

DEPARTMENT OF METALLURGICAL ENGINEERING

Semester wise Syllabus of 2011 and onward

MY-101: INTRODUCTION TO 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.

EE-116: PRINCIPLES OF ELECTRICAL ENGINEERING

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, measurement of power and power factor, 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 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, EMF equation, Transformation ratios, No load working and vector diagram, 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.

HS-101: ENGLISH

Technical Report Writing.

Preparation of Short Speeches for various occasions.

Written Communications:

Writing of formal letters and applications, Drafting of Memorandums, Contracts, Advertisements and Tender notices. Preparation of Minutes of meeting. Writing short papers on technical subjects. Notes taking.

Oral Communication:

Oral reporting, Conference Leading, Dictation. Interviewing, Precise Writing.

Essays on technical and non-technical subjects.

Applied Grammar:

General rules for writing correct English, Punctuation, Study of words, Constructions and improvement of sentences. Vocabulary learning and use of dictionary.

HS-105: PAKISTAN STUDIES

An Outline of Emergence of Pakistan:

A brief historical survey of Muslim community in the sub-continent. War of Independence 1857 and Aftermath. Sir Sayed 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 efforts 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 and Contributing factors in culture, Development of Art, Philosophy and literature.

Foreign Policy:

Relations with neighbors, Super powers and the Muslim World.

HS-127: PAKISTAN STUDIES (FOR FOREIGNERS)

Land & People –Strategic importance – Important beautiful sights – Natural resources (some portion of economics of Pakistan)

A brief Historical Background:

A brief historical survey of Muslim community in the sub-continent – British rule & its impacts – Indian reaction – Two nation theory Origin and development – Factors leading towards the demand of a separate Muslim state – Creation of Pakistan.

Government & Political Development in Pakistan:

Constitution of Pakistan – A brief outline – Governmental structure Federal and Provincial – Local Government Institutions – Political History a brief account.

Pakistan & the Muslim World:

Relations with the Muslim countries.

Language and Culture:

Origins of Urdu Language - Influence of Arabic & Persian on Urdu Language & Literature - A short history of Urdu literature - Dominant Culture features.

ME-101: ENGINEERING MECHANICS

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 and momentum; Conservation of linear and angular momentum.

Friction:

Laws of dry friction; Angles of friction; Wedges; Square-threaded screws; Journal and thrust bearings; Belt friction.

Analysis of Structures:

Internal forces and Newton's Third Law; Simple and space trusses; Joints and sections; Frames and machines. Forces in cables.

ME-102: ENGINEERING DRAWING

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 couplings; 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.

ME-104: WORKSHOP PRACTICE

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, such as turning, shaping, milling and sheet metal work.

ME-108: FUNDAMENTALS OF THERMAL-FLUID ENGINEERING

Introduction to Thermal-Fluid Engineering. Basic Concepts of Thermodynamics. Properties of Pure Substances. Energy Transfer by Heat, Work, and Mass. The First Law of Thermodynamics. The Second Law of Thermodynamics. Entropy. Introduction to Fluid Mechanics. Fluid Statics. Bernoulli and Energy Equations. Momentum Analysis of Flow Structures. Flow in Pipes. Mechanics of Heat Transfer. Steady Heat Conduction Lumped Capacitance Method For Transient Conduction. Forced Convection. Natural Convection. Radiation Heat Transfer.

PH-121: APPLIED PHYSICS

Introduction:

Scientific notation and significant figures. Types of errors in experimental measurements. Units in different systems. Graphical Techniques (Log, semi-log and other non-linear graphs)

Vectors:

Review of vectors, Vector derivatives. Line and 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, Paramagnetism 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. Transverse modes for continuous string. Standing waves. Dispersion relation for waves. LC network and coupled pendulums. Plasma oscillations.

Optics and Lasers:

Harmonic traveling waves in one dimension .Near and far fields. Two-slit interference. Huygens Principle. Single-slit diffraction. Resolving power of optical instruments. Diffraction Grating.

Lasers, Population inversion. Resonant cavities. Quantum efficiency. He-Ne, Ruby and CO₂ lasers. Doppler effect and sonic boom.

Modern Physics:

Inadequacy of classical physics, Planck's explanations of black body radiation Photoelectric effect, Compton effect. Bohr theory of Hydrogen atom, Atomic spectra, 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.

CY-105: APPLIED CHEMISTRY

Gases:

Gas Laws, Kinetic Gas Equation, Van der Waal's Equation, critical phenomenon, liquidification 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).

Thermochemistry:

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, electrodialysis. 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.

MT-111: CALCULUS

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 inequalities in involving modulus with graphical representations; Definition of set, set operations, Venn diagrams, DeMorgan's laws,

Cartesian product, Relation, Function and their types (Absolute value, greatest integer and combining functions). Graph of some well-known functions. Limit of functions 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, Contradiction, Contingency & Logical equivalence.

Boolean Algebra:

Definition, Boolean function, duality, some basic theorems & their proofs, two valued 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 and regions in the complex plane, standard functions and their inverses (exponential, circular and Hyperbolic functions).

Differential Calculus:

Differentiation and Successive differentiation and its application; Leibnitz theorem, Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series. Taylor and Maclaurin series, L'Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, exact differential and its application in computing errors, extreme values of a function of two variables with and without constraints. Solution of non-linear equation, using Newton Raphson method.

Integral Calculus:

Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence, Beta and Gamma functions and their identities, applications of integration, Centre of pressure and depth of centre of pressure.

Solid Geometry:

Coordinate Systems in three dimensions, Direction cosines and ratios, vector equation of a straight line, plane and sphere, curve tracing of a function of two and three variables, Surfaces of revolutions, transformations (Cartesian to polar & cylindrical).

MY-201: METALLURGICAL THERMODYNAMICS AND KINETICS

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 equilibria in single and multi- component systems. Behaviour of solutions, non-ideal solutions, thermodynamics of phase diagrams.

Experimental Methods:

Evaluating thermodynamic functions, estimation and 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.

MY-202: FUELS AND FURNACES

Primary Fuels:

Origin and Formation of Coal and Crude Petroleum, Sizing and Cleaning of Coals, Classification, preparation, storage, handling and transportation of coal. Combustion of Fuels. Physical Processing of

Crude Petroleum, Light and heavy oils, furnace oil. Gaseous fuels, producer gas, water gas, coke oven gas and LPG. Natural gas and its viscosity, calorific intensity, octane number and Cetane number of fuel, analysis of fuel and fuel economy. Liquefied Petroleum Gases.

Secondary Fuels:

Cracking and Reforming Process for Distillation Products of Crude Petroleum, Carbonization and Gasification.

Fuel Combustion:

Combustion of Coal on Grates, Fluidized Beds and in Pulverized Form, Ignition Temperature, Limits of Inflammability and Flame Speed of Combustible Gases, Combustion of Liquid Fuels, Oil and Gas Burners and their Design Calculations on Combustions.

Furnaces:

Introduction, Types of furnaces, electric, oil, gas, coal, thermal efficiency, methods of heat recovery, recuperation and regeneration. Melting furnaces-construction, design and operation of blast, cupola, rotary furnace, electric arc, resistance and induction furnaces. Heat treatment furnaces, Batch type and continuous types, vacuum furnaces and controlled atmosphere furnaces. Pyrometry. Fuel-Fired Furnaces, Refractories for melting and heat treatment furnaces. Applications of Computers in Fuels and Furnaces design, construction and operation.

MY-203: MINERAL PROCESSING

Introduction:

Minerals of economic importance. Mineral processing plant design. Process analysis, simulation, optimization, and control. Basic mineral processing technology, ore handling, sampling, efficiency of operation in mineral dressing plant, Comminution techniques, sizing classification. Flotation: surface chemistry, reagents, on-stream analysis, process optimization, basic flotation; oxide flotation, ore concentration, gravity concentration, magnetic separation, electrostatic separation Gravity and magnetic separations. Tailings disposal, water pollution control, closed circuit operation.

Crushing and Sizing:

Theory of crushing, operation and application of jaw-, gyrator-, cone-, roll, gravity stamp- and special crushers. The theory and application of liberation techniques. Theory and attributes of comminution and use of ball, rod and tube mills. Industrial screening, types and operating characteristics screens, the movement of solids in fluids. Stoke's, Newton-, Rettinger's Law. Reynolds number free setting ratio and hindered setting ratio.

Separation and Concentration:

Heavy fluid separation, liquids and suspension, principles of jigging. Hydraulic and pneumatic jigs, flowing film concentration and tabling. Flotation and dispersion. Magnetic separation and magnetic properties of substances. Processes of separation depending on colour and general appearance, heat properties, electrical properties, differential hardness, amalgamation. Separation of solids from fluids by thickening process, filtration, dust elimination and drying. Theory and techniques of concentrates, palletizing, nodulizing and briquetting. Flow sheets and circuit diagrams of typical mills treating ore.

MY-204: REFRACTORIES IN METALLURGICAL INDUSTRY

Introduction:

Basics of refractories and ceramics. Requirements of good refractory - Classification - Properties and testing - Raw materials for refractories such as fire clay, china clay, silica materials, alumina, magnesite, dolomite, chromite, graphite, carbon materials, zirconia, classification of refractories, Application and selection methods of manufacturing of refractories for ferrous and non ferrous industrial furnaces.

Manufacturing:

Manufacturing, testing, and use of basic, neutral, acid, and specialty refractories. Processing of raw materials and production of ceramic bodies, glazes, glasses, enamels, and cermets. Traditional ceramics, brick and tile, refractory and insulating materials, china, porcelain, enamels, abrasives, cements, coordination number, interstitial sites, solid solutions, types of transformations, silica and silicate structures, mullite and spinels, glass and glass processing, glass ceramics. Advanced structural ceramics, oxide ceramics, nitride ceramics, fracture toughness, micro crack formation,

high temperature application of ceramics, processing of ceramics, shaping and binding, moulding, firing, sintering.

Application:

Refractory materials in metallurgical construction. Relationship between physical properties of the various refractories and their uses in the metallurgical industry. Oxide phase diagrams to explain the behavior of metallurgical slags in contact with molten metals. Erosion of refractory during melting. Case studies on specific ceramic materials. Applications of Computers in Refractories.

MY-205: METALLURGY OF IRON PRODUCTION

Introduction:

Historical and Modern Iron Making Processes. Iron and Steel Manufacture in Pakistan. Raw Materials for Iron Making, Iron Ores and Their Occurrence, Classification, Geological / Geographic Aspect, Valuation of Iron Ores.

Blast Furnace:

Principles and operation of blast furnace, BF Fuels: Coke, Coke-Oven Batteries, Coking, Natural Gas, Functions of Coke, Quality Requirements of Coke. BF Fluxes and their Classification. BF Burden Requirement and Preparation.

Construction and Operation:

Blast Furnace Structure, Auxiliaries, Refractories, Principles of BF Design, BF Operations, Erosion of refractories during Blast furnace operation, Irregularities in BF Operations, BF Modernization, BF Chemistry, Physical Chemistry of Iron making, Ellingham Diagram, Mechanism of BF Reactions (Combustion, Reduction, Slag Formation) Blast Furnace Products, Pig Iron, Grades and Classification, Ultimate Uses. Blast Furnace Calculations Analytical Charge Calculations, Reducibility, Slags, Design Parameters, Material and Energy Balances etc. Applications of Computers in design and operation of blast furnace.

Cast Irons:

Classification / Grading of Cast Irons, Manufacturing of Cast Irons, Properties and Commercial Uses of Cast Irons.

Alternate Routes of Iron Making:

Low Shaft. Furnace. Charcoal furnace. Electrical furnace. Direct reduction- Sponge iron route - Sponge Iron production in Pakistan , Electric smelting.

Ferro Alloys:

Production of Fe-Si. Fe-Mn. Fe-Cr. Fe-Mo. Fe-V. Fe-Ni and Fe-W

MM-201: PHYSICAL METALLURGY

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, Twinning.

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 shortcomings, Polarized light microscopy. Microstructure of plastics, polymers, rubbers and composites.

MM-205: MECHANICS OF MATERIALS

Review mechanics of materials. Deformation; strain; elastic stress-strain behavior of materials; Introduction to stress-strain diagram, working stresses, unit design, Introduction to elastic and nonlinear continua. Poisson's ratio; Determination of forces in frames; Simple bending theory; general case of bending; Shear force and bending moment diagrams; Relationship between loading, shear force and bending moment. Stress; Skew (antisymmetric) bending Direct, shear, hydrostatic and complementary shear stresses; Bar and strut or column;

Theory of buckling instability, Thin ring, Elementary thermal stress and strain; General stress-method. Theory of elasticity, Analytical solution of elasticity problems brittle fracture. strain energy in tension and compression.

Analysis of bi-axial stresses, principal planes, principal stress-strain, stresses in thin walled pressure vessels. Mohr's circles of bi-axial stress. Torsion of circular shafts, coiled helical spring, strain energy in shear and torsion of thin walled tubes, torsion of non-circular sections. Shear center and shear flow for open sections, General case of plane stresses, principal stress in shear stresses due to combined bending and torsion plane strain. Composite materials, Volume dilatation, Theories of Yielding, Thin Plates and Shells Stress Concentration

EE-221: INSTRUMENTATION

General Theory:

Classification, performance and characteristics. Absolute and secondary instruments, indicating, Recording and integrating instruments, Controlling balancing and damping, Static and Dynamic characteristics.

Ammeter and Voltmeter:

Classification, Moving iron, Moving coil, Thermal, Electrostatic and induction type Errors extension of ranges, CT s and PT s their burden and accuracy.

Power and Energy Meters:

Wattmeter types, Active and Reactive power measurement, Max. demand indicator, Calibration, Classification of energy meter, KWH meter and KVARH meters, P.F. meter.

Electronic Instruments: Electronic and digital voltmeters, Counters, Digital frequency meter, Time internal measurement, RLC meter, Power and energy meter, Oscilloscope and its use.

Basic Concepts: Basic concepts of measurement, Measurement of resistance, inductance and capacitance, Potentiometer and bridge methods.

Magnetic Measurement : Measurement of field strength flux Permeability, B-H curve and hysteresis loop, magnetic testing of materials.

Transducers: Variable, Resistance and inductance transducers, Linear variable differential transformer (LVDT), capacitive, photoconductive, Piezo-Electric Transducers thermo electric transducers, Thermo electric transducers, Filtering, Instrument amplifiers, A/D conversion.

Measurement of Non-electrical Quantities: Measurement of temperature, Pressure Flow, Strains, Thermal conductivity, Motion, Speed and Vibrations, Thermal and Nuclear Radiations.

High Voltage Measurement: Measurement of dielectric strength High voltage strength
The practical work will be based on the above course.

HS-205: ISLAMIC STUDIES

HS-205 ISLAMIC STUDIES

موضوعات

أجزاء

الف- توحيد

١. لو كان فيهما الهة عما يصفون ه
٢. والهكم اله واحد
٣. ان في خلق لتقوم يعاقلون ه

ب- رسالات

١. ما كان ليثو كنتم تدرسون ه
٢. وما انكم الرسول المقاب ه
٣. اليوم اكمل لكم دينكم

ج- آثرات

١. يا ايها الناس
٢. واتقوا يوما ربكم عظيم ه

د- ماوعظ

١. عن عمر بن الخطاب قال قال رسول الله ﷺ حين سئل عن الايمان اتق من الله وملا نكته وكتبه ورسله واليوم وتؤمن بالقرآن ويؤدبه وشره. (متفق عليه)
٢. عن ابن عباس عن النبي ﷺ قال قال رسول الله ﷺ ذاق طعم الايمان من رضى بالله ربه وادب الله رسوله وادب الله رسوله وادب الله رسوله (مسلم)

هـ- عبادات

١. سورة المؤمنون كي دياره آيات
٢. قد افلح المؤمنون هم فيها جلدون ه

و- ماوعظ

١. عن ابن عمر رضي الله عنهما قال قال رسول الله ﷺ. نبى الاسلام على خمس شهادة ان لا اله الا الله وان محمدا عبده ورسوله واقام الصلوة وايتاء الزكوة والحج وصوم رمضان (متفق عليه)
٢. في حديث جبريل قال رسول الله ﷺ: الاسلام ان تشهد ان لا اله الا الله وان محمدا رسول الله وتقيم الصلوة وتؤتي الزكوة وتسلم رسنانا وتحج البيت ان استطعت اليه سبيلا (متفق عليه)
٣. امر بالمعروف ونهى عن المنكر

ادبته وكرهت وكرهت

ب- طريق زكوة

النحل: ١٢٥

١. ادع النى سبيل ربك يا لمهتدين هـ

آل عمران: ١٠٢

٢. ولتكن منكم امة يدعون المفلحون هـ

ا- امارع

١. عن ابي سعيد الخدرى عن رسول الله ﷺ قال من رأى منكم منكراً فليغيره بيده فان لم يستطع

فليسأه فان لم يستطع فليقلبه وذلك اضعف الايمان (رواه مسلم)

٢. عن عبد الله بن عمر قال قال رسول الله ﷺ الاكلكم راع وكلكم مسنون عن رعتيه فالامام الذى على

الناس راع وهو مسنون عن رعتيه والرجل راع على اهل بيته وهو مسنون عن رعتيه والمرأة راعية على

بيت زوجها وولده وهى مسنونة عنهم وعبد الرجل راع على مال سيده وهو مسنون عنه الا فكلكم راع

وكلكم مسنون عن رعتيه (متفق عليه)

٣- اخلاص

آل عمران: ١٠٢

١. واعتصموا بحبل الله جميعاً لعنكم تهتدون هـ

الحجرات: ١٠

٢. انما المذمومون اخوة ترحمون هـ

آل عمران: ٢٤

٣. قل يا اهل الكتاب مسلمون هـ

الانعام: ١٠٨

٤. ولا تسير الذين يعملون هـ

ا- امارع

١. عن انس قال قال رسول الله ﷺ والذى نفسى بيده لا يؤمن عبد حتى يحب لاهيه ما يحب لنفسه (متفق عليه)

٢. عن النعمان بن بشير قال قال رسول الله ﷺ ترى المؤمنين فى تراحمهم وتراهم وتقافهم كمثل

الجسد اذا اشتكى عضو تداهى له سائر الجسد بالسهر والحمى . (متفق عليه)

ك- بطل

طه: ٨١

١. فكلوا من طيب فقد هوى هـ

الاعراف: ٣٢، ٣٣

٢. قل من حرم تعلمون هـ

البقرة: ١٨٨

٣. يا ايها الذين امنوا الا تاكلوا تعلمون هـ

ا- امارع

١. عن النعمان بن بشير قال قال رسول الله ﷺ الحلال بين والحرام بين وبينهما مشبهات لا يعلمهن

كثير من الناس فمن اتقى الشبهات استطاع الدينه وعرضه ومن وقع فى الشبهات وقع فى الحرام

كالراعى يرعى حول الحمى يوشك ان يرتع فيه الا وان لكل ملك حمى الا وان حمى الله محارمه

الا وان فى الجسد مضغة اذا صلحت صلح الجسد كله واذا فسدت فسد الجسد كله الا وهى القلب

(متفق عليه)

۲. عن ابی ہریرہ قال قال رسول اللہ ﷺ ان اللہ طیب لا يقبل الا طيبا وان اللہ امر بالمعروف منہا امریہ المرسلین فقال يا ايها الرسل كلوا من الطيبات واعملوا صالحا وقال تعالى يا ايها الذين امنوا كلوا من طيبات ما رزقناكم ثم ذكر الرجل يطيل السفر الشعث اغبريمد يديه الى السماء يا رب يا رب و مطعمه حرام ومثربه حرام وملبسه حرام وغذى بالحرام فاني بمستحاب لذلك (رواه مسلم)

حقوق العباد

بنيادی انسانی حقوق

الف۔ جان کا تحفظ

من اجل ذلك لمسرفون ۵ المائدہ: ۲۲

ب۔ مکیت کا تحفظ

يا ايها الذين بكم رحيماً ۵ النساء: ۲۹

ج۔ عزت کا تحفظ

يا ايها الذين ثواب رحيم ۵ الحجرات: ۱۲.۱۱

د۔ آزادی رائے و عقیدہ

لا اكره في الدين عليهم ۵ البقرہ: ۲۵۲

ح۔ حق مساوات

يا ايها الناس خبير ۵ الحجرات: ۱۳

خ۔ معاشی تحفظ

والذين في المحروم ۵ المعارج: ۲۵.۲۴

ل۔ المیت کی تدفین و مواتی کے حصول کا حق

ان اللہ يا مكرم ان بصيرا ۵ النساء: ۵۸

م۔ حصول نفاق کا حق

يا ايها الذين امنوا نبيآه ۵ النساء: ۱۳۵

۷۔ حقوق نسواں

۱۔ من عمل يحملون ۵ النحل: ۹۷

۲۔ ان المسلمین عظيمه ۵ الاحزاب: ۲۵

۳۔ للرجال نصيب مفروضاه ۵ النساء: ۷

۸۔ غیر مسلموں سے تعلقات

۱۔ لایٰنہا کم اللہ.....الظلمون ۵ الممتحنہ : ۹.۸

۲۔ وان جنحو السلسم.....العلیم ۵ الانفال : ۲۱

احادیث

۹۔ خطبہ حجۃ الوداع

ترجمہ و احکام نکات

نوٹ: مذکورہ بالا تمام عنوانات کی قرآنی آیات کی تفسیر میں ہر عنوان کے تحت احادیث دے دی گئی ہیں۔

۲۔ اسوہ حسنہ (سیرت طیبہ)

۱۔ ولادت باسعادت

۲۔ قبل از نبوت کی زندگی

۳۔ بہشت نبوی

۴۔ دعوت و تبلیغ اور اس کی مشکلات

۵۔ ہجرت مدینہ

۶۔ مواہبات اور بیعت مدینہ

۷۔ غزوات نبوی

۸۔ حجۃ الوداع

۹۔ وصال

۳۔ اسلامی تہذیب

* برصغیر پر اسلامی تہذیب کے اثرات

۱۔ اسلام سے پہلے برصغیر کی تہذیبی حالت

۲۔ اسلامی تہذیب کے عوامل و عناصر

۳۔ برصغیر پر اسلامی تہذیب کے معاشرتی، اخلاقی، سیاسی اور سماجی اثرات

۱۔ اسلامی تہذیب کے عالمی اثرات

* ۱۔ اسلام کی مسلم تحریک کے اثرات

۲۔ فکری اثرات

۳۔ معاشرتی اور سماجی اثرات

Note: The English translation of the Course is available with the Department of Humanities.

HS-209: ETHICAL BEHAVIOUR

Introduction to Ethics:

- i) Definition of Ethics
- ii) Definition between normative and positive science
- iii) Problem of freewill
- iv) Method of ethics
- v) Uses of Ethics

1. Ethics Theories:

- i) History of Ethies: Greek Ethies, Medieval, Modern Ethies
- ii) Basic concept of right and wrong: good and evil
- iii) Utilitarianism, hedonism, self-realization: egoism, intuitionism, rationalism
- iv) Kant's moral philosophy

2. Ethics & Religion:

- i) The relation of Ethics to religion
- ii) Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, christianity, Islam

3. Ethics, Society, and moral theory:

- i) Ethical foundation of Rights and Duties
- ii) Applied Ethics
- iii) Society as the background of moral life
- iv) Universalism and Altruism
- v) Theories of punishment

4. Ethics, Society, and moral theory:

- vi) Ethical foundation of Rights and Duties
- vii) Applied Ethics
- viii) Society as the background of moral life
- ix) Universalism and Altruism
- x) Theories of punishment

IM-207: COMPUTER PROGRAMMING AND DRAFTING

Introduction:

Introduction to programming concepts & languages, Compilation & Interpretation, Overview of modular programming, ASCII character set.

Building Blocks:

Identifiers and keywords, Data-types, Variables and Constants, Statements and Operators, Input and Output Functions.

Branching Statements:

Conditional branching and Looping (Counter and condition controlled loops).

Subroutines:

A 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, 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 setting, Printing and Plotting.

MT-215: DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES

Infinite Series:

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

Ordinary Differential Equations:

Definitions, formation and solution. Boundary conditions. Homogeneous and Non-homogeneous linear differential equations with constant coefficients, linear equations with 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. Heaviside's expansion formula. Simple applications.

Complex Variables:

Limit, continuity, zeros and poles, Cauchy-Reimann Equations, conformal transformations, contour integration.

MY-301: STEEL MAKING PROCESSES

Difference between iron and steel making processes.

General Principles And Open Hearth Steel Making:

An outline of various methods of steel making - Physical chemistry of steel making process - Raw materials for steel making Acid open hearth and basic open hearth processes. Oxygen Enrichment of fuel Operation, control of composition and different slag practices.

Pneumatic and Electric Steel Making:

Acid Bessemer. Basic Bessemer. Side blown converter. L.D.converter. Kaldor Rotor- Bottom blown and combined blown processes of steel making Principles of operation under different slag practices for steelmaking by Electric Arc furnace and Induction furnace. Rapid steel making.

Duplexing and Ingot Making:

Introduction to secondary steel making. Some modern developments in steel making like ESR VOD and AOD process Pre-treatment of steels. Ingot solidification. killed, semi killed. Rimmed and capped steels. Ingot defects, their identification and remedial actions - continuous casting of steel.

Deoxidation of Steels:

Deoxidation by Si. Al- Mn etc., Comparison of deoxidising effects of various deoxidisers. Deoxidation by complex deoxidisers. Vacuum degassing of steels. Ladle Metallurgy. Concept of clean steel.

Carbon and Alloy Steels:

Low, medium and high carbon steels. Alloy Steels, Manganese steels. Free cutting steels. Tool steels and stainless steels. Basis of designing of Steels.

Applications of Computers in steel making processes.

MY-302: NON-FERROUS EXTRACTIVE METALLURGY

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 pyrometallurgical 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 Aluminothermic and silicothermic method, Titanium and its ores, Treatment of its ores concentrate, Production of Titanium metals by reduction with Sodium and Magnesium, Titanium and its alloys.

MY-303: FOUNDRY: PRINCIPLES, METHODS AND PRACTICES

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 & Riser, Computer applications in foundry processes.

MY-304: METALLURGY OF WELDING

Introduction to welding and joining, Metallurgy of welding, effect of heat on metals, pre heating , stress, strain, weldability, weld defects, selection of appropriate welding process.

Fusion Welding Processes:

Overview of welding processes. Gas welding and equipments, fluxes, torch gases hoses and hose connection, torches, mixers, welding tips, regulators clamps 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 metals, arc welding, vapor shielded metal arc welding- MIG 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:

laser welding, electron beam welding, pressure welding, 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.

Material's Specific Welding:

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

MY-305: METAL FORMING & SHAPING PROCESSES

Introduction:

Shaping Processes and Classification, Structure-Property-Processing Relationship, Fundamentals of Mechanical Work on Metals, Cold and Hot Working of Metals.

Metal Forming Processes:

Detailed study of Rolling, Forging, Extrusion, Wire, Rod, Tube and Sheet Metal Forming Processes. Roll-Pass Design. Elements of theory of plasticity, Materials behaviour under forming conditions: Stress and strain, Macroscopic plasticity and yield criteria, Work Hardening, Plastic instability, Strain rate and temperature dependence of flow stress, Ideal work, friction, redundant work, and mechanical efficiency, Slab analysis, upper-bound analysis, Slip-line field theory, Deformation zone geometry, Formability, bending, Plastic anisotropy, Complex stamping and sheet metal properties. Flow stress, deformation resistance, workability, evolution of microstructure during metal working, Friction and surface integrity, Analysis of metal flow in metal forming processes, Analysis and modeling of metal forming processes,

Design and Equipment:

Fundamentals of design of metal forming equipment, An examination of the forging process for the fabrication of metal components. Techniques used to model deformation processes including slab equilibrium, slip line, upper bound and finite element methods.

Applications:

Application of these techniques to specific aspects of forging and metal forming processes. Extrusion, Rolling, wire drawing. Forging processes, Sheet metal forming process Metallurgical structure evolution during working. Application of FEM in metal forming processes, Thermomechanical processing of advanced steels.

MM-301: CORROSION: PROTECTION AND PREVENTION

General concepts of corrosion applied to materials, corrosive environments, atmosphere, water, chemicals, gases, general corrosion, galvanic corrosion, oxygen concentration cell, atmospheric corrosion, chemical corrosion, corrosion in gas, types of scale, mechanism of scale protection, oxide, defect structure, oxidation rates, high temperature gas reactions, localized corrosion, pit and crevice corrosion. Mechanically assisted corrosion, stress corrosion cracking, corrosion fatigue, hydrogen damage, corrosion in ceramics and plastics, atmosphere water, chemical corrosion, corrosion prevention and protection. Chemical inhibitors, 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 of metals, simple electrochemical theory, polarisation curves, activation and concentration polarisation; Evans diagrams, Passivity, pitting, localised corrosion, Common problems, galvanic corrosion, differential aeration, crevice corrosion, Corrosion Prevention: Cathodic protection, anodic protection, inhibitors, Paint; modes of protection, inhibitive and metallic pigments, Metal coatings; action, methods of application, Anodising of aluminium. Design and materials selection.

MM-303: INSPECTION AND TESTING OF MATERIALS

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, 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.

MM-304: HEAT TREATMENT OF MATERIALS

Introduction and scope of the heat treatment processes used for materials. Review of iron carbon phase diagram, Effect of common alloying additions on the equilibrium diagram, annealing and its types, Structures of slowly cooled steels. Specialized heat treatments including full annealing, normalizing, 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. austempering, martempering, retained austenite, tempering of martensitic steels. Secondary hardening, heat treatment of dies and tool steel, Alloy steels, HSLA steels, and stainless steels, surface hardening, carburising, nitriding, cyaniding, carbonitriding, induction and Flame hardening, heat treatment of cast iron heat treatment of non ferrous metal and alloys, age hardening/precipitation hardening, defects caused during heat treatment and their remedies, subzero treatment. Heat treatment of nonmetallic materials like polymers, plastics, rubbers and composites.

MM-305: POLYMER AND COMPOSITES MATERIALS

Survey and classification of polymeric materials. Review of polymer chemistry, introduction to polymers, classification of polymers, polymerization, co-polymerization, structure and properties of thermoplastic and thermosetting polymers, elastomers and rubber, vulcanization, additives and fillers.

Manufacturing, properties and applications of polymers, polystyrene, polybutadiene, polyester, polymethyl methylacrylate (PMMA), nylon 6:6, acrylonitrile-butadiene-styrene (ABS), silicon resin, epoxy resin, phenol- formaldehyde and other advanced polymers, forming processes, testing and identification of polymers, fibers, foams and adhesives, Plastics, conductive polymers and plastics.

Introduction to Composite materials, classification characteristics, mechanical behavior potential advantages, properties and applications. Composite material design, specific stiffness and strength, and recent developments such as metal matrix composite, ceramic matrix composites, carbon fiber reinforced composite, production and processing of fibres and other reinforcements, polymeric matrix composites, processing principles and design of ply and laminate structures, filament winding and pultrusion.

PF-303: APPLIED ECONOMICS FOR ENGINEERING

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:

Labour problems; Labour organizations; Prevention & Settlement of disputes.

HS-304: BUSINESS COMMUNICATION SKILLS AND ETHICS

Part-I Communication Skills (Oral):

Definitions and Conditions. Modes:- verbal, non-verbal, vocal, non-vocal, sender, receiver, encoding, 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.

MT-315: MATHEMATICAL METHODS

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, centre 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, linear transformations, matrix of a linear transformation.

Basic definitions and matrix operations, adjoint and inverse of a 3×3 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.

MY-401: VACUUM METALLURGY

Introduction:

Vacuum principles, their Importance, classification and application in the metallurgical field, Different units of measuring pressure vacuum regimes, mean free path, collision frequency.

Equipment:

Vacuum pumps: Water pumps, positive displacement pumps, rotary and roots pump, vapour ejector and vapour entrainment pumps, diffusion pump, turbo-molecular pump, ion pumps, sieve pumps, adsorption pumps. Classification and working principles of vacuum measuring devices: Manometers, McLeod gauge, Penning gauge, Pirani gauge. Valves used in vacuum technology. Calculation of vacuum systems, conductance and through put, effective pumping speed, gas flow through pipes and orifices. Sources of leakage, leakage detection and remedies.

Application:

Application of vacuum in metal processing. Vacuum induction melting, vacuum arc melting. Metal refining in vacuum, degassing in liquid state, vacuum heat treatment, vacuum sintering, vacuum

coating, use of vacuum technology in the production of strategic materials. Design of vacuum Furnaces.

Vacuum Coatings:

Introduction, purpose of Vacuum Coating, process of Vacuum coating, Process of PVD and CVD coatings, Characterization of vacuum coatings. Coating science and selection, Measurement of coating thickness. Case studies.

MY-402: ADVANCED MATERIALS

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 Superalloys. Directionally Solidifies and Single-Crystal Superalloys. Elevated-Temperature Corrosion of Superalloys. Microstructural Instabilities. Heat-Resistant Materials, Titanium Alloys, Refractory Metals and Alloys Structural Intermetallics 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.

MY-403: METALLURGICAL PLANTS

Plant Location:

Factors affecting location; Multiplant location; Location analysis; Plant layout; Types of layout; Material handling consideration in layout; Internal and External balancing; product and process layout analysis; Layout comparison.

Production Planning and Control:

Product design, Pre-production planning, Production control for intermittent and continuous process; Production control charts; Machine arrangement problems; Control for maximum profit; Scheduling techniques.

Environmental Impacts, Pollution Control and Waste management:

Type of Pollutants and their treatment, Process description, Resources, Consumption and Emissions: Overview, Environmental impacts of Iron and Steel making, Hot rolling, Forging, Cold rolling, Annealing and Tempering, Coating and Plating plants. Environmentally friendly metallurgical plants

Health and Safety:

Occupational Health and Safety Impacts of Metallurgical plants. Basic procedures and remedies.

Computer Applications:

Applications of computers for environmental and Pollution Control and Waste management in metallurgical plants

MY-404: ADVANCES IN SPECIAL STEELS

Introduction:

Microstructure and property relationships in steels, High strength low Alloy (HSLA) steels, microalloyed steels, stainless steels, duplex steels, high yield steels, super alloys, inconels, hastelloy, nickel maraging steels.

Production and Processing:

Classifications, production and processing principles, thermomechanical processing, advantages and limitations, TMT steels, dual phase steels, IF (interstitial-free) and ultra-low carbon steels for structural and automotive applications, ultra-low-carbon bainitic steels (ULCB), martensitic steels.

Special Steels:

Stainless steels, nitrogen containing fine grained steels, orthopedic steels, duplex and superduplex corrosion stainless steels, special Steels, TRIP steels, maraging steels, tool steels, die steels, special steels for low to moderate temperature applications for nuclear and thermal power plants, heat resistance steels for superheaters, tool and die steels, processing and properties. Design and processing: New concepts for engineering steels.

MY-405: INDUSTRIAL QUALITY CONTROL IN METAL INDUSTRY

Fundamentals of Probability and Statistics:

Set theory and set operations, Venn diagram, definition of probability, probability laws, conditional probability, deterministic and probabilistic data, grouping of data, measures of central tendency and dispersion, Random Variable (discrete and continuous), mathematical expectation, laws of expectation.

Probability Distributions:

Discrete probability distributions (Uniform, Binomial, Multinomial, Hypergeometric and Poisson) Continuous probability distributions (uniform, Normal and Exponential)

Statistical Tests of Hypothesis:

Basic concept, types of errors, operating characteristic (OC) curve, testing hypothesis when sample size is fixed, testing hypothesis when sample size is not fixed, drawing conclusions, determining sample size for testing a hypothesis.

Control Charts:

Common causes and special causes of variation, Steps to start a control chart, control charts for variables (X-R chart, X-S chart) control charts for attributes (percentage nonconforming, number of nonconforming items, number of nonconformities, number of nonconformities per unit), interpretation of control charts, uses of control charts (for process improvement and process maintenance).

Acceptance Sampling:

Introduction, types of sampling, OC curve in sampling, consumer and producer risks, AQL, AOQL, LTPD, attributes sampling, variable sampling, selection of proper sampling plan.

Bulk Sampling:

Objectives of Bulk Sampling, determination of the amount of sampling, models for bulk material moving in a stream, obtaining the test-units, test of homogeneity.

Evaluation of Quality in Materials Industry:

Reliability and maintainability, process capability analysis, inspection of different types of materials and products for evaluation of quality reliability of flaw detection by nondestructive inspection, quality control applications of nondestructive inspection.

Quality Control Procedures:

Introduction to standards. Familiarization of standards for testing of materials, ASTM, BS, JIS GOST and ISO. Pakistan Standards, Quality assurance for final products, Measures for quality control.

MY-406: POWDER METALLURGY

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 isostatic 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

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

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, machining, thermal treatment, finishing operations, strength-to-density and modulus-to-density ratios, 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 characterisation, 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.

MY-408: METALLURGICAL ENGINEERING PROJECT

Selected problems from the industry and current materials research issues regarding selection processing, designing, manufacturing and development. Fabrication of prototype/models and laboratory experimentation shall be assigned to individual students/ Grading shall be the reports produced by individual students and their evaluation through an oral examination.

MM-403: FRACTURE MECHANICS AND FAILURE ANALYSIS

Theories of creep and fatigue fracture mechanism in ductile and brittle materials. Brittle and ductile fracture comparison. The theoretical cohesive strength of solids. Stress concentration at a notch and at a crack. Plane stress and plane strain fracture toughness. Fracture toughness parameters and testing.

Fractography: Micro Mechanism of crack nucleation and propagation inter crystalline brittleness. Fracture mechanics in stress corrosion. Impact testing, characteristics of fracture observed in ductile and brittle material. The crack opening displacement approach and empirical methods for assessing crack propagation in thick sections

CH-407: Industrial Organization and Management

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.

IM-414: INDUSTRIAL SAFETY & ENVIRONMENT

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.