دليل

كلية الهندسة

2020

قسم هندسة المواد والمعادن

Department of Materials & Metallurgical Engineering

أولا:- قوائم مسميات المقررات الدراسية للمرحلة العامة :-

The 1st: List of General courses

Humanities courses العلوم الإنسانية

Course No.	Course name	Pre request المتطلبات	Units الوحدات	اسم المقرر	رقم المقرر
GH141	English Language I	Nil	3	اللغة الإنجليزية 1	ع أ 141
GH142	English Language II	GH141	3	اللغة الإنجليزية 2	ع أ 142
GH150	Arabic Language I	Nil	2	اللغة العربيه 1	ع أ 150
GH151	Arabic Language II	GH150	1	اللغة العربيه 2	ع أ 151
GH152	Technical Report Writing	GH151	1	كتابة التقارير التقنيه	ع أ 152
Total Credits			10	إجمالي عدد الوحدات	

General Science Courses العلوم الاساسية العامة

Course No.	Course name	Pre request المتطلبات	Units الوحدات	اسم المقرر	رقم المقرر
GS101	Mathematics I	Nil	3	الرياضيات 1	ع ع 101
GS102	Mathematics II	GS101	4	الرياضيات 2	ع ع 102
GS203	Mathematics III	GS102	3	الرياضيات 3	ع ع 203
GS204	Mathematics IV	GS102	3	الرياضيات 4	ع ع 204
GS111	Physics I	Nil	3	فيزياء 1	ع ع 111
GS112	Physics II	GS111	3	فيزياء 2	ع ع 112
GS112L	Physics Laboratory	GS112	1	فيزيا معمل	ع ع م 112
GS115	Chemistry	Nil	3	كيمياء	ع ع 115
GS115L	Chemistry Laboratory	GS115	1	كيميا معمل	ع ع 115
GS200	Computer Programming	GS102	3	برمجة حاسوب	ع ع 200
GS206	Statistics and Probabilities	GS101	3	الاحصاء والاحتمالات	ع ع 206
Total Credits			30	إجمالي عدد الوحدات	

General engineering courses العلوم الهندسية العامة

Course No.	Course name	Pre request المتطلبات	Units الوحدات	اسم المقرر	رقم المقرر
GE121	Engineering Mechanics I	Nil	3	ميكانيكا هندسية 1	هـ ع121
GE127	Engineering Drawing	Nil	2	رسم هندسي	هـ ع127
GE129	Workshop Technology	Nil	2	تقنية الورش	هـ ع129
GE129L	Workshop Technology Laboratory	GE129	1	معمل تقنية الورش	هـ ع م 129
Total Credits			8	إجمالي عدد الوحدات	

ثانيا :- قائمة مسميات المقررات الدراسية الملزمة لجميع طلبة القسم 2nd : List of Compulsory Courses

Course No.	Course name	Pre request المتطلبات	Units الوحدات	اسم المقرر	رقم المقرر
PH317	Modern Physics	GS112	3	الفيزياء الحديثة	ف317
M305	Advanced Mathematics	GS102/GS203	3	رياضة متقدمة	ر305
EE280	Electrical Engineering Fundamentals	GS102/GS112	3	أساسيات الهندسة الكهربية	هـ كه 280
MME210	Physical Chemistry	GS115/GS111	3	كيمياء طبيعية	هـ م م 210
MME211	Introduction to Thermodynamics	GS115L/MME210	3	الديناميكا الحرارية I	هـ م م 211
MME214	Analytical Chemistry	GS115/GS111	4	الكيمياء التحليلية	هـ م م 214
MME220	Introduction to Materials Engineering	GS101/GS111/ GS115	4	مقاومة المواد والمعادن	هـ م م 220
MME240	Strength of Materials	GS121	2	قوة المواد	هـ م م 240
MME306	Transport Phenomena	MME220/M305	3	ظواهر الانتقال	هـ م م 306
MME 309	Numerical Analysis	GS200/GS102	3	تحليل عددي	هـ م م 309
MME 312	Metallurgical Thermodynamics	MME211/MME220/GS102	3	الديناميكا الحرارية II	هـ م م 312
MME315	Polymer Chemistry	MME214/MME210/MME220	3	كيمياء البلمرات	هـ م م 315
MME320	Electrical Magnetic & Optical Properties	MME220/PH317/ GS112	4	الخواص المغناطيسية والكهربية والضوئية	هـ م م 320
MME325	Physical Metallurgy I	GS115/MME211/MME220	3	علم المعادن الفيزيائ I	هـ م م 325
MME326	Physical Metallurgy II	GS102/MME325	3	علم المعادن الفيزيائ II	هـ م م 326
MME327	Physical Metallurgy Lab	MME326	3	معمل الفحص المجهري	هـ م م 327
MME330	Extractive Metallurgy	MME214/MME312	3	استخلاص المعادن	هـ م م 330
MME331	Materials & Energy Balance	MME330	2	الاتزان المادي والطاقي	هـ م م 331
MME335	Corrosion Principles	MME312/MME325	3	اساسيات التاكل	هـ م م 335
MME340	Mechanical Properties of Materials	GS121/GS203//MME220/MME240	3	الخواص الميكانيكية للمواد	هـ م م 340
MME420	X-ray Diffraction	GS204/MME325/PH317	3	حيود الاشعة السينية	هـ م م 420
MME427	Engineering Alloys	MME327/MME326/MME330	3	السبائك الهندسية	هـ م م 427

MME436	Protection & Corrosion Control	GS203/MME335	3	الحماية والتحكم من التاكل	هـ م م 436
MME440	Mechanical Behaviour of Materials	MME340/MME326	3	السلوك الميكانيكي للمعادن	هـ م م 440
MME441	Fracture Mechanics & Failure Analysis	MME335/MME440/MME326	3	ميكانيكا التحطم وتحليل الانهيارات	هـ م م 441
MME450	Metal Shaping	MME326/MME440	3	تشكيل المعادن	هـ م م 450
MME461	Introduction to Ceramics	MME312/MME340	3	خزفيات I	هـ م م 461
MME462	Processing of Ceramics	MME461	3	خزفيات II	هـ م م 462
MME465	Polymer Chemistry	MME306/MME315/MME440	3	المواد البلمرية	هـ م م 465
MME470	NDT & Quality Control	MME436/MME450	4	الاختبارات اللإتلافية للمواد ومراقبة الجودة	هـ م م 470
MME480	Material Selection and Engineering Economics	M305/MME462/ MME465/MME427	3	مفاضلة واختيار المواد والاقتصاد الهندسي	هـ م م 480
MME499	Seminar		1	الندوة العلمية	هـ م م 499
MME599	B. SC. Project		4	مشروع التخرج	هـ م م 599
Total Credits			100	إجمالي عدد الوحدات	

ثالثا :- قائمة مسميات المقررات الدراسية الاختيارية. 3rd : List of Compulsory & Elective courses

يحق للطالب إختيار عدد 2 مقررات إختيارية من القائمة التالية بإجمالي عدد وحدات 6

Course No.	Course name	Pre request المتطلبات	units الوحدات	اسم المقرر	رقم المقرر
MME550	Elective 1		3	مقرر اختياري 1	هـ م م 550
MME551	Elective 2		3	مقرر اختياري 2	هـ م م 551
Total Credits			6	إجمالي عدد الوحدات	

ملخص متطلبات التخرج للطالب بقسم هندسة المواد والمعادن

القسم	الشعبة	العلوم الإنسانية		العلوم الاساسية العامة		العلوم الهندسية العامة		المقررات التخصصية الملزمة لجميع طلبة القسم		العلوم التخصصية الاختيارية		الإجمالي
		عدد الوحدات	النسبة المئوية من اجمالي عدد الوحدات الكلية	عدد الوحدات	النسبة المئوية من اجمالي عدد الوحدات الكلية	عدد الوحدات	النسبة المئوية من اجمالي عدد الوحدات الكلية	عدد الوحدات	النسبة المئوية من اجمالي عدد الوحدات الكلية	عدد الوحدات	النسبة المئوية من اجمالي عدد الوحدات الكلية	
هندسة المواد والمعادن	القسم شعبة واحدة	10	6.5%	30	19.5%	8	5.2%	100	64.9%	6	3.9%	154

Departmental Courses Syllabus for Materials & Metallurgical Engineering

MME210	Physical chemistry	3 Credits

Pre-requisite: GS115/GS111

Viscosity, surface tension, refractometery, density of liquids, density of porous and non - porous solids. Some basic definition of systems, surrounding boundaries, transition energy, thermodynamic systems and thermodynamic processes, bond dissociation energy and thermo-chemical equations. First law of thermodynamics, enthalpy, molar heat capacity, factors that influence the heat of reactions, Hess's Law, Kirchoff's Law. Second law of thermodynamics, entropy, effect of temperature on entropy , criterion of spontaneity, free energy and equilibrium constant, free energy and temperature, free energy and cell potentials. The third law of thermodynamics, chemical kinetics, reaction rate theory, and factors influencing rate of reactions (first, second, third order). Determination of reaction order, integration method, half life method and Van't Hoff's differential method. Electrochemistry (oxidation / reduction reactions, standard half –cell potentials, Nernst Equation and thermodynamic of electrochemical cells).

MME211	Introduction to thermodynamics	3 Credits

Pre-requisite: MME210/ GE116

Definitions and basic concept, systems, states, work and heat, equilibrium …..etc. First law of thermodynamics, internal energy, heat capacities, different thermodynamic processes. Principle of entropy and the work done, behaviour of ideal gases, thermal and chemical equilibria, principle of phase equilibrium, phase transformation, Gibb's phase rule, electrochemical principles, Bo forms.

MME214	Analytical chemistry	3 Credits

Pre-requisite: GE116

i- Methods of analysis: advantage and disadvantages of chemical and instrumental methods of analysis.
ii- calculations in analytical chemistry:
equivalent weight of an element, an acid, an alkali, a salt, an oxidizing agent and reducing agent.
Molarity, molality, formality, normality, strength of solutions, weight and volume percent.
iii- Primary Standard & Secondary Standard Solutions.
iv- Chemical methods of analysis: theory of volumetric analysis, theory of acid – base titration, theory of complexiметric titration, theory of redox titration, and theory of precipitation titration.
Theory of gravimetric analysis, requirements of weighing and precipitate form in gravimetric analysis, factors influence completeness of precipitation: amount of precipitant, excess of precipitant, temperature, PH, and masking agents. Solubility and solubility product, common ion effect and co-precipitation.
v- Instrumental methods of analysis: atomic emission, atomic absorption, icp-ms and icp-aes,

spectophotometry, principles of lambert and beer's law, and deviation of beer's law.
vi-Analytical separations: a- solvent extraction**,** b-ion exchange

Lab. MME 214

Methods of sampling and dissolution, theory of dissolution, dissolution of sample by fusion, perchloric, acid, by tri-acid volumetric analysis, acid – base titration, complexiметric titration, potentiometric titration, argentmetric titrations, gravimetric analysis, determination of SO4, instrumental analysis, atomic emission spectrophotometer, and maximum absorption spectra determination of Fe by ortho-phenanthroline

MME220	Introduction to materials science	4 Credits

Pre-requisite: GS101/GS111/ GS115

1-classes of engineering materials. **2-**atomic bonds – ionic, covalent, metallic, secondary. **3-**symmetry, crystal systems. **4-**important metal & ionic crystals. **5-**lattice directions & planes. **6-**x-ray diffraction. **7-**mechanical, electrical & thermal properties. **8-**defects of crystal patterns. **9-**solid solutions. **10-**point defects, linear defects, surface defects. **11-** diffusion in solids. **12-**properties of single phase materials. **13-** elastic behaviour. **14-** anisotropy & elastic limit. **15-** onset of plastic behaviour. **16-** cold – working & disloca tions. **17-** annealing of cold worked metals. **18-** creep, fatigue & fracture of metals. **19-** multi-phase materials, alloys, phase rule, phase diagrames, the iron – carbon phase diagram, steels, cast irons. 20- Corrosion of metallic materials, degradation of ceramics & polymers. 21- Ceramics – structures, properties & processing. 22- Polymers – molecular weight distribution polymerization reactions.

MME240	Strength of material	2 Credits

Pre-requisite: GE121

Concept of stress, axial loading, normal stress, shear stress, stress on oblique plane under axial loading, stress under general loading conditions, components of stress, ultimate and allowable stress, factor of safety, concept of strain , normal strain under axial loading, stress and strain diagram, Hook's law, modulus of elasticity, elastic and plastic behaviour of materials, poisson's ratio, general form of Hook's law, stress and strain distribution under axial loading, elastic constants, torsion, stress in circular shaft, deformation in a circular shaft, stresses in elastic range, angle of twist in the elastic range, stress concentration in a circular shaft, design of transmission shafts, pure bending, stress in pure loading, deformation in a symmetric member in pure bending, stress and deformation in elastic range, deformation in a transverse cross section, bending of members made of several materials, Eccentric axial loading in a plane of symmetry, un-symmetric bending. Transformation of stress, transformation of plane stress, Moher's circle for plane stress.

MME360	Transport phenomenon	3 Credits

Pre-requisite: MME220/M305

Momentum Transport

Properties of fluids, laminar flow and momentum balance, and energy balance applications in fluid flow

Energy transport

Fourier's law and thermal conductivity, heat transfer and the energy equation, conduction of heat in solids, and solidification heat transfer.

Mass transport

Ficks's law and diffusivity of materials, diffusion in solids, mass transfer in fluid systems, and interface mass transfer.

MME309	Numerical analysis	3 Credits

Pre-requisite: GE108/M305

Introduction, splines, curve fitting techniques, least squares method, linear regression, asymptotic expansion, numerical methods, Gauss elimination & matrix inversion, solution of eigenvalue problems by iteration method, ill- conditioning, solution of simultaneous linear equations, Newton's – Paphson method, Simpson's rule, Trapezoid rule, solution of 1^{st} & 2^{nd} O.D.E. , Euler method, and Runge – Kutta method.

MME312	Metallurgical thermodynamics II	3 Credits

Pre-requisite: MME211/MME220/GS102

-Behavior of gases: gas mixtures of ideal gases. the thermodynamic treatment of imperfect gases, deiation from ideality and equations of state and the van der walls gas.

-Reactions invocving gases: reaction equilibrium in a gas mixture and the equilibrium constant.

The effects of temperature and pressure on the equilibrium constant. Reaction equilibrium in the system: $SO_{2(g)}$-$SO_{3(g)}$-$O_{2(g)}$.Equilibrium in H_2O-H_2 and CO_2-CO mixtures. Gaseous reaction equilibrium and fugacity.

-Reactions inoling pure condensed phases and a gaseous phase: Free energy variation with temperature, the Ellingham diagrams, effects of phase diagram, the oxides of carbon and graphical representation of equilibrium in the system metal-oxygen- carbon.

-Behaior of solutions: Raoult's law and Henry's law, the activity of a component in solution,

the Gibbs-Durham equation, free energy of solution, properties of Raoultian ideal solutions, and non- ideal and regular solutions.

-Free energy-composition and phase diagrams of binary systems: Free energy and activity, free energy of regular solutions. phase diagrams, free energy, and activity.

-Reaction equilibrium in systems containg components in condensed solutions:

Reaction equilibrium criteria in systems containing components in condensed solution, alternative standard states, the Gibbs phase rule, binary systems involving compound formation, the solubility of gases in metals, the formation of oxide phases of rariable composition, graphical representation of phase equilibrium, solutions containing several dilute solutes, tabular representation of thermodynamic data and the free energy function and analysis of experimental data of the second and third law methods**.**

MME315	Polymer chemistry	3 Credits

Pre-requisite: MME210/MME214/MME220

Clasification of polymers, nomenclature of polymers, molecular weight of polymers, weight average and number average molecular weight,.
Determination of molecular weight: By osmotic pressure, by light scattering, by viscosity, etc
Molecular weight distributions, polymer synthesis, chain growth polymerization, step growth polymerization, free radical polymerization, cationic polymerization, anionic polymerization and
co-polymerization. Polymerization methods including bulk polymerization, Solution polymerization, suspension polymerization and emulsion polymerization.

MME320	Electrical, Thermal, Magnetic and Optical Properties of Materials	3 Credits

Pre-requisite: MME220/PH317

1-Crystal structure, bravais lattices, basis, unit cell, binding in crystals, packing in crystals and simple crystal structure.
2-Reciprocal lattice, brillioum zone, reciprocal lattice to simple cube, face-center cube, base-center cube,…etc.
3-Thermal properties of solids, vibrational waves in one dimensional monoatomic lattice, first brillioun zone, group velocity, vibrational waves in diatomic one dimensional lattice, specific heat, Einstreins) model, Debye model, thermal conductivity, crystal momentum, normal and umklapp processes.
4-Ionic crystals, cohesive energy of ionic crystals, ionic radii and their influence on crystal structure, defects in ionic crystals, and ionic conductivity.
5-Free electron theory of metals and solids.
6-Theory, properties and structures of semi-conductors, equipment based on semi-conductors, optical absorption and emission, magnetic properties of materials, optical properties of materials, laser equipment and their functions.

MME325	Physical methallurgy I	3 Credits

Pre-requisite: GS115/MME211/MME220

1-Crystal structure, imprefections, voids and stacking sequence.
2-Plastic deformation and annealing, recovery, recrestalyzation and grain growth.
3- Solid solution and the humepothery rules .
4- Binary phase diagrams, miscibility gap, eutectic, eutectoid, and peritectic phase diagrams.
5- The Fe-C systems, structure of steels, cost iron, heat treatments, martenstic, perleatic and baintic transformation, and grading and classification of steels.
6-Solidification of metals, thermodynamics, kinetics and casting defects.

MME326	Physical methallurgy I I	3 Credits

Pre-requisite: GS102/MME325

Diffusion in substitional solid solutions and interstial solid solutions, theories of phase transformation, phase transformation of steel on heating, eutectoid transformation, Binaite transformation, transformation associated with steel tempering , heat treatment of metals and alloys, chemical thermal treatment of metals and alloys, hardenability of steels and case hardening including carborization, nitriding and carbonitriding.

MME327	Metallography laboratory	1 Credits

Pre-requisite: MME326

Specimen preparation for microscopical examination of pure metals and alloys, effect of heat treatment on carbon steel and hardenability of alloys.

1- Alloy steels
2- Tool steels
3- Cast iron
4- Non-ferrous metals and alloys

Cu-base alloys, Al-base alloys, Bearing alloys, Solders, Mg-alloys, Mn-alloys, Super alloys, and Titanium alloys.

MME330	Extractive metallurgy	3 Credits

Pre-requisite: MME214/MME312

1-Mineral dressing, benefication.
2-Ore preparation (roasting, calcination, agglomeration)
3-Reduction of metal oxides
4-Matt smelting
5-Iron making and refining processes
6-Hydrometallurgy
7-Electrometallurgy
8-Applications of different methods of treatment.

MME331	Mass & Energy Balance of Extractive Metallurgy	3 Credits

Pre-requisite: MME330

Mass & energy balane which related into metallurgical reactions, overall mass balance, the lever rule in material mixing, material recycle operations, applications of mass balance for different metallurgical applications, energy balance, energy transfere, internal & external energy, types of industrial operations, energy transfer in different flow operations, effeciency of energy transfer, energy transfer in stable operations, specific heat, internal heat of phase transformations, heat balance in different metallurgical operatios and calculations of heat quantity in metallurical operations.

MME335	Corrosion principles	3 Credits

Pre-requisite: MME312/MME325

The importance of corrosion science and engineering study, corrosion classification, principles of electrochemicals and electro-reactions, principles of thermodynamics and tendency of metals to corrosion, mobility of corrosion, calculations of rate reactions, polarization & passivity of metalls phenomena, Bourabi and Erans diagrams for metals, types of aqueous corrosion, pitting corrosion, galvanic corrosion, crevic corrosion, soil and atmospheric corrosion, microbiological corrosion, ways of measurments of corrosion phenomenon and introduction to corrosion control.

MME340	Mechanical metallurgy	3 Credits

Pre-requisite: GS121/GS203//MME220/MME240

1. State of stress in two and three dimensions, stress tensor, Mohr's circle in 2 and 3 dimensions, hydrostatic and deviator component of stress, elastic stress-strain relationship, and calculation of stress from elastic strain.
2. Plastic deformation of single crystals, deformation by slip, strain hardening and deformation by twining
3. The dislocation theory, stress field and energies of dislocations, forces on dislocations, forces between dislocations, interaction of dislocations, multiplication of dislocations, dislocations pile-ups, dislocations in FCC, HCP and BCC lattices, partial dislocations and stacking faults.
4. Strengthening mechanisms, the yield point phenomenon, work hardening, strain aging, solid solution strengthening, dispersion strengthening, strengthening from grain boundaries and age hardening.

Laboratory Experiments

Tensile, compression, impact, hardness, shear and torsion tests.

MME420	X-ray diffraction	3 Credits

Pre-requisite: GS204/MME325/PH317

1- Properties of x-rays, electromagnetic radiation, continuous spectrum, characteristic radiation, absorption, filters, production of X-rays, detection and safety.
2-Crystal structure, planes & directions, atomic sizes and coordination & stereographic projections.
3-Diffraction, Bragg's law, diffraction methods and diffraction under non-ideal conditions.
4-Scattering by an electron, atom and unit cell, structure factor, multibicity factor, Lorentz factor, absorption factor, temperature factor, and intensitive of powder diffraction patterns.
5-Debye Scherrer method, Laue method, diffractometer, proportional counter, Geiger counter and Scintillation counter.
6-Determination of crystal structure, indexing of powder pattern, and effect of cell distortion.

7-Determination of precise lattice parameter and method of least squares.
8-Phase diagram determination, parametric & disappearing phase method.
9-Order-disorder transformation, super-lattice lines and their detection.
10-Qualitative & quanitative chemical analysis; Hanawalt method; parameter method, direct comparison and limitation.
11-Stress measurement and it's application, texture and it's application.
12-Electron & neutron diffraction and its applications.

MME427	Engineering alloys	3 Credits

Pre-requisite: MME327/MME326/MME330

Classification of engineering alloys according to their use, structural steel, roll of structure and heat treatment, weldeability, specifications of tool steels, essential alloying elements in tool steels, heat treatment of tool steels, bearing alloys, wear processes, specifications of wear resistance, wear resistance alloys, composite materials, friction resistance materials, high temperature oxidation resistance materials and alloys, nickle alloys, temperature resistance materials, stainless steels, copper alloys, aluminium alloys., white alloys, materials with specific electrical properties, and magnetic materials.

MME436	Corrosion control	3 Credits

Pre-requisite: GS203/MME335

Types of mechanical corrosion, High temperature corrosion.
Corrosion prevention :- material selection, alternation of environment, design, cathodic and anodic protection, coating, methods of analysing of structural corrosion failures.

MME440	Mechanical Behavior of Materials	3 Credits

Pre-requisite: MME340/MME326

1. Theory of Plasticity

The flow curve, yielding criteria (Von Mises and Tresca), combined stress tests, the yield locus, octahedral shear stress and shear strain, invariant of stress and strain, plastic stress-strain relationship (Levy-Mises equation).

2. Fracture Mechanics

Types of fracture in metals, theoretical cohesive strength of metals, stress concentration, Griffith theory of brittle fracture, energy release rate, stress analysis at crack tip and modes of loading, fracture toughness (plane strain fracture toughness, kic), and crack tip plastic zone size estimation.

3. Fatigue of Metals

Stress cycle, fatigue fracture surface, the s-n curve, effective stress concentration factor, design for finite life (laws of Goodman, Gerber and Soderberg), design for finite life (Basquin's law), cumulative damage and life prediction (Miner's law), fatigue crack initiation and propagation, and fatigue life calculations (Paris equation).

4. Creep of Metals

The creep phenomenon, creep curve, presentation of crep data, Larson-Miller plot, the life fraction rule, mechanism of creep deformation and rupture and steady state creep.

MME441	Fracture mechanics & failure analysis	3 Credits

Pre-requisite: MME335/MME440/MME326

Ductile and brittle fractures fractography, catastrophic fractures Griffth theory of brittle fracture, ductile to brittle transition temperature, stress concentration factor, modes of crack propagation (mode i, ii, and iii), linear elastic fracture mechanics, stress intensitry factor, plane strain and plane stress fracture toughness, plastic zone size estimation, determination of fracture toughness ASTM – E399 test, correlation of impact energy to fracture toughness, factors affecting fracture toughness, ways to improve fracture toughness, fundamental sources of failures, procedure of conducting failure analysis, failure analysis report, failure of metals at high temperature service, tripology, wear, friction and lubrication.

MME450	Metal shaping	3 Credits

Pre-requisite: MME440/MME326

1- **Metals casting:** solidification characteristics, casting alloys, fluidity in casting, casting defects, shrinkage, porosities, hot cracking, macro – microstructure of casting, casting processes, sand casting, risers design (Chvorinov's rule), sand molding, sand requirements, gating systems, casting inspection. die, mold and shell casting.
2- **Forging processes:** classification, forging equipment, forging in plane strain, opened close die foging, forging deffects.
3- **Rolling of metals:** classification, rolling mills, hot rolling, cold rolling, load analysis and rolling deffects.
4- **Extrusion:** classification, extrusion equipment, hot extrusion, deformation, lubrication & deffects in extrusion.
5- **Wire & tube drawing:** drawing processes, analysis of wire drawing and analysis of tube drawing.

MME461	Ceramics I	3 Credits

Pre-requisite: MME312/MME340

1-Introduction : ceramic materials in relation to metals & polymers.
2-Interatomic spacing & bonding, crystal structures including silicate structures& imperfections.
3-Glass – structure, composition transformation range and crystallization.
4-Surface & interfaces – adsorption, ion exchange, interfacial energies.
5-Ceramic phase diagrams.
6-Ceramic microstructures.
7-Structural ceramics & abrasives.
8- Mechanical, thermal, electrical, optical and nuclear properties.

MME462	Ceramics II	3 Credits

Pre-requisite: MME461

Ceramics natural raw materials, their characterization and processing, shaping techniques, drying and firing of ceramic products, methods of glass shapin. Cements, their manufacture and hydration behavior, refractories, their types, manufacturing and applications. Engnerring ceramics, their classes, manufacturing & applications.

MME465	Polymeric Materials	3 Credits

Pre-requisite: MME306/MME315/MME440

1-Introduction, definitions, classification, bonding, general physical properties.
2-Viscoelasticity models.
3-Design methodology.
4-Melt rheology (I) & (II), properties of polymer melts & types of flow.
5-Shaping methods of polymers.
6-Fiber & elastomer technologies.
7-Reinforcements & polymeric composites.
8-Processing – property interactions.

MME470	N.D.T and quality control	4 Credits

Pre-requisite: MME436/MME450

1-Introduction; types of defects in metal forming methods, their effect on mech. Properties and need for NDT.
2-Visual aids:boroscopes, toboscope and their use in testing.
3-Liquid penetrant methods: principles, equipments of dye and fluorescent methods, application and their limitations, examples of such uses in industry.
4-Magnetic methods: magnetic particle technique, magnetization and it's principle, limitations, examples in industry.
X-ray radiography: geometrical factors, principles and industrial radiography practice, technique charts, penetrameters, weld radiography, casting radiography, fine radiography, reference radiography, gamma radiography, examples in industry.
5-Ultrasonic: types of waves, wave velocity, beam spreading, refraction, mode conversion, attenuation. wave production, equipments and different probe, welds tubes, axles, shafts.
6-X-ray radiography: production, absorption, half wave thickness, scattering, film processing, filters, screens, inverse square law, detection technique charts in details.
7-Gamma rays radiography: fundamentals of radioactivity, decay, absorption, Gamma -ray sources, films for Gamma -ray radiography, safety, film protection, handling, storage and transportation, equipments. examples of uses in industry.
8-Thickness measurements: thickness guaging by radiation absorption, x-ray, gamma-ray, b-ray and a-ray (gauges) absorption and magnetic induction and ultrasonic gauging resonance.uses in industry.

9-Eddy current methods: principles, detection, test coils and probes, use of cyclograph and probolog applications in tube, corrosion, thickness measurement, examples in industry.
10-Thermal method: thermography, temp. sensitive pigments, infrared technique. Electrical methods: based on resistance and potential drop, dielectric. Details about standards for all techniques. Some practical problems of industry and depending upon the type of defects, selection of technique.

MME480	Materials selection & engineering economics	3 Credits

Pre-requisite: M305/MME462/ MME465/MME427

1-Brief introduction to metallic, polymeric, ceramic & composite materials.
2-Properties & selection relationship.
3-Materials indentification & designation.
4-Degradetion & stability of the materials.
5-Materials & fabrication selection.
6-Economic analysis in material selection.
7-Economic evaluation of materials, processes & project.
8-Quantitative & non – quantitative methods of materials selection.
9-Case studies of selection.

MME499	Project Seminar	1 Credits

Writing technical reports, report preparation and presentation. Presentation of B.Sc. project literature review and project lay out plan.

MME550	Elective Course I	3 Credits

Pre-requisites: Variable

Elective course offered by the Metallurgical & Materials Engineering department each semester.

MME551	Elective Course I I	3 Credits

Pre-requisites: Variable

Elective course offered by the Metallurgical & Materials Engineering department each semester.

MME599	Project	4 Credits