DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

SYLLABI OF COURSES FOR B.E. (INDUSTRIAL AND MANUFACTURING) DEGREE PROGRAMME

FIRST YEAR					
				Theory	Practical
1.	ME-101	Engineering Mechanics		100	50
2.	ME-102	Engineering Drawing		100	50
3.	ME-103	Thermodynamics		100	50
4.	ME-104	Workshop Practice		0	100
5.	CS-101	Introduction to Computers		100	50
6.	EE-116	Principles of Electrical Engineering		100	50
7.	PY-121	Applied Physics		100	50
8.	CY-105	Applied Chemistry		100	50
9.	MT-111	Calculus		100	0
10.	HS-101	English		100	0
11.	HS-105	Pakistan Studies OR		100	0
	HS-127	Pakistan Studies (for Foreigners)			

				Theory	*Practical*
SECOND YEAR					
				Th	**Pr**
01.	IM 201	Metrology & Gauging		100	50
02.	IM 203	Manufacturing Processes		100	50
03.	IM 207	Computer Programming & Drafting		100	50
04.	IM 208	Materials Engineering		100	50
05.	ME 202	Solid Mechanics-I		100	50
06.	ME 205	Element of Machine Dynamics & Design		100	--
07.	ME 210	Fluid Mechanics		100	50
08.	EL 232	Electronics		100	50
09.	CS 207	Computer Architecture & Organization		100	50
010.	MS 225	Linear Algebra & Ordinary Differential		100	--
		Equations			
011.	HS 205	Islamic Studies or		100	--
	HS 209	Ethical Behaviour			

THIRD YEAR

S. No.	Course No.	Course Title		Maximum Marks	
				Theory	*Practical*
01.	IM 303	Production Management		100	50
02.	IM 307	Advance Manufacturing Processes		100	50
03.	IM 308	Operations Research		100	50

S. No.	Course No.	Course Title	Theory	Practical
04.	IM 309	Machine Design & CAD	100	50
05.	IM 310	Tool Design	100	50
06.	IM 311	Industrial Quality control	100	50
07.	ME 302	Solid Mechanics-II	100	50
08.	EE 373	Machine Control Systems	100	50
09.	MS 332	Advanced Calculus & Fourier Analysis	100	--
010.	HS 303	Engineering Economics	100	--
011.	HS 304	Business Communication & Ethics	100	--

FINAL YEAR				
S. No.	**Course No.**	**Course Title**	**Maximum Marks**	
			Theory	*Practical*
01.	IM 402	Computer Aided Manufacturing	100	50
02.	IM 405	Finite Element Analysis	100	50
03.	IM 408	Automation & Robotics	100	50
04.	*IM 409	Manufacturing Engineering Project	----	200
05.	IM 411	Methods Engineering	100	50
06.	IM 413	Plant Engineering	100	50
07.	IM 414	Industrial Safety & Environment	100	50
08.	IM 415	Applied Heat Transfer	100	50
09.	IM 416	Management Information System	100	50
010.	MS 441	Advance Mathematical Techniques	100	--

ME   101   ENGINEERING MECHANICS

Static's 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; Virginians 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, Hypocyloid, and the 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   103   THERMODYNAMICS

Thermodynamic Properties:

Introduction; Working substance; System; Pure substance; PVT surface; Phases; Properties and state; Units; Zeroth Law; Processes and cycles; Conservation of mass.

Energy and its Conservation:

Relation of mass and energy; Different forms of energy; Internal energy and enthalpy; Work; Generalized work equation Flow and non-flow processes; Closed systems; First Law of Thermodynamics; Open systems and steady flow, Energy equation for steady flow; System boundaries; Perpetual motion of the first kind.

Energy and Property Relations:

Thermodynamics equilibrium; Reversibility; specific heats and their relationship; entropy; Second Law of Thermodynamics; Property relation from energy equation; Frictional energy.

Ideal Gas:

Gas laws; Specific heats of an ideal gas; Dalton's Law of Partial Pressure; Third Law of Thermodynamics; Entropy of an ideal gas; Thermodynamic processes.

Thermodynamic Cycles:

Cycle work; Thermal efficiency and heat rate; Carnot cycle; Stirling cycle; Reversed and reversible cycles; most efficient engine.

Consequences of the Second Law:

Calusius's inequality; Availability and irreversibility; Steady flow system.

Two-Phase Systems:

Two-phase system of a pure substance; Changes of phase at constant pressure; Steam tables; Superheated steam; Compressed liquid; Liquid and vapour curves; Phase diagrams; Phase roles; Processes of vapours; Mollier diagram; Ranking cycle; Boilers and ancillary equipment.

Internal Combustion Engines:

Otto cycle; Diesel cycle; Dual combustion cycle; Four stroke and two-stroke engines; Types of fuels.

Reciprocating Compressors:

Condition for minimum work; Isothermal efficiency; Volumetric efficiency; Multi-stage compression; Energy balance for a two-stage machine with inter-cooler.

ME   104   WORKSHOP PRACTICE

Use of carpenter's tools; Exercises in preparing simple joints; Bench-fitting practice; Exercise in marking and fittings; Use of measuring instruments.

Smith's forge; Exercise in bending, upsetting and swage.

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.

CS   101   INTRODUCTION TO COMPUTERS

Structure and organization of Computers and Computer Systems, Computer Peripherals, Introduction to Software development process, Modular decomposition, Introduction to common Software packages and their applications, Programming languages and their comparative study, High level and low level languages, Introduction to data communication, LAN and WAN, Introduction to operating systems.

The PRACTICAL WORK will base on the above course.

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 annature 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 ad 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.

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 CO_2 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.

Practicals:

Determination of total alkalinity of a given sample; Determination of total acidity of a given sample; Determination of the amount of ferrous ion in a given sample; Determination of total hardness of a given sample of water; Determination of surface tension of a given sample; Determination of coefficient of a given sample; Determination of chloride ion in a given sample; Determination of Bicarbonate and Carbonate ions in a given sample; Determination of turbidity in a given sample by precipitation; Determination of turbidity in a given a sample by spectrophotometer; Plotting of titration curve and determination of total alkalinity in a given sample; Plotting of titration curve and determination of acidity in a given sample; Plotting a calibration cure and determination of ions present in a given sample.

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 representation; 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` Hospitals 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).

HS   101   ENGLISH

Study Skills

Advanced reading skills using (e.g. text related to such issues as ILO laws environment / resettlement / rehabilitation etc.).

Listening and Speaking Oral communication Skills Development. Precis writing, controlled & guided writing: Essay writing.

Writing book and informal Report, Informal letters and memos. Grammar rules and their applications for writing coherently and correctly in English.

HS   105   PAKISTAN STUDIES

An Outline of Emergence of Pakistan:

A brief historical survey of Muslim community in the sub-continent. War of Independent 1857 and Aftermatch. 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 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 of Pakistan:

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.

IM   201   METROLOGY AND GAUGING

Standardization:
Introduction, product simplification & diversification, interchangeability, selective assembly, principles, preparation of standards, application of standards in design and manufacturing, applying for patents, international & national standard organizations

Standards of length:

Light waves as standard of length, design & operation of linear measuring instruments, slip & block gauges, length bars, limits and fits, limit gauges, sine bar, comparators: mechanical, electrical, pneumatic, & optical

Measurement:
Errors in measurement, sensitivity, accuracy, & variation, economics of measurement, measurement of squareness, flatness, straightness, roundness, gear & screw threads, advanced measuring and inspection, non-contact measurement

Surface Texture:
Roughness lay waviness, & flaws. CLA, & RMS values, predication of roughness in turning, drilling, milling, & grinding. Measurement of roughness, Average values of roughness for various manufacturing processes.

Machine Tool Metrology:
Alignment tests, level of installation, spindle straightness, flatness, & squareness.

IM 203   MANUFACTURING PROCESSES

Sand Casting:
Introduction; Sand casting procedures; Patter making; Material types and construction of patterns; Pattern allowances; Moulding process; Moulding materials; Tools and equipment; Testing of sand; Moulding machines; Core making; Types of cores; Core making machines; Shell moulding; Plaster moulding; Centrifugal casting; Trimming and finishing of castings; Seasoning of castings; Inspection of castings.

Die Casting:
Pressure die casting; Vacuum die casting; Gravity die casting; Die casting machines; Hot chamber and Cold Chamber methods; Die casting alloys; Die design, construction, and material; Die casting.

Welding Processes:
Classification of welding processes; Oxyacetylene welding, oxygen torch cutting, and flame straightening; Arc welding; Shielded arc welding, Gas tungsten arc welding, Gas metal arc welding, Flux-cored arc welding, submerged arc welding, plasma arc welding, stud welding, spot welding, Seam welding, Projection welding; Other welding processes: Forge welding, Roll welding, Friction welding, explosion welding, Thermit welding, Electron beam welding, Laser welding and cutting; Brazing and Soldering.

Fabrication of Plastics:
Casting; Blow moulding; Compression moulding; Transfer moulding; Cold moulding; Injection moulding; Reaction injection moulding; Vacuum forming; Welding of plastics.

Machining Processes and Machine Tools:
Machine tools using single point tools: Description, functions and operation performed on lathe, shaper, Planner, and boring machines; work holding devices.

Machine tools using multiple cutting edge tools: Description, functions, and operations performed on drilling, milling, gear cutting, and broaching machines.

Machine tools using abrasive wheels; description and functions of various types of grinding machines; wheel dressing, and wheel balancing; Honing, lapping, and super finishing operations; thread manufacturing.

Non-traditional machining processes such as EDM, ECM, & ultrasonic machining.

Machining parameters:

Determination of machining time and material removal rate for various machining operations. Cutting tools for manufacturing: Cutting tool material characteristics; Cutting tool materials, tool steels, HSS, Cubic Boron Nitrides; Tool Geometry, Tool life, Tool wear, and machinability; Taylor's Tool life model, sharpening and Reconditioning of cutting tools; Basic concept and design of jigs and fixtures.

IM   207   COMPUTER PROGRAMMING & 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).

Subroutine:
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.

IM   208   MATERIALS ENGINEERING

Introduction to Materials Engineering:
Types of materials, sources of materials, material science and engineering crystalline & amorphous materials, application of materials.
Metallic Materials:
Pure metals and alloys, nature and properties of metals and alloys, major properties of metallic materials (chemical, physical, mechanical), single crystal and poly-crystalline metals, crystal defects and the mechanisms of deformation and fracture, plastic flow in poly-crystalline materials, structure- property, relationships, macro & micro examinations, structural aspects of solidification & solid phase transformations in binary systems, ferrous and non-ferrous metals, various heat treatments, TTT- diagram.

Ceramics, Glasses, Rubbers & Refractory Materials:

Compositions, properties, structures of various non-metallic materials, application of ceramics, glasses, rubber & refractory materials, methods of manufacture.

Polymers:
Polymerization, Structural feature of Polymers, Thermoplastic Polymers, Thermo-setting Polymers, Additives, major mechanical properties.

Composites:

Introduction to composite materials; types of composite materials, method of fabrication of composite materials, property averaging, major mechanical properties.

Environmental Degradation:
Metal degradation by atmospheric, aqueous & galvanic corrosion; stress corrosion cracking methods of corrosion prevention, behaviors of metal at elevated temperature – pyrometers oxidation, scaling and creep. Chemical degradation of ceramics & polymers, radiation damage, surface improvement against degradation.

ME 202   SOLID MECHANICS I

Statically Determinate Frames and Beams:
Free-body diagrams; Determination of forces in frames; Shear force and bending moment diagrams; Relationships between loading share force and bending moment.

Statically Determinate Stress Systems:
Stress; Direct, shear, hydrostatic and complementary shear stresses; Bar and strut or column; Thin ring or cylinder rotating; Stresses in thin shells due to pressure or self-weight.

Stress-Strain Relations:
Deformation; strain; elastic stress-strain behavior of materials; Poisson's ratio; elementary thermal stress and strain; General stress-method.

Statically Indeterminate Stress Systems:
Interaction of different materials; Interaction of different stiffness components; Restraint of thermal strain; Volume changes; Constrained materials.

Bending Stresses:
Simple bending theory; General case of bending; Composite Beams; Eccentric and load; Shear stresses in bending.

Bending-Slope and Deflection:
Equation of the deflection curve of the neutral axis; Double integration method; Method of super-position.

Theory of Torsion:
Torsion of thin-walled cylinder; Torsion of a solid circular shaft; Hollow shafts.

Theories of Yielding, Thin Plates and Shells, Stress Concentration.

ME 205   ELEMENTS OF MACHINE DYNAMICS AND DESIGN

Machine Dynamics:

Linkages; Cams; Friction clutches; Brakes and dynamometers; Belt and chain drives; Gear Trains including Epicyclic; couplings for non coaxial shafts; Steering gears; Turning-moment diagrams; balancing of rotating and reciprocating masses.

Principle of Design:

Mechanical properties of materials; Elasticity; Plasticity; Modules of resilience; Endurance limits Hardness; Creep; Effect of stress concentration; Wear. Analysis of operating conditions; Deflection; Torsion; Shear Center; Thermal Stresses Energy Methods: Composite section; closed and open type; Simple framed structure.

Theories of failures including fatigue failure and Soderberg criterion.

Introduction to Design of Simple Machine Elements:

Shaft Materials; Shafts operating under combined loading; Introduction to fluting loads with particular reference to industrial codes of practice such as BSS or DIN or JIS or COST.

Bearings; Methods of Lubrication; Bearing materials; Design of journal bearing; Introduction to design of bass and roller bearings.

Joints; Knuckle, cotter and universal joints; Couplings; Universal, Flanged, flexible, Clutches; Friction and mechanical type.

Springs; Helical and leaf type.

Working of Torsion:

Torsion of thin walled cylinder, Torsion of a solid circular shaft, Hollow circular shafts, Non-Uniform and composite shafts, Tapered shaft.

Theory of Columns:

Euler's theory of buckling for an eccentric loading of long columns; Behavior of ideal and real struts.

Governors and Gyroscopes:

Function, Principle of operations, applications.

Function of gyroscopes, gyroscopic acceleration and couple, application of gyroscopes.

ME   210   FLUID MECHANICS

Properties of Liquids and Gases:
Ideal and real fluids; Fluid Pressure.

Fluid Statics (Equilibrium):
Euler's conditions of equilibrium, Pressure in a fluid under the action of gravity, Homogeneous fluid; several fluids of different specific weights, Interconnected vessels; Constant Velocity rotation of a liquid around fixed axis: Fluid under pressure neglecting gravity; Force on contains wall Force on flat surfaces; Force on curved Surfaces; Buoyancy of Fluid at rest; stability of a floating body; Surface tension and capillary tubes.

Fluid Dynamics:
One dimensional inviscid flow (flow filament theory); equation of continuity; Euler's equations of motion; Bernoulli's equation, inputs and momentum. One-dimensional viscous flow; Generalized Bernoulli's equation; laminar and turbulent flow in circular pipes; pipe flow problems.

Dimensional Analysis:
Buckingham Pi Theorem; Reynolds's law of similitude.

Fluid Measurements:
Measurement of static pressure; stagnation pressure, flow velocity and flow rate.

Fluid Machinery:
Pumps, turbines, similarity laws for turbo-machinery.

EL 232 ELECTRONICS

Conduction in Solids:

Introduction, mechanics of conduction, mobility, Bohr's model for the elements, energy level diagrams for solids, conductors, intrinsic and extrinsic semiconductors, electron-hole pairs in an intrinsic semiconductor, distribution of electron and hole in conduction and valence bands, recombination and lifetime.

Semiconductors and Diodes:

Donar and acceptor impurities, zero biased, forward biased and reverse biased junction diodes, junction diode current equation, depletion barrier width and junction capacitance, diffusion capacitance, Zener and Avalanche break down, Hall effect, Fabrication of pn junction diodes.

Electron Emission Devices:

Type of electron emissions, thermionic diodes, volt ampere characteristics, Child Langmuir Power Law, Gas filled diode, Thermionic triode, Parameters and characteristics, Tetrode, Pentode, And beam power tubes, Parameters and characteristics.

Simple Diode Circuits and Applications:

Mathematical and graphical analysis of diode circuits, The ideal and non ideal diodes, Piecewise linear models, Analysis of piecewise linear models of vacuum tube and junction diodes, The half wave rectifier, The inductance filter, The inductance capacitance filter circuits, zenor and gas diode, Voltage regulator circuits, Clamping and DC restorer circuits, Voltage doubler circuits, Clipping and limiting circuits.

Bipolar and Field Effect Transistors:

Transistor biasing and thermal stabilization, The operating point, Bias stability, Collector to base bias, Fixed bias, Emitter feedback bias, Stabilization for the self biased circuits, Field effect transistors, Basic principles and theory, Types, FET characteristics, Different configurations-common gate, Common source and common drain, The FET, small signal model, Parameters, Biasing of the FET.

Amplifier Circuits:

Introduction "h" parameters, Hybrid model for transistor, Elementary treatment, Low frequency transistor amplifier circuits, Stage cascaded LF.

CS 207 COMPUTER ARCHITECTURE AND ORGANIZATION

Introduction:
Basic computer organization, Arithmetic, Control, Memory and I/O units.
Architecture and Assembly Language Programming:
The CPU, Various registers in the processing unit and their functions, Instruction formats, Architecture of an early computer, Contributions of Charles Babbage & Von-Neuman, Instruction, Instruction encoding and execution of early computers, Later trends.
Data Representation:
Importance of data representation, Numbers Representation of negative numbers, Radix Complement and diminished radix complement methods, Multiplication and division algorithm, Floating point numbers Codes for character representation, Data structures, Arrays, Stacks and Queues.
Introduction to Microcomputers:
Microcomputer architecture and organization, Instruction formats, Addressing modes, Input/Output structure, Single System bus and various interfaces.
Memory and Storage:

Types of memory systems and cost/performance gaps, fundamental system requirements for storing and retrieving information, Random access memory, digital magnetic recording principles, Sequential access storage systems.

MS   225   LINEAR ALGEBRA & ORDINARY DIFFERENTIAL EQUATIONS (C)

Linear Algebra:

Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal tri-diagonal matrix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix, basic concept of tensors, eigen value and eigen vectors of a matrix, Diagonolization, Cayley-Hamiton theorem. Applications of linear algebra in Engineering.

Euclidean Spaces and Transformation:

Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwarz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition of transformations.

1st Order Differential Equations:

Basic concept; Formation of differential equations and solution of differential equations by direct integration and by separating the variables; Homogeneous equations and equations reducible to homogeneous from; Linear differential equations of the order and equations reducible to the linear form; Bernoulli's equations and orthogonal trajectories; Application in relevant Engineering.

2nd and Higher Orders Equations:

Special types of IInd order differential equations with constant coefficients and their solutions; The operator D; Inverse operator 1/D; Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering.

Lap lace Integral & Transformation:
Definition, Laplace transforms of some elementary functions, first translation or shifting theorem, second translation or shifting theorem, change of scale property, Laplace transform of the nth order derivative, initial and final value theorem Laplace transform of integrals, Laplace transform of functions t^n F(t) and F(t)/ t, Laplace transform of periodic function, evaluation of integrals, definition of inverse Laplace transform and inverse transforms, convolution theorem, solutions of ordinary differential using Laplace transform.

HS   205   ISLAMIC STUDIES

Thematic Study of Holy Quran.

1.   *Basic Islamic Believes*

Topics

i) *Tauheed:*

     Al-Ambiya-22, Al-Baqarah-163-164

ii) *Prophethood:*

     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,   Al-Imran-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 Justics*

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.

Serat Life of the Holy Prophet:

Birth, Life at Makkah.

Declaration of Prophethood, preaching & its difficulties migration to Madina. Brotherhood (Mawakhat) & Madina charter. The Holy War of the prophet

(Ghazwat-e-Nabawi) Hujjat-ul- Wida.

Islamic Civilization:

Impacts of Islamic civilization on the sub-continent. 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. The original Text & complete course plan may

be obtained from the Department of Humanities.

HS   209   ETHICAL BEHAVIOUR

1. **Introduction to Ethics:**
   i)   Definition of Ethics
   ii) Definition between normative and positive science
   iii) Problem of freewill
   iv) Methods of Ethics
   v)   Uses of Ethics

2. **Ethical Theories:**
   i)   History of Ethics: Greek Ethics, Medieval, Modern Ethics
   ii) Basic Concepts of right & wrong: good & evil

iii) Utilitarianism, hedonism, self-realization: egoism, intuitionism, rationalism

iv) Kant's moral philosophy

3. **Ethics & Religion:**

   i) The relation of Ethics to religion

   ii) Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, Islam

4. **Ethics, Society and Moral Theory:**
   - Society as the background of moral life
   - **Ethical foundation of rights of moral life**
   - Universalism and Altruism
   - Applied Ethics
   - Theories of punishment

IM 303 PRODUCTION MANAGEMENT

Production Management & Systems:

Introduction to production Management; System concept; Functions of management; Managerial decision making; Models as decision aids.

Plant Location & Plant Layout:

Selection of region; Selection of community; Site selection; Location factor dependence; Sources of assistance; Plant location trends; Quantitative analysis; Plant layout; Product & process layout analysis and comparison; Material handling considerations in layout.

Production Planning & Control:

Formalized production planning; Production planning methods; Master scheduling; MRP; MRP inputs, MRP outputs; Product structures; Types of MRP; Capacity planning and control; Production control systems; Job shop scheduling; Production control charts; Scheduling techniques; Purchasing and procurement.

Planning & control Techniques:

Inventory control; types of inventory; Inventory costs; Independent versus dependent demand; EOQ/EPQ models; Types of control systems; Selective inventory control; Inventory system development; Project planning; CPM/PERT; Network development; Determination of activity times; Establishment of critical path; Probabilistic statements.

Cost Estimating:

Element of cost; Material cost, direct and indirect labour cost and Over head cost. Cost structure; Prime cost, Factory cost, Manufacturing cost, Total cost, Selling price; Estimation of cost elements; Methods of estimation; Economics of tooling.

Maintenance:

Types of maintenance; Breakdown maintenance; Preventive maintenance; Individual versus group replacement; Internal versus external maintenance.

IM   307   ADVANCE MANUFACTURING PROCESSES

Mechanics of Orthogonal Metal Cutting:

Chip formation; Thin-zone models for analysis; Shear angle relationships; Role of friction in metal cutting; Prediction of forces; Velocity relationships; Force and stress relationships.

Tool Life & Tool Wear:

Forms of wear in metal cutting, Tool life criteria, Variables affecting tool life, Taylor's tool life equation, Generalized tool life equation, Methods of tool life testing data. Economics of Metal Cutting: Application of minimum cost per piece, maximum production rate, and maximum profit rate criteria in turning operations.

Metal Forming:

Stress: stress tensor, equilibrium equations, stress transformation equations, plane stress, Mohr's circle for stress transformation. Strain: plane strain, strain tensor, strain transformation equations, isotropic elasticity, strain energy. Bulk forming, sheet forming, Yield criteria, Plastic work, Plastic instability, Effective stress, Effective strain, Flow rules for plastic stress-strain relations.

Work Hardening:

Tensile test, Mechanical properties, Nominal & true stress-strain curves, Work hardening expression, Behavior after necking, Direct compression, Bulge test, Plane-strain compression test.

Bulk Forming Analysis:

Ideal work method, efficiency factors, extrusion and rod drawing, force balance or slab analysis, deformation zone geometry, sheet drawing, flat rolling, direct compression in plane strain, sheet bending, formability.

Hot & Cold Working of Metals:

Advantages and limitations of Hot working and Cold working processes; Methods of Forging; Hammer forging; Die forging; Drop, Press and Upset forging; Construction of drop forging hammers; Forging defects and their causes.

IM   308   OPERATIONS RESEARCH

Linear Programming:

Historical development of Operations Research, Formulation of Model, Linear programming: Graphical Analysis and Solution, Simplex Method of Solution, Equality constraints, Inequality constraints, Big M method, Duality theory, Primal and Dual problems, & Sensitivity Analysis.

The transportation problem, North-west corner rule, Vogel's approximation method, Russell's method, Transshipment problem, Assignment problem.

Queuing Theory:

Basic Queuing process, Assumptions for analysis, Queuing discipline and characteristics, Service mechanism, The birth and death process, Steady-state measures of performance, Single-server models, Multiple-server models, Machine servicing model.

Dynamic programming:

Recursive nature of computations in DP, Forward and backward recursion, Selected DP applications.

Simulation:

Introduction to simulation and its application in manufacturing.

ME   309   MACHINE DESIGN & CAD

Design of Machine elements:

Shafts and columns; Fluctuating and shock loads; Torsional stiffness; Critical speeds; Introduction to flexible shafting; Connecting rods and crank shafts.

Bearing; Details design of journal bearing and roller bearings including spherical and tapered roller bearings; Theory and application of lubrication and its methods.

Design of Drive Units and Assemblies:

Gearing; Design of the spur, helical, worm and bevel gear, Design of gear boxes. Chain drives; Design of chains including drag chain conveyor, apron feeders; Belt drives and belt conveyors; Motors and brakes.

Fundamentals of CAD:

Introduction, the design process, application of computers for design, creating the manufacturing data base, benefits of CAD.

Computer Graphics Software and Data Base:

Constructing the geometry, defining the graphic elements, editing the geometry, display control & windowing functions, data base structure and content, wire-frame versus solid modeling: wire frame models, solid models, other CAD features and CAD/CAM integration.

Mathematical Elements of CAD:

Transformation: Two & three dimensional transformations, Translation, Scaling, and Rotation, Concatenation, plane curves, space curves, surface description & generation, various techniques for design optimization.

IM 310 TOOL DESIGN

Jigs and Fixtures:

Basic Design principles and Classification. Materials for jig and fixture development. Lathe, Milling and Broaching fixtures. Detailed discussion of jigs for drilling and drilling related operations. Consideration for mounting jigs and fixtures on machine tools. *Inspection Jigs and Fixtures*. Analysis of operation with design examples.

Locating and Clamping Methods:

Principles of Location. Pins, plugs, dowels and nests. Conical Locating, adjustable locators. Clamping principles, design of various clamps with typical applications. Pneumatic and Hydraulic clamping.

Design of Cutting Tools:

Design of tools for cutting operations. Single point tools for lathe and boring operations. Multiple point tools for milling and drilling operations.

Design of Dies and Moulds:

Terminology of Press-Working operations. Mechanical, Hydraulic and Pneumatic presses. Materials for press tools. Design of Piercing, Blanking and Shearing dies. Design of Bending, Forming and Drawing dies. *Design of Moulds for plastic and Rubber Parts*. Pressure, Die Casting, Injection and Blow moulding.

IM 311 INDUSTRIAL QUALITY CONTROL

Fundamentals of Probability & Statistics:

Set theory & set operations; Venn diagram; Definition of probability; Probability laws; Conditional probability.

Deterministic & probabilistic data; Grouping of data; Measures of central tendency & dispersion; calculation of mean, mode, median; standard deviation, & range, weighted average, & coefficient of variation.

Random variable; discrete & continuous random variable; Mathematical expectation; Laws of expectation.

Probability Distributions:

Discrete probability distributions: Uniform, Binomial, Multinomial, Hyper geometric & Poisson distribution.

Continuous probability distributions: Normal & Exponential distributions; Transformation of variables; Random sampling; Sampling distribution of mean; Central limit theorem.

Control Charts:

Properties of the distribution of sample means, sample range estimation of standard deviation, chance and assignable causes, control charts for mean & range, control charts for mean & standard deviation, control

charts for proportion defective & defects per assembly. Tests of significance to compute confidence limits.

Acceptance Sampling:

Introduction, OC curve, consumer & producer risks, AQL & LTPD, sampling errors, acceptance sampling for continuous production, acceptance by variables, single, double, & sequential sampling.

Quality, Reliability, & Maintainability:

Definitions, management of quality control, total quality control, Taguchi loss function, economic aspects of quality decisions, process capability & variability analysis, various aspects of life testing, reliability, & maintainability, Introduction to ISO 9000.

ME   302   SOLID MECHANICS - II

Bending Stress:

Asymmetrical bending; Shear stress in thin-walled open sections and shear center; General case of bending of a thin-walled open section; Bending of initially curved bars; Beams with small radii of curvature.

Elastic Strain Energy:

Strain energy under direct stress and in pure shear; Strain energy in bending and in torsion in bending and in torsion; Maximum stress due to a suddenly applied load and due to impact; Bending deflection of a beam from an impact shear deflection; Theorems of Gastiglians and Maxwell's Reciprocal Theorem.

Theory of Torsion:

Torsion of a thin tube of non-circular cross-section; Torsion of thin-rectangular strip; torsion of solid-rectangular and square cross-sections; Helical springs.

Statically Indeterminate Beams and Frames:

Double integration method; Superposition method; Virtual work; Compatibility and equilibrium methods.

Buckling Instability:

Struts having initial curvature; Empirical formulae; Crinkling; Members subjected to axial and transverse loading.

Stress and Strain Transformations and Relationships:

Two-directional stress systems; Mohr's stress circle; principal stresses and planes; combined bending and torsion; Two-directional strain analysis; Normal and shear strain in terms of coordinate and maximum shear strain; Relationship between elastic constants.

Deformation Symmetrical about an Axis:

Thick-walled cylinders; Compound cylinders; Shrink fit, Rotating disk of uniform thickness.

EE   373   MACHINE CONTROL SYSTEMS

Open and closed loop control, feedback simple control system; sequence control, static switching and logic Switching Algebra.

Stability, accuracy, frequency and transient response.

Time Scale Effects

Linear control system, determination of system performance and design with reference to stability, Transient response, steady state accuracy and frequency response' Laplace transformation method; Root Locus; Nyquist criteria and Bode plots; Conformal plotting.

Series parallel and feedback techniques of system compensation.

Three term pneumatic controller for chemical plants.

Control system types; regulations, Servomechanism.

Electrical, hydraulic and pneumatic amplifier.

Instrumentation:

Analysis of the performance of electro mechanical transducers used in control.

MS   333   ADVANCED CALCULUS & FOURIER ANALYSIS

Partial Differential Equation:

Basic concepts and formation of partial differential equations; Linear homogeneous partial differential equations and relations to ordinary differential equations; Solution of first order linear and special types of second and higher order differential equations; D' Alembert's solution of the wave equation and two dimensional wave equations; Lagrange's solution; Various standard forms.

Fourier series:

Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients; Expansion of function with arbitrary periods. Odd and even functions and their Fourier series; Half range expansions of Fourier series, " DFT and FFT, Fourier Spectrum".

Advance calculus:

Define a stationary point of a function of several variables, define local maximum, and saddle point for a function of two variables the stationary points of a several variables, obtain higher partial derivatives of simple functions of two or more variables, iterated integrals, double and triple integrations with applications (area, centoroid, moment of inertia, surface area, and volume, use multiple integrals in solutions of engineering problems.

Vector Calculus:

Vector differential operator, directional derivative, gradient, divergence, curl of a vector field, and laplacian operators with applications. (Solenoid, conservative, etc).

Vector Integrations; Evaluate line integrals along simple paths, apply line integrals to calculate work done, apply Green's theorem in the plane to simple examples, evaluate surface integrals over simple surface, use the jacobian to transform a problem a new co-ordinate system, apply Gauss' divergence theorem to simple problems, apply Stokes' theorem to simple examples.

MF   303   ENGINEERING ECONOMICS

Introduction

Engineering economy defined; Measures of financial effectiveness; Non-monetary 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 live, 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 & ETHICS

Business English:

Writing formal and business letters and memos: Drafting notices and minutes; Theoretical knowledge and comprehension of contracts and agreements; Preparing proposals and conducting and writing research project reports.   Participating in seminars and interviews, and writing and presenting conference papers; Solving IELTS type papers.

Definition of code of ethics: Review of code of ethics of national and international engineering bodies. Relationship between ethics and human rights and their importance in human settlements and societies.

IM 402   COMPUTER AIDED MANUFACTURING (CAM)

Conventional Numerical Control:

Introduction, principles of Numerical Control, Hardware for Numerical Control, NC positioning systems, NC motion control systems, applications of numerical control, economics and justification.

NC Part Programming:

Manual part programming, computer assisted part programming, Lathe CAM Designer, Mill CAM, NC programming with interactive graphics.

Computer Controls in NC:

Problems with conventional NC, NC controller of technology, computer numerical control, direct numerical control, adaptive control machining systems, trends and new developments in NC.

Group Technology and Process Planning:

Part families, methods for developing part families; parts classification and coding, Hierarchical code, Attribute code, Hybrid code, introduction to various available classification and coding systems, Selecting a coding system, production flow analysis, benefits of group technology, machining cells. The role of process planning in CAD / CAM integration, Approaches to process planning: Manual approach, Variant approach, Generative approach; introduction to various process planning systems.

Programmable Logic Controllers (PLC's):

Functions of controllers, control devices, Programmable Logic Controllers: relay device components, switch, relay, counters, timers, relay logic, Programmable Controller Architecture: processor, memory, input /output, power supply, peripherals, Programming a Programmable Logic Controller: ladder diagram, ladder logic, timers and counters, programming examples.

Design for Manufacturing (DFM):

The meaning of DFM, schemes for DFM, axiomatic design, DFM guidelines, design for assembly, Taguchi method for Robust design, manufacturing process design rules, failure mode and effects analysis, summary of DFM tools.

IM 405   FINITE ELEMENT ANALYSIS

Introduction:

The early use of Finite Elements, matrix forces method, matrix stiffness method, interim period, variational principles and Finite Elements, recent developments.

Variational Formulation and Approximation:

Boundary and Initial-Value problems, gradient and divergence theorems, functional, variational symbol. Variational formulation of boundary-value problem, Variational Method of Approximation, Ritz method, method of weighted residuals, time-dependent problems.

Finite Element Analysis of One-dimensional Problems:

Basic Steps in FEA; Modeling, Discretization, Connectivity of Elements, Imposition of Boundary Conditions, Solutions & Post Processing; Applications to Heat Transfer, Fluid Mechanics, & solid Mechanics Problems.

Finite Element Error Analysis:

Approximation Errors, Various Measures of Errors, Convergence of Solutions, Accuracy of Solutions.

Numerical Integration & Computer Implementation:

Isoparameteric Formulations, Numerical Integration, Natural Coordinates, Computer Implementation (Pre-processor, Processor, and Post-processor)

Interpolating Functions, Numerical Integration & Modeling Considerations:

Interpolating Techniques; Triangular, Rectangular, & Serendipity Elements; Coordinate Transformation; Integration on a Master Element; Modeling, Mesh Generation, Load Representation.

Plane Elasticity:

Assumptions of Plane Elasticity; Basic Equations, Weak Formulations; Principle of Virtual Displacement in Matrix Form; Finite Element Model, Matrix & Weak Form Model; Evaluation of Integrals.

IM   408   AUTOMATION & ROBOTICS

Production Operations & Automation Strategies:

Automation defined; Types of automation; Reasons for automation; Arguments for & against automation. Manufacturing industries; Types of production; Functions in manufacturing; Organization & information processing in manufacturing; Plant layout; Production concepts & mathematical models; *CIM, FMS/FMC,* Automation strategies.

Automotive Type Automation

Automated flow lines; Methods of work-part transport; Transfer mechanism; Buffer storage; Control functions; Automation for machining operations; Design & fabrication considerations.

Analysis of Automated Flow Lines & Line Balancing:

General terminology & analysis, Analysis of transfer lines without storage, Partial automation. The assembly process, Assembly systems, Manual assembly lines, The line balancing problem; Methods of line balancing: Largest candidate rule, Kilbridge & Wester's method, Ranked positional weights method.

Automatic Control Systems and Components:

Basic elements of automatic control system, Levels of automation, Analysis of regulated and servo control systems, Sensors, Actuators, Data conversion, Mechanical components of automation.

Robotics Technology & Applications

Robot anatomy, Robot Configurations, Accuracy & Repeatability, Robot specifications, End effectors, *Kinematics and Dynamics of a 2-link Manipulator,* Characteristics of Robot applications, Robot cell design, Types of Robot applications.

IM   409   MANUFACTURING ENGINEERING PROJECT

Selected problems requiring design, manufacturing, development of problem specific software, preparation of drawings, fabrication of prototype / models and laboratory experimentation shall be assigned to individual students or groups of students. Grading shall be based on the reports produced by individual students and their critical evaluation through an oral examination.

IM 411 METHODS ENGINEERING

Work Study:

Introduction to work study, Techniques of work study and their relationship, Basic procedure of work study.

Method Study:

Definition; Objectives; Procedure; Process chart symbols; Outline process chart; Flow process charts; Multiple activity chart; Two handed chart; Critical Examination; Case studies & Application.

Methods and movements at the workplace:

General considerations, The principles of motion economy, Classification of movements, Re-organization of a workplace by means of a two-handed process chart, Micro-motion study, Simo chart, Use of films in methods analysis, The development of improved methods.

Work Measurement:

Definition; Objectives; Techniques of work measurement; Stop watch time study; Timing methods; Performance rating; Standard timing; Allowance factors. Work sampling; Confidence level; Determination of sample size; Making random observations; Scope of work sampling. Predetermined time standards; Definition; Advantages and criticisms; Motion classification; TMU; Use of PTS systems.

Ergonomics:

Human and working environment Interaction, lighting, illumination design, noise and vibration, temperature, dust, humidity, comfort level. Machine controls and displays of dials, Scope of Ergonomics and its practice in Pakistan.

IM 413 PLANT ENGINEERING

Thermal Power Plants:
Basic principles and cycles used; Steam power plants; Diesel power plants; gas power plants; combined heat and power generation.

Internal Combustion Engines:
Basic Internal Engine Types: Spark ignition engines; Compression Ignition engines; speed and load control; supercharging. Idealized cycle and processes; Otto cycle; Diesel cycle. Fuels, high and heavy fuel oil.

Steam Generators and Turbines:
Properties of Steam; Enthalpy and entropy diagram; Rankine cycle, Steam Power Plant: Boilers; Feedwater pump; Air Pre-heaters; Economizers; Super-heaters; Condensers. Boiler Types: Fire tube and water tube designs. Steam turbines; impulse and reaction types; back-pressure and extractive turbines.

Air-conditioning and Ventilation:
Principles of air-conditioning; Comfort and industrial air-conditioning; refrigeration equipment; primary and secondary refrigerants; ventilation equipment. Psychometric chart and its use; calculation of the

simple air-conditioning system. Temperature and humidity control; pneumatic, electric and hydraulic systems.

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.

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, Waste water 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.

IM   415   APPLIED HEAT TRANSFER

Introduction:

Modes of heat transfer, conservation of energy.

Conduction Heat Transfer:

Fourier's law, thermal conductivity, 3-d heat diffusion equation and its 1-d and 2-d simplifications. Application of heat equation to plane walls, long cylinders and spheres. Extended surface heat transfer, transient conduction, lumped capacitance method. Solution of 2-d conduction problems using Heisler Charts.

Convection Heat Transfer:

Newton's law of cooling, convection heat transfer coefficient, momentum and thermal boundary layer development, derivation of continuity, momentum and energy equations, dimensional analysis.

Dimensionless numbers, laminar and turbulent flow. Flow over flat plate, internal and external flow in tubes, empirical correlations for laminar and turbulent flows. Overall heat transfer coefficient; application in heat exchanger.

Radiation Heat Transfer:

Stefan-Boltzman Law, electromagnetic radiation, band spectrum, radiation properties, greenhouse effect, black and gray bodies, emissive power, radiation shape factors, radiation shields.

Diffusion Mass Transfer:

Fick's Law of diffusion, the mass diffusion equation, concentration boundary layer.

Heat Transfer with Phase Change:

Melting and solidification.

Materials Processing and Manufacturing Applications:

Surface heating and quenching. Die, sand and strip casting. Heat treatment of plates, cylinders and spheres. Welding, fibre melt spinning, laser heating, powder processing, crystal growth.

IM   416   MANAGEMENT INFORMATION SYSTEMS

Introduction;

Overview of System and Sub-systems, Information Systems, Relevance of Information Systems to organizational decision making, Information Systems and Manufacturing Environment Responsibilities of an Industrial Engineer from MRP to ERP and beyond.

Tools and Technologies;

Data Flow Diagrams, Functional Flow Diagrams, System Flow Charting, UML Diagrams, Bar Coding Technology, RFIDs, Formal Documentation and Presentation Formats.

Information and Data Base Management Systems;

Data Handling Procedures, Database; their Types and Design Issues including Modeling (ER Diagram etc.) and Normalization, Data Base Management Systems, Data Base Software, Client-Server vs. Distributed Computing, Methods of Data Collection, System Development Life Cycle (SDLC), Feasibility Study Considerations, Effects and Usages of Internet in Manufacturing Industry.

MS   441   ADVANCED MATHEMATICAL TECHNIQUES

Complex Variable:

Limit, continuity, zeros and poles of a complex function. Cauchy-Reimann equations, conformal transformation, contour integration.

Error Analysis:

Types of errors (relative, Absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart.

Use any Computational tools to Analysis the Numerical Solutions.

Finite Difference:

Functions of operators, difference operators and the derivative operators, identities. Linear homogeneous and non-homogeneous difference equations. Numerical Differentiation, Forward Difference Method, Backward Difference Method, Central Difference Method.

Interpolation & Curve Fitting:

Lagrange's, Newton, Hermit, Spline, least squares approximation. (Linear and non-linear curves). With numerical problem in engineering.

Numerical Integration & Differentiation:

Computation of integrals using simple Trapezoidal rule, $\frac{1}{3}th$ Simpson's rule, $\frac{3}{8}th$ Simpson's rule, Composite Simpson's and Trapezoidal rules, computation of solutions of differential equations using (Euler method, Euler modified method, Runge Kutta method of order 4).

Improper integrals:

Definitions, Types of improper integral and their convergence.

Elliptic Integrals:

Introduction and identification of elementary elliptic integrals of first, second and third kinds. Simple applications.