Curriculum for the Bachelor Degree in Materials Engineering
Courses Description

BSE0205	**Engineering Drawing**	**(2:0-6)**
Drawing instruments and their use, lettering, geometric construction, dimensioning, free-hand sketching, Orthographies, isometric projections, sketching and sectioning. Computer drawing using autocad (AutoCAD), engineering applications.		
Prerequisite: CS0101		
BSE0102	**Engineering Workshop**	**(1: 0-3)**
Occupational safety and health in engineering workshops, mechanical forming of metals, machining operations, welding processes, carpentry works, electrical installation.		
Prerequisite: --		
BSC0401	**Engineering Economy**	**(3:3-0)**
Engineering Economy: engineering economic concepts; interest formulas; decision making using present worth, future worth, annual worth, internal rate of return and benefit- cost ratio methods; payback analysis; depreciation.		
Prerequisite: 80 credit hours		
BSE0201	**Programming for Engineers**	**(3:2-3)**
This is a fast-paced introductory course to the C++ programming language. It is customized for the engineers with a little programming background. It covers C++ programming concepts, variables and basic data types, control structures and loops, functions call by value and reference, arrays,structures, calasses and objects,pointers and references to objects, files and streams. Weekly laboratory experience in topics covered in this course.		
Prerequisite: CS101		
BSE0203	**Technical Writing & Professional Ethics**	**(3:3-0)**
This course deals with the definition of technical writing, its standards and how they differ from other types of writing. The basics of writing official reports, laboratory reports, projects and scientific papers. The common mistakes in writing and the process of writing citations and references. The concept of professional work and the definition of professional ethics and the acceptable and unacceptable professional practices. The sources of professional ethics and reasons for non-compliance with professional ethics. Identifying different forms of professions and explaining the importance of their relationship to ethics, standards of ethical behavior in science. Professional ethics in Jordanian laws and regulations		
Prerequisite: AEL102		
BSE0306	**Numerical Methods**	**(3:3-0)**
Error analysis, roots of equations by open methods and parentheses, solutions of the system of linear equations: deletion by Gaussian method, LU analysis method, inverse of matrix, Gauss - Seidel method, representation and fit of curves, derivation and numerical integration, solutions of differential equations: Runge-Kutta method, terms with Value and eigenvalue issues.		
Prerequisite: 30202102		
MAE0211	**Materials Science 1**	**(3:3-0)**
Classification of materials and properties. Atomic theory and atomic bonding in solids, the structure of crystalline and non-crystalline materials: atomic coordination and packing structure types in crystalline solids, amorphous materials. Imperfections in solids, point line and surface defects. Phase equilibria, one and two-component systems. Diffusion. Phase transformations: concepts of driving force, nucleation, growth and TTT curves		
Prerequisite: 30206101		
MAE0212	**Materials Science 2**	**(3:3-0)**

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Introduction to properties of materials. Mechanical behavior of solids: Elasticity,properties, optical properties, magnetic properties and chemical properties		
		Prerequisite: MAE0211
MAE0214	**Materials Science Lab.**	**(1:0-3)**
Experiments covering the topics discussed in scince of materials (1) and science of materials (2) including: Examination of Microstructure of Metallic Sample ,Mounting of Specimen & Optical Microscopy ,Macrostructure Studies of Casting Ingots and the Affecting Parameters ,Cooling Curve of Pure Metal ,Cooling Curve for Noncrystalline Material ,Phase Diagram Cooling of a Mixture of Two Metals (Binary Alloy) ,Plotting and Using Phase Diagram ,Hardness Testing,Cast Iron Structure and Properties ,Effect of Heat Treatment on Hardness and Structure of Steel ,Annealing of a Nonferrous Alloy (Brass).		
Prerequisite: MAE0212		
MAE0315	**Introduction to Polymer Science**	**(3:3-0)**
Definition of monomer and polymer, ethylene. Rubber and elastomers. Polymerization technologies of polymers. Anionic and cationic polymerization. Suspension polymerization, chain growth, chain propagation and chain session inhibitors.		
		Prerequisite: 30206103
MAE0326	**Polymeric Materials**	**(3:2-3)**
Thermoplastic, Duroplastic and Rubber, properties and applications. LLDPE, HDPE, PVC.PS. Natural and synthetic. Co-polymers. ABS Nylon and polyurethane polymers. Step growth polymers. Film, sheet, parts of polymers. Polymer structure. Amorphous, crystalline, two-phase systems. Characterization of polymers. Additives. Experiments related to topics covered		
Prerequisite: MAE0315		
MAE0416	**Ceramic Materials**	**(3:3-0)**
Theory: Classification of ceramic products, classical and technical ceramic crystal structures. Mechanical thermal, electrical, magnetic and optical properties of ceramics. Natural and synthetic ceramic raw materials: plastic and non-plastic raw materials ceramic body preparation, batch calculations and batching. Ceramic forming techniques. Drying and firing of ceramics. Glasses and glazes. Decoration of ceramic products. Applications of oxide and non-oxide ceramics.		
Prerequisite: 100 credit hours		
MAE0226	**Crystallography**	**(3:3-0)**
Theory: Introduction and definition, lattice points, unit cell and primitive cell. Crystal systems, Miller and Miller-Bravais indices, planes and directions, Angles and interplanar distances, coordination number and density. Interstices in different systems, packing factor, packing directions and packing planes. Crystal structure of ceramics. Symmetry of crystal structure, slipping and slip planes, stereographic projections, pole figure.		
Prerequisite: MAE0211		
MAE0228	**Crystallography Lab.**	**(1:0-3)**
Building up some crystal system and determining of interstices, building up the most packed crystallographic planes in FCC and HCP Structures and determination of Lattice Constant by Debye–Scherrer Camera (Powder method), determination of Lattice constant by diffraction pattern analysis (diffractometer), verification of the relationship between slip bands and strain. Dislocation density (ρ) measurements and the relationship between (ρ) and strain (ε). Stacking fault and twinning studies and determination of symmetries in some crystal systems. Stereographic projection, determination of poles, angles, zone axes etc. on stereograms, aspect ratio and determination of previous amount of deformation		
Prerequisite: MAE0226		

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MAE0321	Metallography	(3:2-3)
Optical microscopy sample macro-examination. Micro-examination. Quantitative metallography. Metallography of binary alloys, alloy steels, examples of non-ferrous alloys, introduction to electron Metallography, X-ray spectroscopy, geometry of crystals, X-ray diffraction, phase analysis.		
Prerequisite: MAE0226		
MAE0323	**Physical Metallurgy**	**(3:3-0)**
Alloy Theory, primary solid solutions, intermediate phases, stability of alloys, ordering. Kinetic theory. Interfaces: classification, geometry and energy of interfaces, grain boundary segregation. Mobility of interfaces, Normal grain growth. Homogeneous and hetrogeneous nucleation. Recovery and recrystallization.		
Prerequisite: MAE0226		
MAE0421	**Phase Transformation**	**(3:3-0)**
Diffusion: Phenomenological and atomistic approach. Precipitation free energy-composition diagrams, precipitation transformations, solid-state nucleation, precipitation kinetics, coarsening. Eutectoid transformation and discontinuous precipitation. Martensitic transformations: crystallography, thermodynamics and types of martensites, bainite transformation		
Prerequisite: MAE0348		
MAE0429	**Heat Treatments**	**(3:2-3)**
Property change due to heat treatment. Iron-carbon system. Austenitizing transformation of austenite. I-T and C-T diagrams, annealing, normalizing hardening, critical cooling rate. Actual cooling rate, quenching media, size and mass effect. Hardenability and applications of hardenability data. Tempering. Secondary hardening, temper embrittlement, austempering. Case hardening. Residual stresses, martempering. Experiments related to topics covered		
Prerequisite: MAE0323		
MAE0347	**Thermodynamics of Materials 1**	**(3:3-0)**
Concepts and definitions. First law of thermodynamics: internal energy, heat and work, heat capacities, enthalpy and applications to material processing. The second law of thermodynamics; heat engines. Carnot cycles, entropy concept. The third law of thermodynamics. Auxiliary thermodynamic functions, Gibbs and Helmholtz energies. Maxwell relations. Equilibrium. Reaction equilibrium in gas mixtures. Phase equilbria in one component system. The behavior of gases. Reactions involving gases Reactions involving pure condensed phase and a gaseous phase.		
Prerequisite: 30206103		
MAE0348	**Thermodynamics of Materials 2**	**(3:3-0)**
Reaction equilibria between condensed materials and a gaseous phase. Oxidation of metals and Ellingham diagram. Solution Thermodynamics. Partial and integral molar quantities. Gibbs-Duhem equation. Relative partial and relative integral molar quantities. Microscopic examination of solutions. Ideal and non-ideal solutions.Excess properties. Gibbs-systems. Reaction equilibria in solution.		
Prerequisite: MAE0347		
MAE0349	**Transport Phenomena**	**(3:3-0)**
Basic concepts in transport phenomena. Mass, energy and momentum balances. Classification of fluid flows and friction; laminar and turbulent flow. Mass transport; Heat transport; conduction, convection and radiation.		
Prerequisite: MAE0347		
MAE0422	**Corrosion and Protection of Metals**	**(3:3-0)**

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Electrochemical and metallurgical aspects of Corrosion. Forms of Corrosion. Modem theory of Corrosion and its applications. Iron and steel corrosion. Corrosion prevention methods.		
Prerequisite: MAE0347		
MAE0424	**Corrosion and Protection of Metals Lab.**	**(1:0-3)**
Experiments on unit cells, anode, cathode, electrolyte, electrolysis, polarization, oxidation, reduction, passivity corrosion and protection against corrosion		
Prerequisite: MAE0422*		
MAE0334	**Extractive Metallurgy**	**(3:3-0)**
Processing of ores, concentrates, recycled and partially processed raw materials to render them amenable to further metallurgical treatment. Process flow sheets and details of physical and chemical separation methods for the concentration of raw materials. Principles and applications of mineral processing. Pretreatment processes, drying, calcination, roasting and agglomeration		
Prerequisite: MAE0347		
MAE0430	**Metals Casting**	**(3:3-0)**
Solidification of pure metals. Solidification of alloys. Macrostructure development. Heat transfer in Solidification. Riser design and placement. Gating system. Casting technology. Mold and core making. Foundry sand, green sand concept, quartz clay interface, clay-clay interface. Molding mixtures, additives. Cold setting. Core making, casting processes.		
Prerequisite: MAE0349 MAE0348		
MAE0432	**Metals Casting Lab.**	**(1:0-3)**
Molding sand and sand casting refractoriness test. Mold making practice, carbon dioxide molding core and mold making with organic binders, heat curing binders, core and core making with organic binders, heat curing binders, core resins. Methylene blue test. Thermal analysis heating and casting curves of pure metals and Alloys, principles of temperature measurements. Macro examination of cast ingot structures. Production of nodular cast-iron. Chill casting		
Prerequisite: MAE0430		
MAE0437	**Manufacturing Processes**	**(3:3-0)**
Welding processes. Bulk Deformation processes: extrusion, drawing, rolling, and forging. Friction and slab anaylsis in deformation processes. Machining Processes: turning, milling, and drilling.		
Prerequisite: BSE0205, MAE0310		
MAE0433	**Iron and Steel Technology**	**(3:3-0)**
Blast furnace and its description. Reduction of iron oxides, bosh and hearth reactions, slag formation. Blast furnace operating practice, treatment of hot metal. Importance of steel: modern technological developments in the steel industry; clean steel production techniques; ladle metallurgy; continuous casting technology. Classification of steels: structural steels; HSLA steels; dualphase steels; tool steels; high manganese austenitic steels; stainless steels. Steel selection process: selection according to properties. Hardenability and selection according to hardenability.		
Prerequisite: MAE0334, MAE0348		
CIE0221	**Statics**	**(3:3-0)**
Statics of particles; rigid bodies; equivalent systems of forces; centroids and centers of gravity; analysis of structures: frames, machines, and trusses; friction; moments of inertia; principle of virtual work.		
Prerequisite: 30201101.3202102		
MEE0214	**Strength of Materials**	**(3:3-0)**
Introduction to mechanics of deformable bodies, concept of stress and strain, classification of		

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material behavior, stress-strain relations, application to engineering problems involving members under axial load, torsion of circular rods and tubes, bending and shear stress in beams ,combined stresses , deflection of beams, buckling of columns.		
Prerequisite: CIE221 Statics		
MAE0310	**Testing and Evaluation of Engineering Materials**	**(3:3-0)**
The importance of testing for engineering materials and their types, design of tests and international standared in testing engineering materials, collecting data and evaluation information, mechanical testing and evaluation of different materials : tensile testing, compression testing, hardness testing, torsion and bend testing, fatigue and impact testing, creep testing, Introduction to non-destructive testing		
Prerequisite: MAE0212 MEE0214		
MAE0312	**Testing and Evaluation of Engineering Materials Lab.**	**(1:0-3)**
Tensile testing, compression testing, hardness testing, torsion testing, bend testing, fatigue testing, impact testing, creep testing, testing at different temperatures.		
		Prerequisite: MAE0310*
MAE0534	**Materials Selection and Design**	**(3:3-0)**
The design process and its considerations, materials and their properties in design process, materials property charts, materials selection strategy and materials property indices, selection of materials and product shape, Multiple constraints and compound objectives in materials selection, materials and process selection, case studies.		
Prerequisite: MAE0437		
MAE0531	**Polymer Processing**	**(3:3-0)**
Extrusion of polymers. Film, sheet, profile extrusion. Injection molding of plastic, PVT diagram. Blow molding, screws and molds. Design processing parameters and its influence on polymer properties. Experiments related to topics covered		
Prerequisite: MAE0316		
MAE0533	**Composite Materials**	**(3:3-0)**
Definition of composites materials and their uses, convintional materials and their use restrictions, components of composite materials: their types and functions, classifications of composite materials and their characteristics: particle-reinforced composites,structural composites, materials surface treatment strategies and improvement of their adhesion and properties, methods of manufacturing various composite materials, applications to composite materials		
Prerequisite: MAE0513, MAE0316		
MAE0530	**Nanomaterials Technology**	**(3:3-0)**
Introduction to the underlying principles and applications of the emerging field of nanotechnology, Introduction to the practice and discipline of nanotechnology, Physical basis and principles of nanotechnology, Industry applications, Carbon Nanotube Technologies, Nanofabrication, Thin film applications, Semiconductors		
Prerequisite: MAE0513 , MAE0316		
MAE0568	**Quality Control and Management**	**(3:3-0)**
Statistical principles and concepts used in conforming specifications, quality control panels, analysis of production processes ability, acceptance sampling plans, international standards and continuous quality development. Leadership concept, customer focus, employee involvement in quality management, supplier involvement, performance measurement, total quality management tools, quality assurance systems.		
Prerequisite: 115 credit hours.		

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MAE0558	**Field Training**	**(3:0-0)**
Training for 8 weeks in the field of materials and metallurgical engineering in an approved public or private sector.		
Prerequisite: 115 credit hours.		
MAE0551	**Graduation Project 1**	**(1:0-0)**
Project under the supervision of an academic department staff, on an assigned materials and metallurgical topics, or related engineering topics. This is the first part of the project; it will normally involve literature review, theoretical work and some laboratory or fieldwork.		
Prerequisite: 120 credit hours.		
MAE0552	**Graduation Project 2**	**(3:0-0)**
Project 2 is the second part of the project and will normally involve design, analysis and conclusions of the study and the submission of a final report and a discussion by a committee in the department.		
Prerequisite: MAE0551		
MAE0566	**Cathodic Protection Design**	**(3:3-0)**
Electrochemistry, corrosion cell potential, Reference Electrodes, Practical Cathodic Protection, Parameters, Resistivity and Electrode Resistance, Sacrificial anodes, Impressed Current CP, Instruments, Case Studies.		
Prerequisite: MAE0422		
MAE0560	**Fuels and Furnaces**	**(3:3-0)**
General principles of thermodynamics, heat transfer, heating of metals, characteristics of fuel. Classification of furnaces and their operating. Materials and elements of furnaces, heating furnaces, heat-treatment furnaces, electric Furnaces		
Prerequisite: MAE0349 + 115 credit hours		
MAE0567	**Engineering Biomaterials**	**(3:3-0)**
Introduction.Characteristics of natural and man-made biomaterials, the interface between materials engineering/nanoscience and molecule biology/biophysice. Cellar mechanics and activity,tissue regenerating. Structure-property relationships of biomedical materials with biological systems and compatibility. Fundamentals of motion analysis of human movements		
Prerequisite: MAE0316 MAE0513 + 115 credit hours.		
MAE0569	**Materials and Energy**	**(3:3-0)**
Energy: Introduction, methods of energy conversion. Solar cells: history, solar radiation, working principles of solar cells, photovoltaic (PV) modules, solar cell parameters. Semiconductors solar cells (properties, manufacturing, and design rules). Thin film technology of solar cells. Batteries: introduction, battery parameters and characteristics, type of batteries (primary and secondary i.e. rechargeable). Battery electrode materials and manufacturing by the thin film deposition technique (chemical and physical techniques		
Prerequisite: 115 cridet hours		
MAE0564	**Non-Destructive Testing**	**(3:3-0)**
General description of most common NDT methods, NDT detection of metallurgical properties of metals and their composition and size differences, application of non-destructive evaluation for metallurgical processes and products, NDT detection of defects in service product		
Prerequisite: MAE0310+ 115 credit hours.		
30206103	**General Chemistry 2**	**(3:3-0)**
This course directs student attention to the chemical properties of substances, solutions and relates those properties to the nature of the solvent and solute. Students also learn about the factors that determine whether reactions can occur (thermodynamics), what the fate of a chemical system is (equilibrium), and the factors that determine how fast a reaction gets		

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where its going (kinetics).		
Prerequisite: 30206101		
30206104	**Chemistry 2 Lab.General**	**(1:0-3)**
Determination of the molar mass of a volatile liquid, determination of molar mass of a solid from freezing point depression, calorimetry I: determination of specific heat capacity and molar mass of a metal, calorimetry II: determination of enthalpy of solution for the dissolution of a slat, thermochemistry and Hess's law, studies on some factors affecting chemical reaction rates, determination of the rate law for a chemical reaction, studies on the effects of concentration, temperature and pH changes on the position of equilibrium in some chemical systems (Le Chatllier's principle), determination of the equilibrium constant of a chemical reaction using visible spectrophotometer, oxidation-reduction reactions, commercial bleach analysis, Galvanic cells, electrolytic cells, Faraday's law, molar solubility and common ion effect		
Prerequisite: 30206103		
ELE0217	**Electrical and Electronics Engineering**	**(3:2-3)**
Basis electrical quantities, fundamental circuit laws, sinusoidal steady state analysis and transformers, three phase circuits, principles of electro-mechanical energy conversion, DC and AC machines, Electrical safety.		
Prerequisite:30201102		
MAE0565	**Computational Methods in Materials Science**	**(3:3-0)**
Introduction to computational materials science. Development of atomic scale simulations for materials science applications. Application of kinetic Monte Carlo, molecular dynamics, and finite element analysis to the modeling of diffusion process in solids, mechanical properties and defects dynamics		
Prerequisite: BSE0306+ 115 credit hours.		
MAE0561	**Extractive Metallurgy of Non-Ferrous Metals**	**(3:3-0)**
General principles of the extraction and refining of non-ferrous metals. Copper: Concentration roasting and smelting of copper ores. Converting and refining of copper, zinc: Concentration roasting, sintering and smelting of zinc ores. Leaching and electrolysis of zinc. Lead: Sintering, blast furnace smelting and refining. Aluminum: Ores, manufacturing of alumina by the Bayer process and electrolysis of aluminum. Production of ferroalloys.		
Prerequisite: MAE0334+ 115 credit hours.		