CURRICULUM

COURSE CODE & TITLE

MY-101: INTRODUCTION TO METALLURGICAL ENGINEERING

Credit Hours: 2+1

COURSE CONTENTS

Introduction to Metallurgy and Metallurgical Engineering. Metallurgy: Objectives of Metallurgy, Importance of Metallurgy, Metallurgical Engineer's Jobs, Scope of Metallurgy in Pakistan, Branches of Metallurgy, Art of Metallurgy Metals and Non-Metal: Metals & Their Characteristics, Classification of Metals, Non-metals, Comparison between Metals and Non-metals, Sources of Metals, Differences between Rocks, Ores and Minerals, List of Important Minerals. Alloys: Classification and Sub-classification of Alloys, Effect of Alloying Elements, Properties and Applications of Some Important Alloys, Designation of Alloys, Comparison between Metals and Alloys. Engineering Materials: Classification of Engineering Materials and their Importance, Manufacturing Processes, Materials Properties, Destructive & Non-Destructive Testing. Corrosion: types and protection. Applications of Computers in Metallurgy and Metallurgical Engineering.

COURSE CODE & TITLE

PH-122: APPLIED PHYSICS

Credit Hours: 3+1

COURSE CONTENTS

Introduction: Scientific notation and significant figures. Types of errors in experimental measurements. Units in different systems. Graphical Techniques (Log, semi-log & other non-linear graphs) Vectors: Review of vectors, Vector derivatives. Line & surface Integrals. Gradient of a scalar. Mechanics: The limits of Mechanics. Coordinate systems. Motion under constant acceleration, Newton laws and their applications. Galilean invariance. Uniform circular motion. Frictional forces. Work and Energy. Potential Energy. Energy conservation. Energy and our Environment. Angular momentum. Electrostatics and Magnetism: Coulombs Law. Electrostatic potential energy of discrete charges. Continuous charge distribution. Gauss's Law. Electric field around conductors. Dielectrics. Dual trace oscilloscope with demonstration. Magnetic fields. Magnetic force on current. Hall effect. Biot-Savart Law. Ampere's Law. Fields of rings and coils. Magnetic dipole. Diamagnetism, Para magnetism and Ferromagnetism. Semiconductor Physics: Energy levels in a semiconductor. hole concept. Intrinsic and Extrinsic regions. Law of Mass Action. P-N junction. Transistor. Simple circuits. Waves and Oscillations: Free oscillation of systems with one and more degrees of freedom Solution for Modes. Classical wave equation.LC network and coupled pendulums. Plasma oscillations. Optics and Lasers: Harmonic traveling waves in one dimension, Reduce mass, De- Broglie hypothesis Braggs Law, Electron microscope, Uncertainty relations Modern atomic model, .Zeeman effect, Atomic nucleus, Mass-energy relation, Binding energy, Nuclear forces and fundamental forces, Exponential decay and half-life. Radioactive equilibrium in a chain, Secular equilibrium, nuclear stability, Radiation detection instruments, Alpha decay, Beta decay, Gamma decay attenuation Nuclear radiation hazards and safety, Medical uses of Nuclear Radiation. Fission, Energy release. Nuclear Reactors. Breeder Reactor. Nuclear Fusion.

CURRICULUM

COURSE CODE & TITLE

ME-111: ENGINEERING DRAWING

Credit Hours: 2+1

COURSE CONTENTS

Drawing equipment and the use of instruments; Basic drafting techniques and standards. Geometrical curves including plane curves; Cycloid; Hypocycloid and Involute. Intersections at various positions of geometrical bodies such as prisms, pyramids, cylinders and cones. Development of surfaces of prisms, pyramids, cylinders and cones. Freehand sketching of machine and engine components, locking arrangements; foundation bolts; stuffing box; shaft coupling; foot step bearing; pulleys; engine connecting rod. Concept of working drawing of component parts of machines and engines size description, dimensions and specifications. Limit dimensioning and geometric tolerancing; limits; fits and tolerances; conventional symbols. Sectioning of machine and engine components. Orthographic projections and standard practices. Isometric views with particular reference to piping and ducting.

COURSE CODE & TITLE

HS-111/EA-111: FUNCTIONAL ENGLISH

Credit Hours: 3+0

Credit Hours: 2+0 (For Batch 2024 onwards)

COURSE CONTENTS

Listening: Types of Listening, Problems in listening and coping strategies, Listening skills, Sub skills, Practice in Listening. Note taking: Techniques for taking notes, Note taking in different forms paragraphs (points, figures, processes, tables, graphs etc.). Vocabulary development: Enhancing current vocabulary to reflect a better usage of words in spoken and written language, Tips / strategies in vocabulary enhancement, Practice in vocabulary development. Reading: Reading skills, Sub skills, reading comprehension levels, reading Strategies, Reading practice through variety of reading texts and comprehension exercises, Beyond reading [outline, précis, speech and presentation]. Writing: Process of Writing, Informal Writing strategies. Writing Correctly: Sentence structure and punctuation, Error correction. Paragraphs: Structure, Types, Topic and the topic sentence, Unity, Adequate development and coherence in paragraphs. Essays: Types, Five paragraphs, long essays, Structure (thesis statement and the paragraphs). Short Reports: Structure, Format and types (informational and analytical). Letters: Elements, Styles, Formatting (digital letter writing), Organization and structure of the letter, Types (Routine requests and intimation, invitation, thank you and condolence letters etc.)

CURRICULUM

COURSE CODE & TITLE

ME-104: WORKSHOP PRACTICE

Credit Hours: 0+2

COURSE CONTENTS

Use of carpenter's tools, Exercise in preparing simple joints, Bench fitting practice, Exercise in marking and fittings; Use of measuring instruments. Smith's forge; Exercise in bending, upsetting and swaging. Familiarizing the students with the following processes: Soldering and brazing, Welding, Heat treatment, Moulding and casting. Simple machine shop processes include turning, shaping, milling, and sheet metal work.

COURSE CODE & TITLE

MT-114: CALCULUS

Credit Hours: 3+0

COURSE CONTENTS

Set and Functions: Define rational, irrational and real numbers; rounding off a numerical value to specified number of decimal places or significant figures; solving quadratic, and rational in equalities in involving modulus with graphical representation; definition of set: set operations, Venn diagrams, De-Morgan's laws, Cartesian product, relation, function and their types (Absolute value, greatest integer and combining functions). Graph of some well-known functions. Limit of Function and continuous and discontinuous functions with graphical representation. Propositional Logic: Definition of proposition, statement and argument, logical operators, simple and compound proposition various types of connectives, truth table, tautology, and contradiction, contingency & logical equivalence. Boolean Algebra: Definition, Boolean function, quality, some basic theorems & proofs, to evaluate Boolean algebra, truth functions, Canonical sum of product form, Digital logic Gates & Switching circuit designs. Complex Number: Argand diagram, De Moivre formula, root of polynomial equations, curve & regions in the complex plan, slandered functions & their inverses exponential, circular & hyperbolic function.) Differential Calculus: Differentiation & Successes differentiation & its application; Leibnitz theorem. Taylor & Maclaurin theorem with remainders in Cauchy & Lagrange form, power series, Taylor & Maclaurin series, L. Hospital rule, extreme values of a function of one variable using first & second derivative test, asymptotes of a function, curvature & radius of curvature of a curve, partial differentiation, exact differential & its applications in computing errors, extreme values of a function of two variables with an without constant. Solution of non-linear equation, using Newton Raphson Methods. Integral Calculus: Indefinite integral & their computational techniques, reduction formulae, define integral & their convergence. Beta a* Gamma functions & their indefinites, applications of integration. Centre of pressure and depth of center of pressure. Solid Geometry: Coordinate Systems in three dimensions. Direction cosines & ratios, vector equation of a straight line, plane & sphere, curve tracing of a function of two & three variables.

CURRICULUM

COURSE CODE & TITLE

EE-116: PRINCIPLES OF ELECTRICAL ENGINEERING

Credit Hours: 3+1

COURSE CONTENTS

Electric and Magnetic Circuits: Circuits Sources and Elements, Ohm's Law, Resistance, Inductance, Capacitance, Fundamental Circuit Laws, Kirchhoff's Laws, Direct application of Fundamental Laws to simple resistive networks, Introduction to node Voltage and Loop current methods, Network Theorems, Star / mesh transformation, Magnetic Circuit, Series and Parallel Circuit, Principles of Calculation of ampere turn. AC Single Phase and Poly phase Systems: Single Phase systems, Series, Parallel and series parallel circuits, J operator method and polar method. Resonance and measurement of power and power factor. Poly phase systems, Poly phase generation, Star and Delta connections, Voltage and current relations, power and power factor measurement, Balanced load analysis. DC Machines: Construction and principle of DC machine, Simple lap and wave windings, Concept of armature reaction and commutation Cross and demagnetizing ampere turns, DC Generators, Types of EMF equation, Losses, Efficiency principle Back EMF, Speed and speed regulation. Types, Characteristics, Performance curves, Losses and efficiency, Speed and torque problems involving magnetization curve, charging and Ignition circuits of automobiles. AC Synchronous Machines: Working Principle and Construction, Stator single layer, Double layer and concentric windings, Damping windings, Coil Span factor, Distribution factor, Leakage and armature reaction, Synchronous impedance. Alternators, Types, EMF equation, speed and frequency, Losses and efficiency, Alternator and load, Voltage regulation by synchronous impedance method, Synchronous Motors, Types, Principle of working, Vector diagram on load and its analysis for stator current, Power factor, torque and mechanical output. Effect of Variation of excitation, Losses and efficiency. AC Induction Machines: Principle of induction Motors construction, Types, Rotating field theory, Principle of working, Slip and its effect on motor current quantities. Losses, efficiency and performance curves. Starting, Full load and maximum torque relations, Torque slip characteristics. Transformers: Construction, Principle of working, EM F equation, Transformation ratios, Magnetizing current, Vector diagram on load, Equivalent circuit, Open circuit and short circuit tests, Losses, Efficiency and performance curves, All day efficiency, Percentage and per unit R, X and Z. Voltage regulation. Rectifiers and Applications: Rectification, Half Wave and Full Wave Rectifiers simple treatment, Elementary concept of amplification with transistor used as amplifier in common emitter configuration.

CURRICULUM

COURSE CODE & TITLE

ME-101 ENGINEERING MECHANICS

Credit Hours: 3+1

COURSE CONTENTS

Statics of Particles: Forces in a plane; Newton's First Law, Free body diagram; Forces in space (rectangular components); Equilibrium of a particle in space. Kinematics of Particles: Rectilinear and curvilinear motion of particles; Components of velocity and acceleration; Motion relative to a frame in translation. Kinetics of Particles: Newton's Second Law; Dynamic equilibrium; Rectilinear and curvilinear motion; Work and energy; Kinetic energy of particle; Principle of Work and Energy; Conservation of energy; Impulse and momentum; Impulsive forces and conservation of momentum; Impact, direct and oblique; Conservation of angular momentum. Rigid Bodies: Equivalent systems of forces; Principle of transmissibility; Moment of a force; Couple; Varignons Theorem. Centre of gravity of a three-dimensional body and centroid of a volume. Moments of inertia, radius of gyration, parallel axis theorem. Equilibrium of Rigid Bodies: Free-body diagram; Equilibrium in two and three dimensions; Reaction of supports and connections; Equilibrium of two-force and three-force bodies. Kinematics of Rigid Bodies: General Plane motions; Absolute and relative velocity and acceleration. Plane Motion of Rigid Bodies: Forces and acceleration; Energy & momentum; Conservation of linear and angular momentum. Friction: Laws of dry friction; Angles of friction; Wedges; Square-threaded screws; Journal & thrust bearings; Belt friction. Analysis of Structures: Internal forces & Newton's Third Law; Simple & space trusses; Joints & sections; Frames & machines. Forces in cables.

COURSE CODE & TITLE

CY-109: APPLIED CHEMISTRY

Credit Hours: 3+1

COURSE CONTENTS

Gases: Gas Laws, Kinetic Gas Equation, Van der Waal's Equation, critical phenomenon, liquification of gases, specific heat (molar heat capacity). Properties of Solution & Liquids: Surface Tension, Viscosity, Osmosis, Osmotic Pressure, pH-Buffer Solution, Spectrophotometer, Basic concepts of Colloidal Chemistry, classification purification (dialysis). Thermo-chemistry: Chemical Thermodynamics, Hess' Law, Heat of reaction, Relation between H and U measurement of heat reaction, Bomb Calorimeter. Electrochemistry: Laws of Electrolysis, E.M.F. series, corrosion (Theories, inhibition & protection). Water and Sewage: Sources of water, impurities, hardness, water softening, purification of water for potable and industrial purposes, electro dialysis. Introduction to environmental pollution; main sources and effects. Sewage treatment. Fuels: Types of fuels, classification of fossil fuels. Metals & Alloys: Properties and general composition of metals and alloys such as Iron, Copper, Aluminum, Chromium, Zinc used in engineering field. Engineering Materials: Inorganic Engineering materials: Cement, Glass. Organic Engineering Materials: Polymers, Rubbers, Plastics, and Paints. Semiconductors and Dielectric materials.

CURRICULUM

COURSE CODE & TITLE

HS-105/ES-105: PAKISTAN STUDIES

Credit Hours: 2+0

COURSE CONTENTS

An Outline of Emergence of Pakistan: A brief historical survey of Muslim community in the sub-continent. War of Independent 1857 and After match. Sir Syed Ahmed Khan, Development of Two Nation Theory. Formation of Muslim League. Lucknow Pact. Khilafat & Non-Cooperation Movement. Political Events from 1924 to 1937. Pakistan Resolution - Struggle for Pakistan from 1940 to 1947. Emergence of Pakistan. Land of Pakistan: Geophysical conditions, Territorial situation and its importance, Natural Resources-Mineral and Water Constitutional Process: Early effects to make constitution - Problems and issues. Constitution of 1956 and its abrogation. The constitution of 1962 and its annulment. Constitutional and Political Crisis of 1971; The constitution of 1973. Recent constitutional developments. Post-Independence Development: Education in Pakistan; Planning & Development in the Field of Education. Development of Science and Technology with special reference to Engineering and Architecture. Brief survey of Pakistan Economy: Industrial and Agricultural Development. Internal and external trade. Economic planning and prospects. Cultural Development in Pakistan: Definition, Contents & Contributing factors in culture, Development of Art, Philosophy and literature. Foreign Policy: Relations with neighbors, Super powers & the Muslim World.

COURSE CODE & TITLE

MT-215: DIFFERENTIAL EQUATION AND COMPLEX VARIABLES

Credit Hours:

COURSE CONTENTS

Infinite Series: Applications of simple convergence tests such as comparison, root, ratio, Raabe's and Gauss' tests on the behaviour of series.

Ordinary Differential Equations: Definitions, formation and solution. Boundary conditions. Homogeneous and Non-homogeneous linear differential equations with constant coefficients, and linear equations will variable coefficients. Cauchy's and Legendre's equations. Equations of second order. System of simultaneous linear equations with constant coefficients. Numerical approximation to solutions. Solution in Series. Simple applications in Engineering. Orthogonal trajectories.

Partial Differential Equations: Formation of partial differential equations. Solution of first-order linear and special types of second and higher-order differential equations used in Engineering problems. Various standard forms

Laplace Transformations: Elementary transformations. Shifting Theorems. Heaveside's expansion formula. Simple applications.

Complex Variables:Limit, continuity, zeros and poles, Cauchy-Reimann Equations, conformal transformations, contour integration

CURRICULUM

COURSE CODE & TITLE

MY-206: FURNACES AND REFRACTORIES

Credit Hours: 3+1

COURSE CONTENTS

Fuels and their types: Solid fuels: Coal, Charcoal, Peat Liquid fuels: Petroleum and its products, Light and Heavy oils and Furnace oils Gaseous fuels: Natural Gas, producer gas, water gas, coke oven gas and LPG Fuel Combustion: Combustion of Coal, Combustion of Liquid Fuels, Oil and Calculations on Combustions Furnaces: Types of furnaces, methods of heat recovery, recuperation and regeneration. Furnaces construction, design, Operation of cupola, rotary furnace, and induction furnaces. Introduction to refractories: Fundamentals of refractories and ceramics, Requirements of good refractory, Classification, Properties of raw materials for refectories such as, Fire clay, silica materials, alumina, magnesite, dolomite, chromite, graphite, carbon materials, zirconia. Production of Refractories: Manufacturing, testing and applications of refractories. Production of ceramic bodies, glazes, glasses, glass ceramics and enamels and insulating materials.

COURSE CODE & TITLE

HS-205/ES-205 ISLAMIC STUDIES OR

HS-209/ES-209: ETHICAL BEHAVIOUR

Credit Hours: 2+0

COURSE CONTENTS

Thematic Study of Holy Quran. 1. Basic Islamic Believes Topics i) Tauheed: Al-Ambiya-22, Al-Baqarah-163-164 ii) Prophet hood: Al-Imran-79, Al- Huda-7 Al-Maidah-3 iii) Here-After: Al-Hajj-5, Al-Baqarah-48 *Two Hadith 2. Basic Islamic Practices: Al-Mu'minun-l-ll 3. Amre-Bil-Ma'Roof Wa-Nahi Anil Munkar The Concept of Good & Evil. i) Importance & necessity of Da'Wat-e-Deen Al-Imran-llO. ii) Method of Da'Wat-e-Deen. An-Nehl-125, AlImran-l04 *Two Hadith 4. Unity of the Ummah: Al-Imran-l03, Al-Hujurat-l0, Al-Imran-64, AI-An'am-l08 *Two Hadith 5. Kasb-e-Halal. Taha-8l, Al-A'raf-32-33, Al-Baqarah-188 *Two Hadith. 6. Huquq-ul-Ibad: i) Protcetion of Life: AI-Maidah-32 ii) Right to Property: An-Nisa-29 iii) Right of Respect & Dignity: AI-Hujurat-11-12 iv) Freedom of Expression: AI-Baqarah-256 v) Right of Equality: AI-Hujurat-13 vi) Economic Security: AI-Ma'arij-24-25 vii) Exployment Opportunity on Merit: An-Nisa-58 viii) Excession Right to Justices: An-Nisa-135 7 .Women Rights: An-Nehl-97, AI-Ahzab-35, An-Nisa-O7 8. Relations With Non-Muslims: AI-Mumtahanah-8-9, AI-Anfal-61. Last sermon of Hajj at Arafat Translation & the important points of the sermon. 9. Serat Life of the Holy Prophet: Birth, Life at Makkah. Declaration of Prophet hood, preaching & its difficulties migration to Madina. Brotherhood (Mawakhat) & Madina charter. The Holy War of the prophet (Ghazwat-e-Nabawi) Hujjat-ul- Wida. 10. Islamic Civilization: Impacts of Islamic civilization on the subcontinent. The civilization of sub- continent before Islam. The Political, Social & Moral impacts of Islamic Civilization on sub-continent. Academic, Intellectual, Social & Cultural Impacts of Islam on the World. *N. B: As prescribed by UGC.

CURRICULUM

COURSE CODE & TITLE

MY-210: IRON MAKING PROCESSES

Credit Hours: 2+0

COURSE CONTENTS

Historical of Iron Making Processes. Iron Manufacture in Pakistan. Raw Materials for Iron Making, Iron Ores and Their Occurrence, Classification, Geological / Geographic Aspect, Valuation of Iron Ores. Iron ores and Iron bearing minerals. Iron making and its importance. Fluxes and Slags, their sources chemistry and uses. Agglomeration and testing of blast furnace burden. Sintering and roasting, blast furnace theory, construction, chemistry and the process. Factors affecting the reducibility and other metallurgical properties of burden. Wrought Iron and sponge Iron. Direct reduction processes of iron making. Blast Furnace Calculations Analytical Charge Calculations, Reducibility, Slags, Design Parameters, Material and Energy Balances etc. Applications of Computers in design and operation of iron making processes.

COURSE CODE & TITLE

MM-201: PHYSICAL METALLURGY

Credit Hours: 3+1

COURSE CONTENTS

Basic Principles of chemistry and physics applied to structure of materials, especially metals and alloys. Crystal structure of materials, Space lattice, Crystal system, Unit cell, Packing density, Coordination number, Allotropy, Rotational and Reflection Symmetries, Crystal planes and direction, Crystalline defects, Twining. Phase transformations in metals, glasses and organic materials. Elementary physical chemistry of phases, phase diagrams and phase rule application, Binary system, Ternary system, Solid Solution, Interstitial solid solution and Substitutional solid solution, Factor affecting the limit of solubility, Ordered and Disordered solutions, diffusion in solids, structure of interfaces, nucleation and growth, Crystallization, solidification, Grain boundaries, Grain size, Cast structure, Segregation, Shrinkage defects, Solid state transformations, Iron -Carbon Diagram, Microstructure and properties of steel and Cast Iron, pearlitic, bainitic, massive and order disorder transformations, precipitation. Elementary treatment of martensitic transformation, iron carbon system, and heat-treatment of steels. Microstructure of Copper based and Aluminum based alloys and their relationship to the properties, Metallurgical Microscope, Objective lenses and their short comings, Polarized light microscopy. Microstructure of plastics, polymers, rubbers and composites.

CURRICULUM

COURSE CODE & TITLE

MY-208: MINERAL PROCESSING

Credit Hours: 2+1

COURSE CONTENTS

Introduction: Minerals of economic importance, Processing Approach and Basic mineral processing technology, Efficiency of operation in mineral dressing plant. Liberation and Comminution Theory and attributes of comminution, Primary Crushers, Secondary Crushers, special crushers, their operation and applications, , Grinding Mills, Autogenous and Semi-Autogenous Mills, their operation and applications Screening and Classification Screening Equipment's, Grizzly, Revolving Screen (Trommel), Moving Screens and different Industrial screening types and operating characteristics, Classification Equipment, Sedimentation and Hydraulic Classifiers, Spiral and Rake Classifiers, Hydro cyclones (Cyclones) The movement of solids in fluids. Stoke's, Newton-, Rettinger's Law. Reynolds number free setting ratio and hindered setting ratio Separation and Concentration Techniques Theory and techniques of concentration, palletizing, nodulizing and briquetting, Separation Methods: Sorting, Gravity, Dense-Medium Separation, Magnetic Separation and Froth Flotation, Separation of solids from fluids by thickening process Flow sheets and circuit diagrams of typical mills treating ore Case Studies and Simulation Case studies on Mineral Processing of non-metallic ores (i.e. Chromite, Corundum, Mica, Dolomite, Gypsum etc.) and Metallic ores (i.e. Sphalerite, Cassiterite etc.) Process analysis, simulation, optimisation, and control using software.

COURSE CODE & TITLE

MY-207: MECHANICAL BEHAVIOUR OF MATERIALS

Credit Hours: 2+1

COURSE CONTENTS

Mechanism of plastic deformation, Theory of dislocations, Theory of elasticity, Unsymmetrical bending and shearing. Horizontal shearing stresses, shear flow, flow deflection due to shear, photo elastic method. Plasticity, relationship between stress and deformation, moment of inertia along different axes. Ellipse of inertia, determination of principal axes. Introduction to stress strain diagram, working stresses strain energy in tension and compression. Analysis of bi-axial stresses, principal planes, principal of stress-strain curves, stresses in thin-walled pressure vessels. Mohr's circles of bi-axial stress. Torsion of circular shafts, strain energy in shear and torsion of thin-walled tubes, Thermal stresses, buckling.

CURRICULUM

COURSE CODE & TITLE

IM-207: COMPUTER PROGRAMMING AND DRAFTING

Credit Hours: 2+1

COURSE CONTENTS

Introduction: Introduction to programming concepts & languages, Compilation & Interpretation, Overview of modular programming, ASCII character set. Building Blocks: Identifiers & keywords, Data-types, Variables & Constants, Statements & Operators, Input & Output Functions. Branching Statements: Conditional branching & Looping (Counter & condition-controlled loops). Subroutine: As brief overview, defining a subroutine, accessing a subroutine, passing arguments, Returning values and Recursion. Arrays & Strings: Defining an array, referring to individual elements of an array, Processing an array, Multidimensional arrays, String handling and Manipulation, and Overview of pointers. Computer-Aided Drafting: Introduction, Application of computers in drafting and designing, Methods for creating drawing entities, Common editing features, Dimensioning with variable settings, Printing and Plotting.

COURSE CODE & TITLE

MY-209: METAL FORMING AND SHAPING PROCESSES

Credit Hours: 2+1

COURSE CONTENTS

Introduction: Metal Shaping Processes, their classification and Structure-Property-Processing Relationship. Theory of plasticity: Material behavior under forming conditions, Stress and strain, Macroscopic plasticity and yield criteria, Work Hardening, Plastic instability, Ideal work, friction, redundant work, and mechanical efficiency, Flow stress, deformation resistance, Strain rate and temperature dependence of flow stress, workability, evolution of microstructure during metal working, Friction and surface integrity, Formability, bending, Plastic anisotropy. Analysis of Metal Forming Processes: Slab analysis, upper-bound analysis, Slip-line field theory, and deformation zone geometry, Study of Forging, Rolling, Extrusion, Wire, Rod, Tube and Sheet Metal Forming Processes. Design of Metal working Equipment: Fundamentals of design of metal forming equipment such as: Forging presses, Rolling Mills and accessories, and extrusion equipment Applications: FEM based simulation of metal forming processes.

CURRICULUM

COURSE CODE & TITLE

MY-211: METALLURGICAL THERMODYNAMICS & KINETICS

Credit Hours: 3+0

COURSE CONTENTS

Fundamentals of Thermodynamics: State functions, First law of thermodynamics, Enthalpy, Heat capacities, Second law of thermodynamics, Entropy, Gibbs and Hemholtz energies, Equilibrium conditions, Chemical potential, Maxwells relationships, Third law of thermodynamics, Enthalpy and entropy calculations, activity, Gibbs-Hemholt equation, Gibbs-Duhem equation, Measurement of heat reactions, Phase equilibrium single and multi- component systems. Behavior of solutions, non- ideal solutions, thermodynamics of phase diagrams. Experimental Methods: Evaluating thermodynamic functions, estimation &calculation of the values of thermodynamic functions, free energy of formation, free energy diagrams. Kinetics The Arrhenius equation, the activated complex theory, collision theory, calculation of reaction rates. Heterogeneous reactions, gas-solid reactions, liquid-solid reactions, liquid-liquid reactions at slag metal interface, gas-liquid reactions. Kinetics of phase transformations under non equilibrium conditions. Application: Application of the laws of thermodynamics to metallurgical processes, electrochemistry, interfacial phenomena, extraction and refining of metals, corrosion, and electrodeposition. Computational thermodynamics.

COURSE CODE & TITLE

MY-309: STEEL MAKING PROCESSES

Credit Hours: 2+0

COURSE CONTENTS

Introduction: History of steel making, principles of steel making reactions, Slag theories, Bessemer, Thomas and Open Hearth and steel making practices. L.D. Process: Design of converter and lance, chemical reactions involved, Catch Carbon technique. Recovery of waste heat. Electric arc furnace: Advantages charging melting and refining practices for plain carbon and alloy steel; uses of Direct Reduced Iron in arc furnace De-oxidation of liquid steel: Requirements of deoxidizers, de-oxidation practice. Inclusions and their influence on quality of steel. Killed, semi-killed and rimmed steel. Secondary refining of steel Continuous Casting of steel: Advantages; types of machines; mould lubrication and reciprocation.

CURRICULUM

COURSE CODE & TITLE

MY-308: POLYMER AND COMPOSITE MATERIALS

Credit Hours: 2+1

COURSE CONTENTS

Introduction to Polymeric materials, Classification of Polymers, Addition and Condensation Polymerization, Molecular weight, Molecular Shape, Structure of Polymers. Melting and Glass Transition Phenomena, Deformation and strengthening of plastics materials, Creep and Stress Relaxation. Structure, Properties and Applications of some selected Thermoplastics, Thermosets, and Elastomers. Processing of Plastic Materials (Extrusion, Injection Molding, Blow Molding, Compression Molding, Transfer Molding, Vulcanization, Processing, Properties and Applications of Elastomers. Composite Materials: Dispersion – Strengthened, Particulate Composites, Fiber – Reinforced Composites, The mechanics of fibre reinforcement, Metal-matrix composites, and Ceramic-matrix composites. Polymer-matrix composites, Processing of fibres and other reinforcements, Design of Ply and Laminate structures, and Sandwich structures. Manufacturing of composites.

COURSE CODE & TITLE

MG-481: ENTREPRENEURSHIP

Credit Hours: 3+0

COURSE CONTENTS

Understanding the Entrepreneurship Mind-set, The revolution impact of Entrepreneurship, The individual Entrepreneurship Mind-set Corporate Entrepreneurship Mind-set, The Social and Ethical perspectives of Entrepreneurship Launching Entrepreneurship Ventures, Creativity and innovations, Methods to initiate ventures Legal challenges in Entrepreneurship, The search for Entrepreneurship Formulation of Entrepreneurship The assessment of function with opportunities, The marketing aspects of new ventures, Financial statements in new ventures, Business plan preparation for new ventures Strategies perspectives in Entrepreneurship, Strategies growth in Entrepreneurship, Valuation challenges in Entrepreneurship, Final harvest of a new venture.

CURRICULUM

COURSE CODE & TITLE

MM-303: INSPECTION AND TESTING OF MATERIALS

Credit Hours: 3+1

COURSE CONTENTS

Introduction to inspection and testing of materials, its scope and importance. The Brinell test, the Vicker test, the Rockwell test, the Knoop test, the Scleroscope test, conversion tables for various scales of hardness. Stress and strain, load extension diagrams, modules of elasticity, elastic limit, yield stress, proof stress, work hardening, tensile testing, (equipment and specimens). Compression testing, bend testing, and torsion testing. Impact testing. Toughness, brittleness and ductility, notched bar impact testing, the Charpy and Izod impact tests, brittle and ductile fractures. The fatigue test, different types of fatigue fractures, Goodman diagram, endurance limit-ultimate tensile strength. The Creep Test. Overview of the main NDT techniques of materials testing, Visual, Ultrasonic, Penetrant, Magnetic particles and x-ray, and eddy current techniques, Example in NDT of materials. Advanced techniques used for testing of plastics, rubbers, polymers and composite materials

COURSE CODE & TITLE

MT-315: MATHEMATICAL METHODS

Credit Hours: 3+0

COURSE CONTENTS

Solid Geometry: Rectangular Coordinate Systems in three-dimension, direction cosines, plane (straight line) and sphere. Advanced Calculus: Taylor's Theorem for functions of two variables without proof. Maxima and minima of functions of two variables. Lagrange's method of multipliers. Double integration, change of order, conversion to polar form. Applications in finding areas, volumes, centroids, center of pressure. Movement of inertia and principal axes. Theorems of Pappus and Guldinus. Surface area and volumes of revolution. Vector Calculus: Differentiation of vectors, gradient, divergence and curl. Laplacian and spherical harmonies. Vector integration. Theorems of Gauss, Green and Stokes. Simple applications. Linear Algebra & Matrices: Linearity, dependent and independent vectors, bases and dimension, vector spaces, fields, liner transformations, matrix of a linear transformation. Basic definitions and matrix operations, adjoin and inverse of a 3 x 3 matrix. Rank of a matrix. Cayley-Hamilton Theorem, Eigen values. Applications in solving linear homogeneous and non-homogeneous equations in three unknowns. Cases of existence of solution, no solution, infinite and unique solutions. Elements of Tensors: Cartesian Tensors, understanding of stress tensor and deformation.

CURRICULUM

COURSE CODE & TITLE

MY-310: NON-FERROUS EXTRACTIVE METALLURGY

Credit Hours: 3+0

COURSE CONTENTS

Introduction: Non Ferrous metals and its ore deposits in Pakistan, Introduction to Non- Ferrous Extractive Metallurgy: Scope and importance in Pakistan. Principles of extractive metallurgy; The application of the principles of thermodynamics, kinetics, and heat and mass transfer to the extraction and refining of non-ferrous metals. Aluminum and its Alloys: Aluminum and its ores, Preparation of Alumina, Preparation of Cryolite, Production of metallic Aluminum, Thermal process of Aluminum, Alloys production, Recovery of other values from Aluminum ores, Aluminum and its alloys, Copper and its Alloys: Copper and its ores, Preparation of concentrate, Extraction of Copper ores by pyro-metallurgical methods, Matte smelting, Pier Smith converter, Top Blown Rotary Converter, Electrolyte and fire refining of Copper, Recovery of values such as Gold and Silver from Copper ores, Copper and its alloys. Zinc and its Alloys: Zinc and Zinc ores, General Preparation of extraction of Zinc, Roasting of Zinc concentrate, Leaching of roasted Zinc concentrate, Electrolysis of Zinc Sulphate solution, Melting of Cathodic Zinc, Production of Zinc retort and blast furnace method, Refining of Zinc, Zinc and its alloys. Lead and its Alloys: Lead and its ores, Extraction of lead, Blast roasting of lead concentrate, Blast furnace smelting of lead bullion, Recovery of Cadmium and other metals from lead concentrate, Lead and its alloys. Magnesium, Chromium, Titanium and its Alloys: Magnesium and its ores, Chromium and its ores, Extraction of magnesium and Chromium by Alumino-thermic and silico-thermic methods, Titanium and its ores, Treatment of its ores concentrate, Production of Titanium metals by reduction with Sodium and Magnesium, Titanium and its alloys.

COURSE CODE & TITLE

MM-304: HEAT TREATMENT OF MATERIALS

Credit Hours: 3+1

COURSE CONTENTS

Introduction and scope of the heat treatment processes used for materials. Review of the iron-carbon phase diagram, Effect of common alloying additions on the equilibrium diagram, annealing and its types, and Structures of slowly cooled steels. Specialized heat treatments include full annealing, normalizing, and process annealing. Oxidation and decarburization during heat treatment, Batch and continuous annealing. Quenching, tempering and hardening of steel, quenching rates and quenching media, martensitic transformation, time temperature transformation diagrams, effects of austenizing, grain size and alloying element on the transformation diagram, continuous cooling diagrams. Hardenability and its measurement, Jominy test. Aus-tempering, mar-tempering, retained austenite, tempering of martensitic steel. secondary hardening, heat treatment of dies and tool steel, Alloy steels, HSLA steels, and stainless steels, surface hardening, carburizing, nitriding, cyaniding, carbon-nitriding, induction and Flame hardening, heat treatment of cast iron heat treatment of nonferrous metal and alloys, age hardening/precipitation hardening, defects caused during heat treatment and their remedies, subzero treatment. Heat. Heat treatment of nonmetallic materials like polymers, plastics, rubbers and composites.

CURRICULUM

COURSE CODE & TITLE

MY-303: FOUNDRY PRINCIPLES, METHODS AND PRACTICE

Credit Hours: 3+1

COURSE CONTENTS

Introduction: Foundry Engineering and Practice, Scope and importance of the subject, Foundry plant layout, design and calculations, Tooling, equipment, machines. Advanced design techniques and calculation using personal computer, Pattern and Moulds: Types of pattern, pattern making, shrinkage and contraction allowances, Selection of suitable moulding and core materials, Properties of moulding and core materials, Analysis, testing and control of moulding and core materials requirements. Melting: Melting methods and practice and their effect upon metal quality. Melting furnaces and equipment, Gases in metal, their control and removal, Solidification, Nucleation and growth phenomenon, Microstructure of cast metal and alloys, Heat flow in solidification, Solidification of single phase systems, Solidification of multiphase systems, Structures of casting and segregation. Melting of Ferrous & Non-Ferrous Metals & Alloys. Casting Methods and Techniques: Casting process and procedures, Pouring & Feeding of Casting, Different casting techniques: sand casting, shell mould casting, plaster casting, investment casting, permanent mould casting, centrifugal casting, continuous casting, Gravity and pressure die casting methods, Selection of die casting alloys, Moulding materials and mould dressings, Metallurgy of die casting alloys, Shell moulding, Lost wax, Investment and Precision casting processes. Cast metal systems: non-ferrous alloys, cast irons, steels Casting techniques of Ferrous and Non- Ferrous metals. Defects and Quality: Inspection & Quality Control, Casting Defects: Identification, Causes of defects and their remedies. Fettling & Processing of Castings, Patterns, Sand Moulding, Gating & Risering, Computer applications in foundry processes

COURSE CODE & TITLE

EA-304: BUSINESS COMMUNICATION AND ETHICS

Credit Hours: 3+0

COURSE CONTENTS

Part-1 Communication Skills (Oral): Definitions and Conditions. Modes: verbal, non-verbal, vocal, non-vocal, sender, receiver, decoding, noise, context, emotional maturity, relationships, etc. Language, perception. Non-verbal, body language, physical appearance, cultural differences etc. Personal and interpersonal skills/perceptions. Communication dilemmas and problems. Public Speaking – speaking situation, persuasion. Part-II Written Communication: Formal / Business letters. Memos (brief revision). Notice and minutes of meetings. Contracts and agreements (basic theoretical knowledge and comprehension). Research / scientific reports. Tenders (basic theoretical knowledge and comprehension). Participating in seminars, interviews, writing and presenting conference papers, solving IELTS type papers. (Non- examination). Part-III Engineering / Business Ethics: Course objective. Need for code of ethics. Type of ethics, involvement in daily life. Problems/conflicts/dilemmas in application. Review of Pakistan Engineering Council Code of Conduct.

CURRICULUM

COURSE CODE & TITLE

MY-304: METALLURGY OF WELDING

Credit Hours: 2+1

COURSE CONTENTS

Introduction to welding and joining, Metallurgy of welding, the effect of heat on metals, preheating, stress, strain, weld-ability, weld defects, and selection of appropriate welding process.

Fusion Welding Processes: Overview of welding processes. Gas welding and equipment, fluxes, torch gases hoses and hose connection, torches, mixers, welding tips, regulators clamp outfits. Arc welding, power sources, DC and AC power sources, cables, electrodes, current and circuit polarity, electrode selection, weld deposit. TIG & MIG welding, Submerged arc and other shielded methods, equipment, current, flux, electrodes, atomic hydrogen welding, plasma arc welding, electro-slag welding, under water shielded metal arc welding, vapour shielded metal arc welding - CIG welding. Thermite welding, equipment techniques, process, ignition powder removing the mold inspection.

Non-Fusion Joining Processes: Joining processes in which the base materials are not melted. Brazing, Soldering, Diffusion bonding, Explosive bonding, and Adhesive bonding processes. Resistance welding, resistance spot welding, multiple spot welding, MIG spot welding, PIGME welding process, flash and upset welding.

Other welding processes include laser welding, electron beam welding, pressure welding, and ultrasonic welding. Solders principles, Equipment, fluxes

Design of Welded Structures and Assemblies: Introduction and concepts in welding structures and assemblies. Analytical practice of designing weldments. Welding codes and specifications. Estimation of welding costs.

Physics of Welding: Introduction to arc welding physics, fluid flow in the plasma, weld pool phenomena, thermal experience during welding, Quality of weld, Applications of Computers in welding processes.

Aluminum and aluminum alloys, magnesium and magnesium alloys, brazing, equipment, copper and copper alloys, aluminum brazing, dissimilar metals joining, plastic welding.

COURSE CODE & TITLE

MY-410: FRACTURE MECHANICS & FAILURE ANALYSIS

Credit Hours: 2+1

COURSE CONTENTS

Linear elastic fracture mechanics, Elastoplastic fracture mechanics, Ductile and Brittle fracture, Tensile fracture, Creep and Creep fracture, fatigue and Fatigue fracture, Fracture toughness theory ductile to brittle transition, the effect of temperature, Griffith's theory, micro-voids formation and ductile fracture, cleavage for brittle fracture, cleavage planes, crack opening displacement (COD), stress intensity factor, J integral, elastic-plastic fracture mechanics, , plane stress and plane strain fracture toughness, real-time fracture toughness, fracture re-enforcement mechanisms. Fractography, differentiation among different types of fracture surfaces Root cause analysis, and Case studies of failed components.

CURRICULUM

COURSE CODE & TITLE

PF-303: APPLIED ECONOMICS FOR ENGINEERS

Credit Hours: 3+0

COURSE CONTENTS

Introduction: Engineering economy defined; Measures of financial effectiveness; Nonmonetary factors and multiple. Objectives; principles of engineering economy. The Economic Environment: Consumer and producer goods; Measures of economic worth; Price, Supply, & Demand relationship; Production; Factors of production; Laws of return. Cost Concepts Analysis: Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring costs; Direct, indirect, and overhead costs; Standard costs; Breakeven analysis; Unit cost of production; Cost-Benefit analysis; Feasibility studies; Value analysis in designing & purchasing. Time Value of Money: Simple interest; Compound Interest; Cash flow diagrams; Interest formulas; Nominal versus effective, interest rates; Continuous compounding. Depreciation and Depletion: Purpose of depreciation; Types of depreciation; Economic life. What can be depreciated? Comparing Alternatives: Present economy; Selection among machines, materials, processes, and designs, Payback period method; Present worth method; Uniform annual cost method; Rate of return method; Alternatives having identical lives. Alternatives having different lives. Production Concepts & Mathematical Models: Manufacturing lead time, Production rate; Capacity; Utilization; Availability; Work in process; WIP and TIP ratios. Linear Programming: Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems. Capital Financing and Budgeting: Types of ownership; types of stock; partnership & joint stock companies; Banking & specialized credit institutions. Industrial Relations: Labor problems; Labor organizations; Prevention & Settlement of disputes.

COURSE CODE & TITLE

MY-413: CORROSION ENGINEERING

Credit Hours: 2+1

COURSE CONTENTS

Corrosion General concepts of corrosion applied to materials, corrosive environments, Electrochemical Theory, Polarization curves, Activation & Concentration polarization curves, general corrosion, galvanic corrosion, oxygen concentration cell, Oxidation of Metals, types of scale, Oxidation rates, localized corrosion, Pitting and Crevice corrosion. Stress corrosion cracking, hydrogen damage, Intergranular corrosion, Selective leaching, Protection and Prevention, Chemical inhibiters, environmental control, anodic and cathodic protection, mechanical protection, coatings, anodizing, painting, corrosion resistant materials, corrosion of carbon steels, stainless steel, aluminum alloys, case studies. Corrosion inhibitors: Paint; Modes of protection, inhibitive and metallic pigments, Metal coatings, methods of application, Anodizing of aluminum, Design and selection of materials.

CURRICULUM

COURSE CODE & TITLE

IM-417: HEALTH, SAFETY AND ENVIRONMENT

Credit Hours: 2+1

COURSE CONTENTS

Safety Management: Understanding accident and hazard, Hazard control and loss control, Company policy and management responsibilities, Direct and indirect cost, Accident causes and their control, Principles and processes of lost control, Knowledge of existing safety codes and standards. Accident Prevention and Control: Fire safety, Electrical Safety, Safety in boilers and unfired pressure vessels and high-pressure systems, Safety in material handling and storage, Safety in production operations (hand portable power tools, Wood working machinery, welding and cutting, metal working machinery, cold and hot forming of metals, automated lines system and processes). Process Safety Management: Development of facility operation and procedures, Analysis of process hazard, Permit to work systems, Hazard communication (Material safety data sheet), Chemical inventory record, Accident reporting and investigation, Ensuring mechanical integrity, Industrial Hygiene and Workers Protection: Understanding industrial hygiene, various hazards encountered in workplace, Types of personal protective equipment (PPE), Availability in market their design standards and selection criteria. Environment Management: Environment pollution, Air emission management, Waste management, Wastewater treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000 machinery, cold and hot forming of metals, automated lines system and processes). Process Safety Management: Development of facility operation and procedures, Analysis of process hazard, Permit to work systems, Hazard communication (Material safety data sheet), Chemical inventory record, Accident reporting and investigation, Ensuring mechanical integrity, Industrial Hygiene and Workers Protection: Understanding industrial hygiene, various hazards encountered in workplace, Types of personal protective equipment (PPE), Availability in market their design standards and selection criteria. Environment Management: Environment pollution, Air emission management, Waste management, Wastewater treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000.

COURSE CODE & TITLE

MM-413: NUCLEAR MATERIALS (Elective-I)

Credit Hours: 2+0

COURSE CONTENTS

Overview of Nuclear Systems, Nuclear energy, nuclear reactors. Introduction to nuclear power plant operation, nuclear fission and fusion reactions, neutron absorption cross section. Nuclear fuels: uranium, thorium, plutonium; Fuel cladding materials: Aluminum alloys, stainless steels, zirconium alloys; Reflecting materials: graphite, beryllium, moderators, light water, heavy water, graphite;Control rod materials: cadmium, boron. Overview of UO2, Irradiation hardening and embrittlement. Structural materials in nuclear power plants, overview of Materials used in nuclear power plants. Effect of radiations on properties of materials. Radiation hazards and their safety, Radiation Damage, health physics. Disposal of radioactive waste.

CURRICULUM

COURSE CODE & TITLE

MY-407: DESIGN, SELECTION AND CHARACTERIZATION OF ENGINEERING MATERIALS

Credit Hours: 3+1

COURSE CONTENTS

***Introduction*:** Philosophy and practice of design and selection of engineering materials. Overview, the selection of materials, service conditions, materials and primary processes, secondary processes, welding, MY-409: Metallurgical Plants and Quality Control machining, thermal treatment, finishing operations, strength-to-density and modules-to-density reading and using specifications, safety and reliability, quality control and quality assurance, help from the computer, prototypes and experimentation, cost analysis for a component, the recycling and reuse of materials.

Selection: Selection of materials for specific applications, designing for corrosion resistant service, concept of passivity, designing for wear resistant service, designing for high temperature service and designing for high strength/weight applications. Selection of Non-Ferrous materials including aluminum, copper, nickel, cobalt, stainless steel, cast irons, titanium, refractory materials, rubber, plastics, polymers and composites materials systems. Intelligent selection of materials for better design, manufacturing and performance. Case studies of real-life engineering problems and solutions.

Characterization: Overview of characterization techniques of engineering materials. Wet analysis, microscopic characterization, Optical microscopy, interference contrast, quantitative analysis. Image analysis, SEM and TEM principles and configuration, elastic and inelastic scattering, SE, BSE, imaging, WDS and EDS microanalysis, BSCP, TEM BF and DF contrast, diffraction patterns, STEM. Defect analysis, sample preparation, EPMA, field ion microscopy (AP-FIM) and concentration profiling. Scanning tunneling, acoustic and atomic force microscopy, DTA, DSC and dilatometry, AES and SIMS, molecular spectroscopy, Electron microprobe analysis, Gas analysis by mass spectrometry, Application and limitation of characterization techniques-case studies.

COURSE CODE & TITLE

CH-407 Industrial Organization and Management

Credit Hours: 2+1

COURSE CONTENTS

Introduction and History, Company and Organization, Facility Location and Layout Planning, Operation Planning and Control, Marketing and Distribution, Total Quality Management, Project Management, Maintenance Management, Financial Management, Human Resources, Other Topics and Recent Trends in Management.

CURRICULUM

COURSE CODE & TITLE

MY-411: VACUUM METALLURGY

Credit Hours: 2+0

COURSE CONTENTS

Vacuum principles, their Importance, classification and application in the metallurgical field, Different units of measuring pressure vacuum regimes, mean free path, collision frequency. Vacuum pumps: Water pumps, positive displacement pumps, rotary and roots pump, vapor ejector and vapor entrainment pumps, diffusion pump, turbo-molecular pump, introduction to vacuum measuring devices, Vacuum degassing Plant and Different techniques, Electron Beam Melting and Casting, Production of Nickel-Titanium Alloys by Electron beam Technique, Vacuum arc Skull Melting and Casting, Button Melting, Drip Melting of Refractory metals, Continuous Flow Melting, Introduction to Vacuum in Scanning Electron Microscopy, Introduction to the Mass Spectrometer, Vacuum Sintering, Physical Vapor deposition, Chemical vapor deposition Synthesis of Graphene, Vacuum Heat treatment. Vacuum coating.

COURSE CODE & TITLE

MY-406: POWDER METALLURGY

Credit Hours: 2+1

COURSE CONTENTS

Introduction: General concepts of Powder Metallurgy, Techniques for Production of metallic powders: gas atomization, chemical processes, electrolysis, gaseous reduction, mechanical processes, spray deposition, powder characterization techniques, bulk, density, particle size, surface area, consolidation of powder. Compaction: Compaction of metallic powder, Types of presses, mechanical press, cold iso-static press, hot isostatic pressing, moulds and dies, consolidation mechanism, effect of lubricants, binders, compaction defects, Sintering and Finishing: Mechanism, theory of sintering, sintering defects, sintering environments, characterization of sintered components; finishing operations; structural and porous components; cutting tools. Application: Advantages and limitation of powder metallurgy, application of powder metallurgy, merits and demerits of powder metallurgy, applications of P/M parts. Case histories.

COURSE CODE & TITLE

MM-411: NANOMATERIALS AND NANOTECHNOLOGY (Elective-II)

Credit Hours: 3+0

COURSE CONTENTS

Introduction & Scope of Nanotechnology, Units of Measurement, The Significance of the Nano-scale, Advancing beneficial nanotechnology, Nano-scale in Three Dimensions, Introduction to Molecular nanotechnology and Nano robotics. Review of structures of Materials, Effects of Materials' Properties Change at the Nano-scale, Equipment for Nano studies, tools for Characterization of Nano materials, Present Applications of Nanotechnology, and Potential applications of Nanotechnology. Introduction to Nano-particles, Nano materials and nano products, Processing and Synthesis Techniques for Nano particles, Chemo-physical processes in nano particle, Lithographies, Design, production and application of Nano-composite, devices and materials. Concept of a molecular assembly, Nobel Metal nanotechnology, Natural Nano particles. Carbon Nanostructures, Nano wires, Nano indentation.

CURRICULUM

COURSE CODE & TITLE

MY-402: ADVANCED MATERIALS (Elective-II)

Credit Hours: 3+0

COURSE CONTENTS

Introduction: Development of new breeds of engineering materials, smart materials and functionally gradient materials, biomaterials. Semiconductors, superconductors, optical and magnetic materials. **Magnetics Materials:** Classification of materials according to magnetic properties. Magnetic fields, flux density and magnetization. Magnetic materials, magnetic measurements. Magnetic properties of materials, hysteresis. Technological application, soft magnetic materials for electromagnets, hard magnetic materials, permanent magnets, magnetic recording technology. **Biomaterials:** Basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

High Temperature Materials: Overview Elevated-Temperature Characteristics of Materials, Mechanical Properties at Elevated Temperatures, Corrosion at Elevated Temperatures. Processing and Properties of Super alloys. Directionally Solidifies and Single-Crystal Super alloys. Elevated-Temperature Corrosion of Super alloys. Microstructural Instabilities. Heat-Resistant Materials, Titanium Alloys, Refractory Metals and Alloys Structural Intermetallic Ceramics Carbon-Carbon Composites. Materials for Aerospace applications. Materials for nuclear applications. **Nanomaterials:** Overview of Nanomaterials and their classification. Mechanically alloyed Nanomaterials, ODS alloys, Nanostructured materials, Fuel cell Materials, Materials for Hydrogen Storage, Ceramic and Ceramic matrix composites, Metal Matrix composites. Shape memory alloys Application of Computer in Advanced materials.

COURSE CODE & TITLE

MY-409: METALLURGICAL PLANTS AND QUALITY CONTROL

Credit Hours: 3+0

COURSE CONTENTS

Metallurgical plant location, Factors affecting location; Multiplan location; Plant layout; product and process layout analysis; Layout comparison. Types of pollutants and their treatment, overview of environmental impacts of iron and steel making, hot rolling, forging, cold rolling, annealing and tempering, coating and plating plants. Environmentally friendly metallurgical plants. Occupational health and safety impacts of metallurgical plants, basic procedures and remedies. Application of computers for environmental, pollution control and waste management in metallurgical plants. Fundamentals of statistics and analysis techniques. Probability distributions. AQL, AOQL, LTPD, attributes sampling, variable sampling, selection of a proper sampling program. Reliability and maintainability, inspection of different types of materials and products for evaluation of quality, reliability of flaw detection by non-destructive inspection, and quality control applications of non-destructive inspection. Introduction to standards. Familiarisation with standards for testing of materials, ASTM, BS, JIS, GOST, and ISO. Pakistan standards, quality assurance for final products. Measures for quality control.

CURRICULUM

COURSE CODE & TITLE

MY-412: METALLURGY OF ADVANCED STEEL

Credit Hours: 2+0

COURSE CONTENTS

Ni steel, Cr steel, Ni-Cr steel , Mn- Steels, Steel containing, MO, V, W, B, Si, Cu, Reconstructive, Displacive and diffusion less transformation product in steel, characteristics and microstructural of phases, High strength low Alloy (HSLA) steels, Advanced High Strength Steels (AHSS), Dual Phase (DP), Transformation Induced Plasticity (TRIP), Twinning Induced Plasticity (TWIP), Ferrite Bainitic, Other HSLA-micro alloyed steels, stainless steels, duplex steels, Martensitic-Stainless steel, Maraging steels, Bainitic steel, Thermomechanical processing, advantages and limitations, TMT and Thermomechanical Controlled Processing (TMCP) and steels, IF (interstitial-free) and ultra-low carbon steels for structural and automotive applications, ultra-low-carbon bainitic steels (ULCB),orthopedic steels, duplex and super duplex, corrosion stainless steels, tool steels, die steels, Steels for low to moderate temperature applications for nuclear and thermal power plants, heat-resistance steels.

COURSE CODE & TITLE

MM-408 High Temperature Materials and Superalloys (Elective-I)

Credit Hours: 2+0

COURSE CONTENTS

Overview of elevated temperature characteristics of engineering materials, mechanical properties, and industrial applications of heat-resistant materials. Properties, Metallurgy, and processing of superalloys. Elevated temperature corrosion of materials. Microstructural instabilities. Protective coatings, properties of nonferrous heat-resistant materials, refractory Metals and alloys. Structural Intermetallic, ceramics, carbon-carbon composites. Analysis and design assessment of creep rupture data. Thermomechanical fatigue of structural materials. Elevated-temperature crack growth. Creep-fatigue interaction. Materials design for elevated temperature applications; Design for oxidation resistance, creep, thermal fatigue, high temperature corrosion, erosion, ageing, structural changes, and material damage. Crack propagation, damage mechanics, lifetime analysis, creep resistant steels, superalloys, ceramics and polymers for high temperature applications, intermetallic. Uses of high-strength steels, spring steels. Evaluation of property data extrapolation. Plastics and composite materials for high temperature applications.