (2 Credit points)
Introduction, types and characteristics of rubber raw material and products, additives for rubber product, manufacturing process and equipment for rubber product, testing methods and applications of rubber products
Prerequisite: Polymer Technology

ENMT 608958 - NANO TECHNOLOGY – (2 Credit Points)
Scope and definition of nanotechnology, physical and chemical of solid surface, nanostructures (zero, one and two dimensional), special nanomaterials, fabrication processes (lithography, nanolithography, soft lithography, assembly), nanomaterial characterizations (physical, chemical and structural) and applications (MEMS, DNA chips, photonics, crystal)
Prerequisite: Polymer Technology, Composite Technology, Ceramic Technology