SEMESTER I

15Y101 CALCULUS AND ITS APPLICATIONS

Differential Calculus: Basic concepts - Limits, continuity, differentiation, functions of several variables, partial derivatives, total derivatives, Taylor’s formula for functions of two variables. (8+5)

Integral Calculus: Double integrals - double integrals over rectangles, double integrals as volumes, Fubini’s theorem (concept and statement only), double integrals in polar form, changing the order of integration. (6+4)

Ordinary Differential Equations of First Order: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, Bernoulli equation, modelling- mixing problems, Newton’s law of cooling. (8+5)

Linear Differential Equations of Second Order: Homogeneous linear equations of second order, linearity principle, initial value problem, general solution, second order homogeneous equations with constant coefficients, Euler – Cauchy equation, solution by variation of parameters, modelling- free oscillations. (7+5)

Vector Calculus: Gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field. Integration in vector field – Line integrals, work, circulation and flux, path independence, conservative fields, surface integrals. Green’s, Gauss divergence and Stoke’s theorems (concepts and statements only), evaluation of line, surface and volume integrals. (16+11)

Total L: 45 + T: 30=75

Text Books:

References:

15Y102 PHYSICS


Total L: 45

Text Books:

References:


TEXT BOOKS:

REFERENCES:

15A103/15M103/15P103/15Y103 CHEMISTRY

15Y104 PROBLEM SOLVING AND C PROGRAMMING

INTRODUCTION TO PROBLEM SOLVING: Program development - Analyzing and Defining the Problem - Algorithm - Flow Chart. (2+2)

PROGRAMMING LANGUAGES: Definition - Types of programming language – Modular Programming - Program Development Environment. (2+2)


CONTROL STATEMENTS: If else - Switch Case - While - Do While - For - Nested loops - break – continue – goto statements. (4+4)

FUNCTIONS: Function prototype - Defining a function – function call - Passing arguments to a function - Storage classes - auto - static - extern and register variables. (4+4)

ARRAYS: Defining an array - Processing an array - Passing array to a function - Multi dimensional array - Arrays & strings. (4+4)

POINTERs: Definition - Pointer Arithmetic - Pointer and arrays – Dynamic memory allocation. (2+2)

STRUCTURES AND UNIONS: Definitions - Processing a structure – Array and structures – Nested structures - Structures and pointers - Structures and functions. (4+4)

FILES: Need for files – Operations on files - Sequential and Random access file functions - File Handling Functions - Error handling functions. (2+2)

Preprocessor Directives - Command Line Arguments. (2+2)

Total L: 30 + T: 30 = 60
TEXT BOOKS:

REFERENCES:

15Y105 MINERAL BENEFICIATION

ELEMENTARY KNOWLEDGE OF CRYSTAL SYSTEMS: Three laws of crystallography - systems of crystallisation - Symmetry elements. (3)

PHYSICAL, CHEMICAL CHARACTERISTICS AND USES: Hematite, Magnetite, Bauxite, Pyrolusite, Braunite, Chalcopyrite, Galena, Sphalerite and Chromite. (4)

ELEMENTARY KNOWLEDGE OF VARIOUS PROCESSES OF ORE FORMATION: Rock cycle, Crystal interlock, Economic grinding mesh, Mineral paragenesis and diagenesis, Physical properties of minerals made use of in mineral dressing studies, Study of petrological microscope and its applications. (3)

MINERAL RESOURCES OF INDIA: General resources -deposits of iron, Manganese, copper, lead and zinc, Bauxite, chromites, beach sand minerals, uranium, limestone, and refractory mineral. Sea as a source of mineral. (2)

SCOPE, OBJECTIVES AND ADVANTAGES OF MINERAL PROCESSING: Choice of mineral processing method, Principal steps in ore processing. Laws of crushing and work index. Recovery, concentration and separation efficiency. Simple problems. (6)


GRINDING: Dry and wet grinding, Open and closed circuit grinding. Screening, sizing and sampling. (5)

THEORY OF SETTLING: Practice of hydraulic and mechanical classification, working of thickeners, hydrocyclones and rotary filters. (4)

GRAVITY CONCENTRATION TECHNIQUES: Heavy media separation, Principles of Jigging and tabling. Processes with equipment used, important controlling factors in operation, applications, Simple problems. (3)

FROTH FLOTATION, MAGNETIC AND ELECTRO STATIC SEPARATION: Froth flotation - frothers, collectors, depressants, activators, pH modifiers, etc., multistage flotation. Electrostatic and magnetic separation (dry and wet) - principle, equipment, and applications, Simple problems – floatation chambers and capacity. (6)

FLOW CHARTS: mineral beneficiation processes of iron ore, copper ore and coal cleaning. (3)

Total L: 45

TEXT BOOKS:

REFERENCES:

15C106 ENGLISH LANGUAGE PROFICIENCY

LEARNING LANGUAGE THROUGH STANDARD LITERARY AND GENERAL TEXTS: Integrated Tasks focusing on Language Skills – Training based on Text based Vocabulary, tone, register and Syntax features. (12)

GRAMMAR IN CONTEXT: Word Order - Subject Verb Concord - Style features - Tenses, Conditionals, Prepositions, Active and Passive Voice, Modals and Transformation of Sentences. (14)


24
WRITING PRACTICE

FOCUS ON SPOKEN ENGLISH: Task – based activities with graded levels of difficulty and with focus on language functions
Level 1: Self – expression – Greetings in Conversation, Hobbies, Special interests, Daily routine.
Level 2: General Awareness – Expression of Concepts, Opinions, Social Issues, Description of a process / picture/chart, news presentation / review.
Level 3: Advanced Skills – Making Short Speeches and Participating in Role Plays

LISTENING ACTIVITY: Task- based Activities using Language Lab.

TEXTBOOK:
1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:

15Y110 ENGINEERING GRAPHICS

INTRODUCTION: Introduction to Engineering Drawing. BIS. Principles of dimensioning.


PICTORIAL PROJECTIONS: Principles of pictorial views, isometric view of simple engineering components. Orthographic views from given pictorial views. Isometric views from given two or three views. Drawing isometric views of typical electronic components, Body centered, Face centered and hexagonal close packed crystal structures.

SECTION OF SOLIDS: Section of regular solids, types of sections, selection of section views. Sectional views of simple engineering components. Drawing sectional views of assemblies like electric motor, mobile phone, blast furnace, induction furnace.

DEVELOPMENT OF SURFACES: Development of lateral surfaces of regular solids and truncated solids. Preparing parts like tray, funnel, CPU housing using cardboard material.

TEXT BOOKS:

REFERENCES:

15Y111 PHYSICS LABORATORY I

List of Experiments:
1. Determination of coefficient of viscosity of liquid – Poiseuille’s method.
2. Determination of surface tension of water- capillary rise method.
3. Determination of Young’s modulus by cantilever method.
5. Determination of lattice constants of bcc and fcc using the powder photographs.

REFERENCES:
1. Physics Practicals, Department of Physics, PSG College of Technology 2015.
15Y112 CHEMISTRY LABORATORY I

0 0 2 1

1. Estimation of strength of an acid by pH -metry.
2. Estimation of acids in a mixture by conductometry.
3. Anodizing of aluminium, determination of thickness of anodic film, sealing and dyeing of the anodic film.
4. Determination of total, permanent, temporary, calcium and magnesium hardness of water by EDTA method.

Total P: 30

REFERENCE:

SEMESTER II

15Y201 COMPLEX VARIABLES AND TRANSFORMS

3 2 0 4

COMPLEX VARIABLES: Complex differentiation- Analytic function, Cauchy Riemann equations, harmonic functions. (6+4)

COMPLEX INTEGRATION: Cauchy’s integral theorem, Cauchy’s integral formula, Laurent series (concept and statement only), singularities and zeros, residue integration method (Residue integration of complex integrals only), linear fractional transformations. (8+5)

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t-shifting, Dirac's delta function, periodic functions, convolution, differentiation and integration of transforms, Method of solving differential equations and integral equations by using Laplace transform technique. (12+9)

FOURIER ANALYSIS: Fourier series - functions of any period 2L, half range expansions. Fourier transforms, Fourier cosine and sine transforms. (9+6)

HOMOGENEOUS PARTIAL DIFFERENTIAL EQUATIONS: Basic concepts, modeling – vibrating string, wave equation, solution by separating variables, one-dimensional heat equation, steady state two-dimensional heat equation (Cartesian coordinates only) - solution by Fourier series. (10+6)

Total L: 45+T: 30= 75

TEXT BOOKS:

REFERENCES:

15Y202 MATERIALS SCIENCE

3 0 0 3

SEMICONDUCTORS: Formation of energy bands-Band theory of solids: metals, semiconductors and insulators-intrinsic and extrinsic semiconductors- Fermi energy levels for doped, undoped semiconductors. Physics of PN junction, solar cell and LED. Hall effect- Hall sensors- Hall effect switches and commutators. (9)


SUPERCONDUCTIVITY: Concepts and quantities of superconductivity -Meissner Effect, Type I and Type II Superconductors, BCS theory (Qualitative only), London’s equation, properties of superconductors & applications-Magnetic levitation-SQUID. (9)


ADVANCED MATERIALS : Shape memory Alloys, Pseudo elastic materials-Self assembly mechanism of material-ferroelastic materials, Bio mimetic materials. Composites- physical properties and applications. Introduction to nanophase materials. (10)

Total L: 45
15Y203 APPLIED CHEMISTRY


BATTERIES AND FUEL CELLS Batteries- Types-battery characteristics- construction and working of Leclanchce cell, lead-acid battery, nickel-cadmium battery, lithium ion battery. Batteries for special applications such as automobiles, airplanes, satellites, torpidoes, etc. Fuel cells – direct methanol and proton exchange membrane fuel cells.


Total L: 45

TEXT BOOKS:

REFERENCES:

15Y204 FLUID MECHANICS AND HEAT TRANSFER

FLUID MECHANICS: Properties of fluids such as density, viscosity and specific weight - Fluid statics - Pressure at a point - Pressure variations in horizontal and vertical directions - Concept of gauge and absolute pressure - Use of manometer for pressure measurements - Forces on plates - Horizontal and inclined.

ENERGY BALANCE IN FLUID FLOW: Types of flow - continuity equation - Application to one dimensional problems. Derivation of Bernoulli's equation and Euler's equation - Examples illustrating the use of energy equation in metallurgical processes.

INTERNAL AND EXTERNAL FLOW: Classification of flow - Reynolds number - Laminar flow between parallel plates and circular pipes - Simple problems.

PRESSURE IN FLUID FLOW: Head loss due to friction -Darcy - Weisbach equation - flow through pipes - use of Moody diagram - Minor losses - Simple problems.
STEADY HEAT CONDUCTION: Steady state heat conduction in plane wall, cylinder and sphere - simple examples, Composite Systems. (3)

UNSTEADY HEAT CONDUCTION: Lumped parameter systems, infinite solids, semi-infinite solids, numerical and graphical methods, periodic heating. - Examples on Heat Treatment. (5)

CONVECTION HEAT TRANSFER: Forced Heat transfer from flat plate, laminar and turbulent flow, cylinders and spheres, flow through tubes. Free convection, heat transfer from vertical and horizontal surfaces. Boundary layer concept - Simple problems on velocity and thermal boundary layers (no derivation) – problems on laminar and turbulent boundary layers (no derivation) (9)


TEXT BOOKS:

REFERENCES:

15Y205 APPLIED MECHANICS

STATICS OF PARTICLES: Forces – systems of forces - concurrent forces in plane - resultant - problems involving the equilibrium of a particle - free body diagram. (7)

STATICS OF RIGID BODIES IN TWO DIMENSIONS: Rigid bodies – two dimensional structure - moment of force about an axis - moment of a couple - equivalent systems of coplanar forces - rigid body in equilibrium - problems involving equilibrium of rigid body - types of supports - reactions of beams and frames. (9)

ANALYSIS OF TRUSSES: Roof trusses - Method of joints - Method of sections. (8)

CENTROID AND MOMENT OF INERTIA: Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia - radius of gyration. (7)

AXIAL STRESSES AND STRAINS: Stress and strain due to axial force - elastic limit - Hooke's law - factor of safety - stepped bars - uniformly varying sections - stresses in composite bar due to axial force. (8)

SHEAR FORCE & BENDING MOMENT DIAGRAMS: Bending moment and shear force diagrams in simply supported, overhanging and cantilevers subjected to concentrated loads and UDL. (7)

FLEXURAL STRESSES: Theory of simple bending and assumptions - flexure equation - section modulus - normal stresses due to flexure. (7)

TORSION: Concept of torsion and torsional shear stress – torsion formula - design of circular shaft – Power transmitted by a shaft. (7)

TEXT BOOKS:

REFERENCES:

15Y210 FUELS AND MINERAL DRESSING LABORATORY

List of Experiments:

FUELS LABORATORY:
1. Proximate analysis of coal.
2. Determination of flash and fire point, cloud and pour point of liquid fuels.
3. Determination of kinematic viscosity & viscosity index of oils using Redwood/ Saybolt viscometer.

MINERAL DRESSING LABORATORY:
1. Sampling methods.
2. a. Study of petrological microscope.
   b. Study of two metallic minerals using petrological microscope.
3. Primary crushing and Secondary Crushing.
4. Ball milling.
5. Sedimentation (Verification of stokes law).

REFERENCE:
1. Laboratory Manuals prepared by the Department of Chemistry and Metallurgical Engineering, 2015.

15Y211 PHYSICS LABORATORY II

List of Experiments:
1. Determination of band gap of thermistor using post office box.
2. Determination of magnetic hysteresis of ferromagnetic material.
3. Determination of thickness of a thin wire - air wedge method.
4. Determination of IV characteristics of solar cell and determination of its efficiency.
5. Determination of wavelength of mercury spectrum using grating.

Demonstration:
2. Compound microscope.
3. Thin film deposition using DC/RF sputtering technique.
4. Hall effect.
5. Differential scanning calorimetry (DSC).

REFERENCES:
1. Physics Practicals, Department of Physics, PSG College of Technology 2015.

15Y212 CHEMISTRY LABORATORY II

List of Experiments:
1. a. Determination of alkalinity and TDS of water.
   b. Photocolorimetric estimation of iron.
2. Potentiometric determination of ferrous iron.
4. Determination of rate constant of acid hydrolysis of ester.

REFERENCE:
1. Laboratory Manual Prepared by the Department.

15Y213 ENGINEERING PRACTICES

List of Experiments:
1. Welding - Metal arc welding tools and equipment, exercises by Arc welding and TIG welding Processes.
5. Sheet metal work & Soldering - Tools, operations, exercises Make a Rectangular Tray in Galvanized Iron sheet.

REFERENCES:
1. Laboratory manual prepared by the Department of Mechanical Engineering, 2010.
SUMMER TERM COURSES  
(4 weeks duration)

15Y215 PROFESSIONAL SKILLS  
6 0 9 2

UNIT I: HISTORY OF METALLURGY
INTRODUCTION: History of metals, smelting and other processes  
(T: 1)
TOOLS AND ARMS: Bronze age weapons, swords, Wootz-Damascus steel, colonial fire arms and artillery.  
(T: 2)
MONUMENTS AND ARTS: Delhi iron pillar, metal arts, coins, Rome church paintings, iron bridges, investment casting statues, Aranmula metallic mirrors  
(T: 2)
METALLURGY: Importance in manufacturing and failure analysis.  
(T: 3)
MEDICINE: Metals bone replacements in ancient medicine, current trends.  
(T: 2)

UNIT II: USE OF SOFTWARES  
(L: 4, P: 12)

UNIT III: TECHNICAL WRITING  
Introduction – Literature collections, preparation of powerpoint presentations, industrial training / visit report writing, review paper writing, project report writing, technical paper writing.  
(L: 10, P: 12)

Total L: 24 + T: 36 = 60

REFERENCES:

15Y216 IN-PLANT TRAINING & TECHNICAL SEMINAR  
6 0 9 2

Trainings: Visiting various engineering facilities in PSG Industrial Institute, PSG Neelambur Metallurgy and Foundry Division, Centers of Excellence in PSG Tech.  
(P: 36)

Technical Seminar: Presentations on industry visits by the students.  
(L: 24)

Total L: 24+P: 36= 60

SEMESTER III

15Y301 NUMERICAL METHODS  
2 2 0 3

ERRORS: Approximations and round-off errors - truncation errors.  
(2+1)

(5+5)

(4+4)

(4+4)

DIFFERENTIATION AND INTEGRATION: Numerical differentiation - equally spaced and unequally spaced data, numerical integration, Newton-Cotes formulae, Trapezoidal rule, Simpson’s1/3 rule.  
(4+4)

(6+6)

TEXT BOOKS:

REFERENCES:

15Y302 DESIGN OF MACHINE ELEMENTS

INTRODUCTION TO MACHINE ELEMENTS: Introduction to machine elements and design, manufacturing aspects of design selection of materials, standards and codes, fatigue theory, design against fluctuating loads.

SHAFTS AND COUPLINGS: Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and critical speed, couplings, types and applications, design of rigid and flexible flange couplings, selection of materials for shafts and couplings.

SPRINGS: Spring configurations spring rate, spring materials, helical compression springs, buckling, design for static and fatigue loading helical tension spring, Introduction to leaf springs.

JOINTS: Introduction to bolted and riveted joints-types of welded joints, weld symbols, strength of welds, centrally loaded, unsymmetrical sections, axially loaded and eccentrically loaded joints.

BEARINGS: Static and dynamic load capacity, cubic mean load, variable load, probability of survival, and selection of bearings - (deep groove). Hydrodynamic Sommerfeld number, dimensionless parameters, optimum bearings, newer bearing materials, design of hydrodynamic bearings.

BELTS AND CHAINS: Belts for given power and velocity ratio, selection of V-belts, chains, Selection of roller chain and silent chain. Materials for belts and chains.

GEARS: Gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Introduction to helical bevel gear, worm and worm wheel. Selection and treatment of materials for gears.

CLUTCHES AND BRAKES: role of clutches, positive and gradually engaged clutches, design of single plate and multiple plate clutches, Role of brakes-types of brakes-self energizing and de-energizing brakes.

TEXT BOOKS:

REFERENCES:

15Y303 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRIC CIRCUITS: Ohm’s law, KCL, KVL, solving simple DC Circuits-single phase AC circuit fundamentals-Power, Power factor-solving simple AC circuits-3 phase AC circuits-Star and Delta Connection.


INDUSTRIAL APPLICATIONS: Motor Selection-factors to be considered-power rating-types of Duty cycle-selection of motors for machine tools applications, centrifugal pumps, Converyors, cranes, furnaces.
ELECTRONIC DEVICES: Operation of PN junction diodes, VI characteristics, zener diode, BJT, types-CB, CE, CC configurations, input and output characteristics, JFET, difference between FET and BJT-working principle and characteristics. MOSFET-types, principle of operation and characteristics. Op-Electronic Devices-Introduction, types, photo conductive, photo diode, phototransistor, Light emitting diode-Principles and Applications.

ELECTRONIC CIRCUITS: (Qualitative analysis only) Half wave and full wave rectifier, capacitive filters, zener voltage regulator, RC- coupled amplifier, frequency response, oscillator, Barkhausen criteria, RC phase shift oscillator. (6)

LINEAR INTEGRATED CIRCUITS: Operational amplifiers, Ideal op-amp characteristics. Inverting and Non-inverting amplifier, op-amp applications - Adder- Subtractor, integrator, differentiator, comparator, zero crossing detector. (6)

DIGITAL ELECTRONICS: Number systems-representation of signed numbers: 1’s complement and 2’s complement, logic gates, Half adder, full adder, parallel adder/subtractor, Flip flops, RSJKJK Master slave, D and T type, counters and shift registers. (6)

Total L: 45

TEXT BOOKS:

REFERENCES:

15Y304 ELEMENTS OF PHYSICAL METALLURGY

CRYSTAL STRUCTURES: Review of atomic bonds-crystal systems and Bravais lattices, principal metallic crystal systems-BCC, FCC, HCP, atom positions and directions in cubic unit cells, miller indices for crystallographic planes in cubic unit cells, crystallographic planes and directions in hexagonal unit cells, volume, planar and linear atomic density calculations, allotropy, single crystal and polycrystalline materials, anisotropy, X-ray diffraction and determination of crystal structures, non-crystalline solids-Numerical Problems. (12)


SOLIDIFICATION OF METALS: Homogeneous nucleation and Heterogeneous nucleation, growth of crystals in liquid metals and formation of grain structure, grain structure in casting. (9)

PHASE DIAGRAMS: Gibb’s phase rule, binary isomorphous alloy systems, non-equilibrium cooling, binary eutectic system, eutectoid, peritectic and monotectic reaction, phase diagrams with intermediate phases and compounds, iron-carbon diagram ternary phase diagrams. Development of microstructures worked examples. (12)


COLD WORKING AND ANNEALING: Cold working- structure and properties of cold worked metals. Recovery, recrystallisation and grain growth. recrystallisation temperature. factors influencing recrystallisation temperature. comparison of cold working and hot working- Numerical problems. (6)

ADVANCED MATERIALS: Basic concepts of nano materials, shape memory alloys, bulk metallic glasses and fullerenes. (4)

Total L: 60

TEXT BOOKS:

REFERENCES:

32
15Y305 METALLURGICAL THERMODYNAMICS

INTRODUCTION: System and surrounding, classification of systems, path and state properties, thermodynamic processes, thermodynamic equilibrium, reversible and irreversible processes, intensive and extensive properties-zeroth law of thermodynamics. (3+3)

FIRST LAW OF THERMODYNAMICS: Heat and work, internal energy, heat capacity of materials, enthalpy, thermo chemistry Hess's law, Kirchoff's law. (3+3)

SECOND LAW OF THERMODYNAMICS: Carnot cycle, entropy-statistical interpretation of entropy, combined statement of first and second laws. Free energy, thermodynamic functions-Maxwell's relations, Gibbs-Helmholtz equation, effect of temperature on the thermodynamic properties-Ellingham diagram. (6+6)

THERMODYNAMIC POTENTIALS: Fugacity, activity and equilibrium constant. Clausius-Clayperon equation: effect of pressure on the equilibrium temperatures (water and iron systems). Le Chatelier's principle, Vant Hoff's equation. (3+3)

THIRD LAW OF THERMODYNAMICS: Third law of thermodynamics and its applications. (3+3)

THERMODYNAMICS OF SOLUTIONS: Gibbs-Duhem equation, partial and integral molar quantities, ideal solutions-Raoult's law, real solutions, activity coefficient, Henry's law, alternative standard states, Sievert's law, mixing functions and excess functions, regular solutions, applications of Gibbs-Duhem equation. (6+6)

EQUILIBRIA IN PHASE DIAGRAMS: Phase rule, phase stability, P-G-T diagrams, Ellingham diagram and its use-application of free energy-composition diagrams to the study of alloy systems. Free energy-temperature diagram for metastable phases, thermodynamic factors behind the iron carbon phase diagram. (6+6)

Total =L: 30+T: 30= 60

TEXT BOOKS:

REFERENCES:

15C070 ECONOMICS FOR ENGINEERS

INTRODUCTION: Definition – Nature and Scope - Significance of Economics for Engineers. (4)


MARKET STRUCTURE: Types of Market - Perfect Competition – Characteristics –Monopoly –Monopolistic Competition –Oligopoly and Duopoly - Price Discrimination and Product Differentiation under different markets – Price and output determination in short run and long run. (6)


Total L: 45

TEXT BOOKS:
REFERENCES:

15Y310 METALLOGRAPHY LABORATORY I

1. Sample preparation and study of metallurgical microscope.
2. Microstructural study of grey cast iron, S.G.iron and malleable iron in unetched condition.
3. Microstructural study of grey iron, S.G.iron, white cast iron and malleable iron in etched condition.
4. Microstructural study of low, medium and high carbon steels in annealed condition.
5. Microstructural study of hardened and tempered low alloy steels
6. Microstructural study of austempered low alloy steels
7. Microstructural study of cast and wrought stainless steels.
8. Microstructural study of tool steel and Hadfield steel.
9. Inclusion rating and grain size measurement.
10. In-situ Metallography Practice - Demonstration.

Total P: 60

REFERENCES:
1. Laboratory Manual prepared by the Department of Metallurgical Engineering, 2015.

15Y311 METAL CUTTING PRACTICES LABORATORY

1. Facing and step turning operation.
2. Drilling and taper turning.
4. Thread cutting operation-external and internal.
5. Step turning, drilling, counter boring and assembly.
6. Internal and external dovetail machining using shaper.
7. Experiment in surface grinding and cylindrical grinding processes.
8. Experiment in keyway slotting.
9. Experiment in spur gear shaping.
10. Experiment in drilling and pocket milling.

Total P: 30

REFERENCES:
1. Laboratory Manual prepared by the Department of Mechanical Engineering, 2015.

15Y312 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

1. Verification of Ohm's law and Kirchoff's laws.
3. Load test on DC Shunt and Compound Motor.
4. Load test on Three phase Induction Motor.
5. Load Test on Single phase transformer.
7. RC coupled transistor amplifier.
9. Study of logic gates and implementation of binary adder/subtractor.
10. Study of optoelectronic devices. (LDR, photodiode, phototransistor)

Total P: 30

REFERENCE:

SEMESTER IV

15Y401 PROBABILITY AND STATISTICS

PROBABILITY: Sample spaces and events, interpretations of probability, addition rule, conditional probability, multiplication
and total probability rules, independence, Baye’s theorem. (4+4)

**RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS:** Random variables - discrete random variables, probability distributions and probability mass functions, cumulative distribution functions, expectation, binomial, Poisson and geometric distributions - continuous random variables – probability distributions and probability density functions, cumulative distribution functions, expectation, uniform, normal, and exponential distributions. (6+6)

**JOINT PROBABILITY DISTRIBUTIONS:** Two dimensional discrete and continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation and linear regression. (8+6)

**POINT ESTIMATION OF PARAMETERS AND SAMPLING DISTRIBUTIONS:** Sampling distributions and the central limit theorem, point estimation - unbiased estimators, variance of a point estimator, standard error and mean squared error of an estimator, method of point estimation - maximum likelihood estimation. (4+4)

**HYPOTHESIS TESTING:** Statistical hypothesis, tests of statistical hypothesis, one-sided and two-sided hypothesis, confidence intervals, large and small sample tests, inference concerning means, variances and proportions - Chi-square test for goodness of fit and independence of attributes. (5+6)

**ANALYSIS OF VARIANCE:** Introduction, assumptions of analysis of variance, completely randomized design, randomized block design, Latin square design. (3+4)

**TEXT BOOKS:**

**REFERENCES:**

**15Y402 ENVIRONMENTAL SCIENCE AND ENGINEERING**

**FUNDAMENTAL CONCEPTS:** Earth and its eco systems-constituents of environment: air, water, land-pollutant and their types (air, water, land, noise, thermal, electromagnetic radiation and radioactive pollutants). Energy-forms of energy-renewable and non-renewable sources-advantages and limitations. Global and Indian energy scenario-relationship between energy and environment-measures to minimize energy use and solving environmental issues-Environmental awareness-Global and Indian initiatives. (9)

**METALLURGICAL INDUSTRIES AND ENVIRONMENT:** Metals and their uses-metals production and its life cycle-Impact on ecology. Classification of metallurgical industries-steel plants-sources of pollution-waste disposal (solid, liquid and gaseous) and noise control in (i) Integrated iron and steel plants (ii) Steel plants based on coal and gaseous fuels (iii) Electric arc furnaces (iv) Ferro alloy plants-pollution control in foundries (v) Pollution control in non ferrous industries (Al,Cu,Pb,Zn and Hg). (9)

**ENERGY MANAGEMENT:** Need and role of energy in steel and non ferrous industries-energy audit-need and procedure-Identifying environmental problems due to energy in metallurgical industries and possible solutions-alternate sources of fuel (hydrogen, biomass and carbon). Location and Layout of Metallurgical Industries-Important factors to be considered-availability of various resources (raw material, water, power). Environmental issues- natural disaster, health and safety aspects-disaster management. Environmental-Legal and related issues-environmental laws in India-Indian constitution and environment-important legislation-EPA clean water act, air act, EIA Acts, hazardous wastes act...) Biodiversity act, wild life production act, labour welfare acts-Environmental management systems-ISO14000&ISO50001 comparison-concept of carbon credit-green rating projects. (9)

**TEXT BOOKS:**
1. Deswal S and Deswal A, “A Basic course in Environmental studies”, Dhanpat Rai and company, New Delhi, 2004

**REFERENCES:**
15Y403  MECHANICAL BEHAVIOUR AND TESTING OF MATERIALS

INTRODUCTION: Strength of materials-Basic assumptions-elastic and plastic behaviour-Average stress and strain-concept of stress, strain and the types of stresses and strains. (2+2)

DISLOCATION THEORY: Theoretical cohesive strength, dislocation types, Burger’s Vector and dislocation loop, dislocations in FCC, BCC and HCP. Stress fields and energies of dislocations forces on dislocations, forces between dislocation-Interaction of dislocations, dislocation multiplication, dislocation pileups, Interaction with points defects. (9+6)

PLASTIC DEFORMATION OF CRYSTALS: Deformation by slip, slip in a perfect lattice, slip by dislocation movement, critical resolved shear stress for slip, Deformation of single crystals, polycrystalline materials, Deformation by twinning, stacking faults, strain hardening. (4+5)


HARDNESS TESTING: ASTM standards. Brinell hardness testing, Rockwell hardness testing, Vickers hardness testing and knoop hardness testing, Nano indentation, Problems. (2+2)

TENSION TESTING: ASTM Standards and specification, Engineering stress & strain, True stress strain curves, Holloman - Ludwig equation, Plastic Instability (Necking), Testing machines-types, testing procedures, properties measured, specimen dimensions, Problems. (3+3)

TORSION TESTING & SHEARING TEST: ASTM Standards and specification Testing Machines and procedures. (2+1)

IMPACT TESTING: Principle, Izod and Charpy Impacts tests. ASTM Standards and specification. Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, determination of DBTT. (2+2)


TEXT BOOK:

REFERENCES:

15Y404  NON FERROUS EXTRACTION METALLURGY

INTRODUCTION: Availability of raw materials in India. Sources of metals, unit operations and unit processes of metal extraction. Pyrometallurgical Processes-Principles of drying, calcination, sintering, roasting-Roasting techniques, predominance area diagrams, principles of smelting and converting. Ellingham diagrams, Carbothermic, Hydrothermic and Metallothermic reductions. (9)

HYDROMETALLURGY: Principles of hydrometallurgy, advantages, Leaching-properties of good solvent, preparation of ore for leaching, leaching methods, recovery of metal from liquor, solvent extraction, ion exchange, gaseous reduction of metals in aqueous solutions, cementation, recycling of leach liquor, bio leaching. (9)

ELECTROMETALLURGY: Aqueous and fused salt electrolysis, principles of electro refining and electro winning of metals. (3)

PURIFICATION OF CRUDE METALS PRODUCED IN BULK: Distillation, Lication, Liquid-Liquid extraction, fire refining, electrolytic refining, zone refining, VAR, EBM and ESR- examples. (6)

EXTRACTION AND REFINING OF METALS FROM SULPHIDE ORES: Copper, Nickel and Lead. (5)

EXTRACTION AND REFINING OF METALS FROM OXIDE ORES: Aluminium, Magnesium, Zinc and Tin. (5)

EXTRACTION AND REFINING OF METALS THROUGH HALIDE ROUTE: Titanium, Zirconium and Uranium. (3)

EXTRACTION OF PRECIOUS METALS: Gold, Silver and Platinum. (3)

RECOVERY of by product metals and treatment of metallurgical waste, material and energy balance. (2)

TEXT BOOKS:

REFERENCES:

15Y405 PRODUCTION OF IRON

INTRODUCTION TO PRODUCTION OF IRON: Early history of iron, evolution of iron making technology, iron making in India, overview of blast furnace iron making, sponge iron making, smelting reduction processes, general physiochemical fundamentals.

RAW MATERIALS AND THEIR PREPARATION: Characteristics of coal for coke making, selection of coals, assessment of coke quality, processes used for coke making - by product coke ovens, non-recovery ovens, iron ores, iron ore reserves in India, beneficiation of iron ore, agglomeration methods - principle and mechanism of sintering, Dwight-Lloyd sintering technology, pelletisation - disc and drum pelletisers, physical & chemical characterization and metallurgical tests of lump ore / sinter / pellets, fluxes used in iron making.

BLAST FURNACE AND ITS ACCESSORIES: plant layout, constructional features of the blast furnace, distribution of burden - charging equipment - bell type and bell less type, blast furnace gas cleaning and utilization, hot blast stoves.

BLAST FURNACE OPERATION: operation and process control, operational irregularities, physical chemistry of blast furnace reactions - carbon - oxygen reactions, gas - solid reaction equilibria, thermal and chemical features of the blast furnace, RAFT calculations, Reichardt's diagram, The Rist diagrams, Internal zones and gas flow in blast furnaces, Blast furnace productivity, fuel efficiency, Modern developments - high top pressure, bell-less top, pulverized coal injection, humidification of blast. Blast furnace products and their utilization - Hot metal, slag & blast furnace gas, treatment of hot metal, modeling approaches to iron making.

ALTERNATE IRON MAKING PROCESSES: Sponge iron making - coal - based and gas - based, smelting reduction processes - fundamentals, categorisation, salient features of Corex, Hismelt, Finex, Fastmet, ITmk3 processes, Mini-blast furnace.

TEXT BOOKS:

REFERENCES:

15Y410 METALLOGRAPHY LABORATORY II

1. Electrolytic polishing and etching practice.
2. Microstructural study of cast Al-Si eutectic alloys.
3. Microstructural study of brass and bronze.
5. Microstructural study of magnesium and nickel alloys.
7. Microstructural study of Cr-Mo steels.
8. Macro examination of low carbon weldments.

REFERENCES:
1. Laboratory Manual prepared by the Department of Metallurgical Engineering, 2015.
4. Impact Test and Torsion Test.
5. High cycle fatigue testing.

COMPUTER INTEGRATED MANUFACTURING LABORATORY
1. CAD-Modeling and assembly of components.
2. CAD-Creation of bill of materials, extraction of 2D views and sections.
3. Exercise on CAE analysis.
4. CAM-NC code generation for cylindrical components.
5. CAM-NC code generation for prismatic components.

REFERENCES:
1. Laboratory Manual prepared by the Department of Metallurgical Engineering, 2015.
2. Laboratory Manual prepared by the Department of Production Engineering, 2015.

15Y412 INDUSTRIAL VISIT CUM LECTURE

INDUSTRIAL LECTURE
Faculty will arrange for lectures by experts preferably from industries to highlight the recent technical and soft skill trends.

VISIT TO INDUSTRIES
Study tour/Industrial visit. Reports are to represent the observations of the students after the visits with their personal comments/suggestions.

SEMESTER V

15Y501 PHYSICAL METALLURGY

NUCLEATION AND GROWTH: Introduction-types of nucleation-free energy change during solidification, thermodynamics of homogeneous nucleation - critical nucleus size and critical free energy change-extension to heterogeneous nucleation-growth considerations-overall transformation rate-example problems. Planar, cellular, equiaxed and dendritic solidification. (6+5)


DIFFUSIONLESS TRANSFORMATIONS: Martensitic transformation-definition, characteristic features of martensitic transformation in steels, morphology of martensite-lath and acicular martensites, crystallography of martensitic transformation. Martensite in non-Ferrous systems-thermoelastic martensite and shape memory effect-examples and applications of shape memory alloys. (5+5)

STRENGTHENING MECHANISMS: Grain size strengthening-solid solution strengthening-factors affecting solid solution strengthening, martensitic strengthening, precipitation hardening-conditions for precipitation hardening-aging-formation of precipitates-coarsening of precipitates, mechanism of strengthening, dispersion strengthening-Introduction, factors for effective dispersion hardening-worked examples. (5+7)

FRACTURE: Types, brittle and ductile fracture, Griffith Theory-Orowan's modification, metallographic aspects of fracture, crack propagation, concept of fracture curve. numerical problems. (3)


Total L: 45 +T: 30=75

TEXT BOOKS:

REFERENCES:
15Y502 PRODUCTION OF STEEL

INTRODUCTION TO PRODUCTION OF STEEL: Early history of steel, evolution of steel making technology, steel making in India, present status of world steel industry, overview of modern steel making, general physiochemical fundamentals, general layout of integrated steel plants, raw materials for steel making, steel making refractories. Overview of Bessemer converters, open hearth practice: furnace and operation, Basic open hearth steel making practice. Electric arc furnace steel making. (11)

PHYSICAL CHEMISTRY OF PRIMARY STEEL MAKING: Reactions and heat effects, primary steel making slags, the reaction equilibria – reactions of carbon, phosphorus, oxidation of iron, carbon. (4)

BOF PLANT PRACTICE: shop layout and basic operation, LD converter - vessel design, construction, steel refining, inputs for BOF steel making, pre-treatment of hot metal prior to steel making, Metallurgical features - interaction of oxygen jet with the surroundings and the bath, change in temperature and composition during the blow, carbon - oxygen reaction, slag - metal - gas interaction, bath agitated processes, oxygen bottom blown processes. (12)

SECONDARY STEEL MAKING: ladle furnace, inert gas purging, deoxidation - thermodynamics and kinetics, decarburisation methods - AOD, VOD, degassing - thermodynamics and kinetics of degassing reactions, desulphurization - thermodynamics and kinetics, injection metallurgy, clean steel technology, cleanliness control, tundish metallurgy (7)

RECENT TRENDS: CONARC process, EOF process, recent trends in stainless steel making, manufacture of ultra - low carbon steel, alloy steel making, different slag practices in EAF steel making, direct steel making, modeling approaches to steel making. (4)


TEXT BOOKS:

REFERENCES:

Total L: 45

15Y503 METAL CASTING

INTRODUCTION: Foundry as a manufacturing centre and types of foundries. (1)

PATTERN: Types of patterns- Pattern materials- Pattern allowances- Pattern layout, pattern making. (3+3)

MOULDING AND CORE MAKING: Materials: Ingredients, properties, Moulding methods:- Green sand moulding, dry sand moulding, CO2 moulding, no bake moulding, shell moulding, investment casting, permanent moulding, die casting and centrifugal casting. Modern moulding methods like rheocasting, Thixo casting, Squeeze casting, magnetic moulding, Impulse moulding and high pressure moulding, Core and core making. (6+4)

TESTING OF FOUNDRY SAND: Strength permeability, moisture content, shatter Index, mouldability, compactability, loss on ignition, clay content and AFS grain fineness number. (3+3)

GATING AND RISERING: Gates and risers- their functions-types-design principles, design of gating and risering for steels and cast irons. Simple problems in riser and gating design. (5+6)

MELTING FURNACES: Construction and operation of crucible furnaces, cupola, rotary furnace-core type and coreless type Induction furnaces-arc furnace (direct and indirect arc furnaces), resistance furnaces. (6+2)

QUALITY CONTROL: Composition control and temperature control. simple problems in composition control for steels and cast irons. (2+3)

FETTLING AND INSPECTION OF CASTINGS: Knock out and finishing operations, checking the suitability and salvaging of castings. (2)
**PRINCIPLES OF MECHANISATION:** Sand reclamation, moulding machines, foundry layout, mechanization and automation. (2)

**COMPUTER AIDED METAL CASTINGS:** Use of softwares for foundry applications. (1+6)

**CASTING DESIGN:** Considerations, functional design, simplification of foundry practices, metallurgical design. (3+3)

**TEXT BOOKS:**

**REFERENCES:**

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**15Y504 POWDER METALLURGY 3003**

**PRODUCTION AND CONDITIONING:** Introduction, principles of powder metallurgy, classification of powder production methods, methods of metal, alloy, ceramic, intermetallic and nano crystalline powders production, Rapid Solidification Processing (RSP) techniques; Conditioning- powder annealing, powder mixing and blending – principle, mechanism, equipment used, preparation for further processing. (9)

**CHARACTERIZATION:** Need for characterization, individual powder characteristics-morphology, topography, structure, surface area; bulk powder characteristics - density, flow rate, size distributions, angle of repose, compressibility; powder handling, safety, pyrophrocity, toxicity, environmental issues. (9)

**SHAPING AND CONSOLIDATION:** Fundamentals of powder compaction, Pressureless shaping techniques – additives, processing steps, baking; Pressure compaction techniques: stages, densification mechanisms, Powder forming – rolling, forging, injection moulding, extrusion, explosive forming, powder coatings; Sintering – mechanisms, effect of process variables, sintering furnaces, types of sintering - solid state and liquid phase sintering, reactive, activated and supersolidus sintering; hot compaction techniques – principle, mechanisms; advanced compaction techniques: isostatic pressing (cold and hot), spark plasma sintering, additive manufacturing; defects in powder compacts – blow out, blisters, slumping, lamination crack, surface roughness. (9)

**TESTING AND FINISHING OPERATIONS:** Determination of strength of green compacts and sintered parts, hardness factor, stability factor, abrasion resistance, permeability of powder compacts, standards, additional treatment of sintered materials: to enhance the strength dimensional accuracy, wear and corrosion resistance and other properties. (9)

**DESIGN CONSIDERATIONS AND SPECIFIC P/M PRODUCTS:** Design aspects in powder metallurgy parts and dies, process variables, comparison with conventional manufacturing techniques; Production, properties and applications of self lubricating bearings, friction materials, tungsten filaments, cerments, cemented carbide tool tips, magnets, contact materials, porous materials. (9)

**TEXT BOOKS:**

**REFERENCES:**

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**15Y505 HEAT TREATMENT AND SURFACE ENGINEERING 3003**

**IRON-CARBON EQUILIBRIUM DIAGRAM:** Transformations on heating and cooling, Influence of alloying elements, TTT & CCT diagrams. General principles of heat treatment of steels. (3)

**HEAT TREATMENT EQUIPMENT:** Various heating media used for heat treatment, furnaces, temperature and atmosphere control. (8)

**HEAT TREATMENT PROCESSES:** Annealing-types, Normalising, hardening & tempering, Hollomon Jaffe parameter, retained austenite - measurement and methods of its elimination, hardenability studies, Jominy end quench test, austempering and martempering, thermo mechanical treatments. Precipitation hardening. (9)

**SURFACE MODIFICATION TECHNIQUES:** Induction hardening, flame hardening, electron beam hardening and laser beam hardening, carburizing, nitriding, carbo-nitriding, cyaniding, boriding, CVD and PVD processes, ion implantation. (9)

DEFECTS: Defects in heat treated parts, causes and remedy design for heat treatment.

SOFTWARES: Introduction to heat treatment softwares.

TEXT BOOKS:

REFERENCES:

15Y510 FOUNDRY AND POWDER METALLURGY LABORATORY

FOUNDRY LABORATORY
1. AFS Grain Fineness Number.
2. Moisture Content determination and Mouldability Test.
5. Permeability Test and Shatter Index Test.

POWDER METALLURGY LABORATORY
1. Powder production by electrolytic method, sol-gel method and milling.
2. Determination of individual particle characteristics using SEM and XRD reports.
3. Determination of bulk powder characteristics using Hall-flow meter and BET apparatus.
4. Cold compaction of powders and green compact strength measurement.
5. Sintering of green compacts and determination of density, hardness and microstructure of sintered parts.

REFERENCES:
1. Laboratory Manual prepared by the Department of Metallurgical Engineering, 2015.

15Y511 HEAT TREATMENT AND SURFACE ENGINEERING LABORATORY

HEAT TREATMENT LABORATORY
3. Jominy end quench hardenability evaluation test.
5. Solutionizing and Precipitation hardening of wrought aluminium alloys.

SURFACE ENGINEERING LABORATORY
1. Adhesive wear testing using Pin on Disc equipment.
2. Abrasive wear testing in dry and wet conditions.
3. Erosive wear testing using slurry erosive wear tester.
4. Surface modification treatment by chemical conversion.
5. Surface roughness and coating thickness measurement.

REFERENCES:

15Y512 TECHNICAL SEMINAR

TECHNICAL SEMINAR
Individual student will give seminar presentation on the topics allotted by faculty and details of his/her visits to the industries. Students are evaluated based on their technical content, preparation of power point presentations and communication skills.

Total P: 30
SEMESTER VI
15Y601 MATERIALS CHARACTERIZATION 3 0 0 3

OPTICAL MICROSCOPY: Macro - examination and micro - examination, optical microscope, metallographic specimen preparation, optic properties - magnification, numerical aperture, resolving power, depth of field, depth of focus, aberrations in lenses, bright field, dark field, phase-contrast, polarized light illuminations, interference microscopy, confocal microscopy, high temperature microscopy, low temperature microscopy, quantitative metallography, use of image analyzer system.

X-RAY DIFFRACTION: Characteristic X-ray spectrum, Bragg’s law, diffraction methods - Laue, rotating crystal and powder methods, X-ray diffractometer, X-ray filters and detectors, structure factor calculation for cubic systems, applications of X-ray diffraction studies - determination of crystal structure, lattice parameter, measurement of stress, wide - angle and small - angle x - ray diffraction , introduction to textures - stereographic projection and pole figures.

ELECTRON MICROSCOPY : Overview of electron optical instruments, electron - specimen interactions, signals used in electron optical instruments, vacuum pumps and gauges for electron microscopy Transmission Electron Microscopy (TEM) - principle, construction and working, imaging modes, selected area diffraction, specimen preparation techniques , applications of TEM, HRTEM, Scanning Electron Microscopy (SEM) - principle, construction and working, operating modes, applications, electron probe microanalyses - energy dispersive spectroscopy, wave length dispersive spectroscopy, qualitative and quantitative analysis, principle and application of electron backscatter diffraction (EBSD) technique

OTHER MICROSCOPIC TECHNIQUES: Scanning probe microscopy, scanning tunneling microscopy, atomic force microscopy, field ion microscopy, atom probe tomography - principles, instrumentation and applications. SURFACE ANALYSIS METHODS - principle, instrumentation, working and applications of Auger electron spectroscopy, X-ray photoelectron spectroscopy, secondary ion mass spectroscopy

SPECTROSCOPY TECHNIQUES: Optical emission spectroscopy, X-ray fluorescence spectroscopy, fourier transform infrared spectroscopy, raman spectroscopy - principle, construction, working and applications.

THERMAL METHODS: Principles and instrumentation of differential thermal analysis, differential scanning calorimetry and thermo-gravimetric analysis, results interpretation. Dilatometry.

Resistivity and magnetic measurements, anelasticity measurements.

Total L: 45

TEXT BOOKS:

REFERENCES:

15Y602 METAL FORMING 3 0 0 3


YIELD CRITERIA: Von Mises, Tresca yield criteria. comparison of yield criteria, Octahedral shear stress and shear strain-Forming load calculations.

FUNDAMENTALS OF METAL FORMING: Flow stress determination, temperature in metal forming, hot, cold and warm working, strain rate effects, metallurgical structures, friction and lubrication, deformation zone geometry, hydrostatic pressure, workability, residual stresses.

FORGING: Forging-types of presses and hammers, classification, open die forging-forging of disks-closed die forging-die design, calculation of forging loads-defects, causes and remedies, forging applications.

ROLLING: Types of rolling mills, hot and cold rolling, forces and geometrical relationship in rolling, analysis of rolling load gauge control, torque and power, rolling defects and applications.

EXTRUSION: Direct and indirect extrusion, equipments, container less extrusion port hole extrusion die, hydrostatic extrusion, defects and remedies. Analysis of extrusion, tube extrusion and production of seamless pipe and tube. Hydrostatic extrusion, defects causes and remedies, extrusion application.
DRAWING OF RODS, WIRES AND TUBES: Simple analysis of wire and tube drawing, residual stress in rod, wire and tubes application. (3)

SHEET METAL FORMING: Bending, wrap forming, spinning, stretch forming, deep drawing. Forming methods-rubber forming, shearing, blanking, bending, stretch forming, deep drawing, forming limit diagram, defects and application. (3)

HIGH VELOCITY FORMING: Comparison with conventional forming, types-explosive forming, electro hydraulic, magnetic pulse forming and pneumatic method, dynapak machine, applications. (3)

SUPERPLASTICITY: Definition, conditions, merits and demerits of superplasticity, superplastic forming and diffusion bonding. (2)

SEVERE PLASTIC DEFORMATION: Introduction, methods and applications. (2)

TEXT BOOKS:

REFERENCES:

15Y603 METAL JOINING 2203


TESTS, QUALIFICATIONS AND SAFETY: Overview of Weld Discontinuities, Weldability and Weldability testing, Mechanical tests. Welding procedure specifications (WPS), Sample WPSs for welding of carbon steels, low alloy steels and stainless steels, Procedure Qualification Records (PQR) and Welder Performance Qualifications (WPO), Safety in Welding, Personal Protective Equipment, Protection against Fumes and Gases, Safe Handling of Compressed Gases, Protection against Electromagnetic Radiation, Electrical Safety, Fire Prevention, Explosion Prevention. (6+6)

TEXT BOOKS:

REFERENCES:
1. AWS Welding hand books, 9th Edition, Volume1 to Volume 5, American Welding Society

15Y604 CERAMICS AND COMPOSITES 2203

CERAMICS:
INTRODUCTION TO CERAMIC STRUCTURES AND DEFECTS: Crystal Structures of Ceramics, Silicate Structures, Structures of Covalent ceramics, Ceramic crystal structures: Sodium chloride, cesium chloride, alumina, spinel and fluorite structures-examples, problems on crystal systems(Pauling's Rules), Structures of Glasses and properties . Simple problems involving Packing Fraction, critical radius ratio and density. Defects In Ceramics-Problems. (5+4)


FORMING OF CERAMICS: Brief description of slip and slurry casting, hot pressing, isostatic pressing, liquid phase sintering - applications.

COMPOSITES:


PARTICULATE COMPOSITES: Types-true particulate and dispersion strengthened composites-function and examples of dispersoids-particle size-interparticle spacing-simple problems-examples of particulate composites-brief idea of creep in dispersion strengthened composites.

LAMINAR COMPOSITES: Types - layered and honeycomb structures-examples manufacture and applications.

PRODUCTION TECHNIQUES: Metal matrix composites (MMCs), polymer matrix composites (PMCs) and ceramic matrix composites (CMCs)-Directionally Solidified Eutectics (DSE’s)-production Selection of composites for specific application (Qualitative methods)

TEXT BOOKS:

REFERENCES:

15Y610 MATERIALS CHARACTERIZATION LABORATORY

1. Determination of Phase fraction and grain size using image analyzer.
2. Composition analysis of steels and cast irons using spectrometer.
3. X-ray diffraction analysis of bulk metal and powder samples.
4. Determination of crystal structure, lattice parameter & crystallite size using XRD.
6. Fractography using SEM.
7. Composition analysis using SEM - Energy Dispersive Spectroscopy.
8. (a) Study of TEM images and SAD patterns.
   (b) Study on texture in metals.

REFERENCES:
1. Laboratory Manual prepared by the Department of Metallurgical Engineering, 2015.

15Y611 WELDING AND FORMING LABORATORY

WELDING LABORATORY
1. Welding practice on SMAW, GMAW and GTAW processes.
2. Practice for preparation of Welding procedure specification (WPS) and procedure qualification record (PQR).
3. Implant test to determine cold cracking susceptibility.
4. Varestraint test to determine hot cracking susceptibility.
5. Microstructural study of low carbon steel weldments.
7. Microstructural study of cast iron weldments.

FORMING LABORATORY
1. Determination of n and K values using tension test.
2. Determination of friction coefficient using ring compression test.
3. Cold working of low and high stacking fault energy materials.
4. Determination of plastic strain ratio in sheet metals.
15Y612 INNOVATION PRACTICES AND COMPREHENSIVE VIVA-VOCE

INNOVATION LABORATORY

PREPARING A PROJECT - BRIEF PROPOSAL INCLUDING:
- Problem Identification.
- A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree).
- List of possible solutions including alternatives and constraints.
- Cost benefit analysis.
- Time Line of activities.

PRESENTATION INCLUDING THE FOLLOWING:
- Implementation Phase (Hardware / Software / both).
- Testing & Validation of the developed system.
- Learning in the Project.

REPORT PREPARATION AND SUBMISSION:
- Consolidation of results obtained from experiments.
- Writing the introduction about the problem identified.
- Adding literature supports and discussing their understanding from the project.

COMPREHENSIVE VIVA-VOCE

At the end of the semester every student will be evaluated in a viva voce examination by a team of department faculty. The overall knowledge of the student in all the courses studied in the previous semesters will be evaluated.

SEMESTER VII

15Y701 KINETICS IN METALLURGICAL PROCESSES

REACTION KINETICS: Introduction to thermodynamics and kinetics, Types of processes, Kinetics at high temperatures, Kinetics of heterogeneous reactions, Kinetics of homogeneous reactions, variation of reaction rate with concentration and temperature, Theory of absolute reaction rate, Problems, Gas–solid and gas–liquid interfacial reactions. (9+6)

DIFFUSION AND ITS APPLICATIONS: Fick’s first law, Generalized diffusion equation, Steady state, Pseudo steady state, Unsteady state diffusion – One dimensional cases, Diffusion coefficient, Examples of Pseudo steady state diffusion and examples of unsteady state diffusion. (9+6)

MASS TRANSFER IN FLUIDS: Mass transfer under laminar flow, Mass transfer in turbulent flow, Turbulence and mixing, Boundary layer and mass transfer coefficient, convective mass transfer, Momentum – heat – mass transfer analogy, Application in studies in pyrometallurgical reactions, Mass transfer between two fluids, Surface renewal theory, Examples. (9+6)

POROUS SOLID REACTIONS WITH GASES: Diffusion of gases through porous solids, kinetics of reduction of oxides by gases, kinetics of gasification of carbon by carbon dioxide, kinetics and mechanism of reduction of iron oxides by carbon, Problems. (9+6)

PHASE TRANSFORMATIONS: Thermodynamics of transformations, Types and kinetics of phase transformation, Therally activated growth, Overall transformation kinetics, transformations by athermal growth, solidification kinetics for one component liquid. (9+6)

TEXT BOOK:

REFERENCES:

15Y702 NONDESTRUCTIVE TESTING

BASIC CONCEPTS: Concepts of Nondestructive testing-relative merits and limitations-NDT Versus mechanical testing- various physical characteristics of materials and their applications in NDT. Codes and standards for NDT. (3)
SURFACE TECHNIQUES: Visual Inspection: Direct and remote visual inspection-visual aides. Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, fluorescent penetrant test.

MAGNETIC AND ELECTROMAGNETIC TECHNIQUES: Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, dry technique and wet technique, demagnetization, advantages and limitations. Magnetic Flux Leakage Testing-principle, instrumentation and applications. Principle, instrumentation and applications of Eddy current testing and remote field testing.

ULTRASONIC TESTING: Types of ultrasonic waves, characteristics of ultrasonic waves, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, LASER ultrasonic testing, calibration: ASTM Test blocks, IIW-reference blocks.

RADIOGRAPHY TESTING: Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens. Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, radiographic equivalence. Penetrameters, safety in radiography.

SPECIAL TECHNIQUES: Principle, instrumentation and applications of Acoustic Emission Testing, Infra Red Thermography, pressure and leak testing, LASER shearography.

TEXT BOOKS:

REFERENCE:

15Y703 CORROSION ENGINEERING

INTRODUCTION: Definition, free energy criteria for uniform corrosion, corrosion rate expressions, electrochemical nature of corrosion reactions, electrode potential, Standard Hydrogen Electrode, Nernst equation, galvanic series, thermodynamic and kinetic considerations, Pourbaix diagram (Fe, Zn, Al)- uses and limitations.

FORMS OF CORROSION: Uniform corrosion, galvanic corrosion, pitting corrosion, crevice corrosion, inter granular corrosion, stress corrosion cracking, corrosion fatigue and environmentally influenced corrosion, mechanically assisted corrosion, soil and biological corrosion, hydrogen embrittlement.

CORROSIVE ENVIRONMENTS: Corrosion of metals by atmosphere, factors influencing atmospheric corrosion, acid corrosion, iso corrosion chart, alkaline environments, marine environments, account on corrosion susceptibility and resistance of common metals and materials.

KINETICS AND PASSIVITY: Exchange current density, types of polarizations, Tafel equation, mixed potential theory, effect of velocity, depolarizers, galvanic coupling, kinetics of passivation, kinetics of high temperature oxide corrosion. Pilling-bedworth ratio, passivity potentiostatic polarization curves.

CORROSION OF METALS AND ALLOYS: Corrosion susceptibility and resistance of high silicon cast iron, high purity stainless steel, Al and its structural alloys, corrosion free nickel and its alloys, corrosion damages on Pb alloy, corrosion advantages of polymers.

CORROSION TESTING: Objectives, classification, weight loss method, salt spray test, tests for intergranular corrosion, and stress corrosion cracking. Electrochemical polarization techniques, basics of electrical impedance spectroscopy, mention of NDT techniques, ASTM and other standards.

CORROSION PROTECTION: Types, protection by design, metal deposition techniques, organic coatings, polymer linings, paints, pigments and enamels, corrosion inhibitors, oxygen scavengers, soft water corrosion and LSI.

TEXT BOOKS:

REFERENCES:
15Y710 CORROSION AND NONDESTRUCTIVE TESTING LABORATORY

CORROSION LABORATORY
2. Electroplating of Cu and Ni.
3. Oxalic acid etch test for intergranular corrosion (Streicher test) ASTM A262-practice A & B.
4. Investigation of pitting corrosion in steel by indicator tests.
5. Evaluation of corrosion characteristics by potentiostatic/galvanostatic polarization techniques.
   a) Study of passivation characteristics of MS and SS steels in acid media.
   b) Determination of pitting potential of various steels.
   c) Potentiostatic investigation of the effectiveness of inhibitors.

NONDESTRUCTIVE TESTING LABORATORY
2. Dye penetrant inspection.
3. Magnetic Particle inspection.
4. Ultrasonic thickness measurement and flaw detection.
5. X-ray radiography (Film Interpretation).

REFERENCE:
1. Laboratory Manuals prepared by Department of Chemistry and Department of Metallurgical Engineering, 2015.

15Y720 PROJECT WORK I

- Identification of a real life problem in thrust areas.
- Developing a mathematical model for solving the above problem.
- Proposing different solutions for the problem based on literature survey.
- Future trends in providing alternate solutions.
- Experimental work done to validate.
- Characterization and testing of the samples.
- Discussion and finalisation of system requirements and specification.
- Consolidated report preparation of the above.

SEMESTER VIII

15Y820 PROJECT WORK II

REVIEW OF LITERATURES
- Detailed literature survey / review of patents.
- Identification of problems in the existing system.
- Need for current study and its feasibility.

PREPARATION OF PROJECT PROPOSAL AND CONTRIBUTION
- Formulation of methodology / time line to carry out the project work.
- Designing / planning / execution of experiments and file maintenance for progress monitoring.
- Testing and characterization of samples as per the requirement.
- Validation of the developed system/model.

REPORT PREPARATION/SUBMISSION AND PRESENTATION
- Introduction to the problem.
- Literature review and Identification of objectives.
- Experimental work and analysis / interpretation / consolidation of results.
- Summary of results.
- Presentation as an individual / team.

LANGUAGE ELECTIVES

15C080 COMMUNICATION SKILLS FOR ENGINEERS

COMMUNICATION CONCEPTS: Process of Communication – Inter and Intrapersonal Communication – Essentials for effectiveness


BUSINESS CORRESPONDENCE: Writing Emails, Preparing Resumes, Memos, Technical and Business Proposals (7)

TECHNICAL COMMUNICATION: Seminars, Process Description and Group Discussions, Use of Visual Aids. (10)

TEXTBOOK:
1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:

15C081 BASIC GERMAN

3 0 0 3

INTRODUCTION: German Culture, Tradition, Universities and Companies, Alphabets, Greetings, Countries, Nationalities and Languages. (3)

VOCABULARY: Context related to School, University, Professions, Family, Supermarket, Food and Beverages, Entertainment, Celebrations, Weather. (4)


GENERAL USAGE: Number system, Question words, Statements and Questions, Negation: nicht/kein. Imperatives Simple dialogues. Exercises. (5)

SYNTAX: Word order and sentence formation. Practice with mini-dialogues (4)

COMMUNICATION SKILLS: Conversing in formal and informal situations, Dialogue writing, Letter writing, Email writing, Invitations and Telephone conversations. (7)

PRACTICALS: Listening, Speaking, Reading and Writing. (6)

TEXT BOOK:
1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:

15C082 BASIC FRENCH

3 0 0 3

INTRODUCTION


TEXT BOOK:

REFERENCES:

15C083 BASIC JAPANESE

Orientation Session, Geographic & Socio, economic perspective to Japan, Japanese people and culture and Basic greetings and responses. (3)

Basic script, Method of writing hiragana and katakana, and Combination sounds and simple words. (3)


Demonstratives — Kore ||, — Sore ||, — Are ||, Demonstrative — Kono ||, — Sono ||, — Ano ||, Possessive noun particle — no || and Japanese apartments: Greeting your neighbour (2)

Place markers — Koko ||, — Soko ||, — Asoko ||, Direction markers — Kochira ||, — Sochira ||, — Achira || and Japanese department stores: Asking for and buying something (2)

Asking for and telling the time, Particle — ni (at) || for time, kara (from) ~ made (until), Particle — to (and) ||, Time periods: Days of the week, months, time of day, Verbs (Present / future and past tense) and Telephone enquiry: Asking for a phone no. And business hours (2)

Destination particle — e ||, Particles — de (mode of transportation) || and — to (with) and Japanese train station: Asking for Fare and track no. / types of trains (2)

Direct object particle — o ||, Particle — de (place of action) ||, Verbs (— masen ka ||, — mashou) || and — Ohanami || Cherry blossom viewing (2)

Particle — de (by means of) ||, Particle — ri (to) ||, Aaemasu (give) and Moraimasu (receive) and Visiting a Japanese house (2)

Adjectives (— i || and — na || type), Adjectives (Positive and negative useage), Particle — ga (however, but), — Dore which? || and Leaving a room, thanking some one for hospitality (2)

Likes and dislikes, Potential verbs (wakarimasu and dekimasu), — Kara ( ~ because) ||, Adverbs and Asking some one out over the phone (2)

Verbs denoting presence: — Imasu || and — arimasu ||, Particle — ni (in) ||, — Dare (who?) ||, Adverbs (— Chikaku ni —), Particle — dare mo (negative ~ no one) ||, Dare ka (anyone), dare ga (who) , Nani ka (anything) , nani ga (what) · ~ ya (and) · ~ nado (etc.) and Asking for directions (2)

Counters and Counting suffixes (2)

Introduction to Adjectives (na and ii type), Different usages of adjectives, Comparison, Likes and dislikes and Going to a trip (2)

Need and desire (ga hoshii), Wanting to … (Tabetu desu), Going for a certain purpose (mi — ni ikimasu) and Choosing from a menu (2)

Verb groups, I, II and III and Exercises to group verbs (2)
Please do (te kudasai), Present continuous tenses (te imasu), Shall I? (~ mashou ka) and Describing a natural phenomenon (It is raining) (2)

To grant permission (~te mo ii desu), Asking for permission (~ te mo ii desu ka) and Should not do (~ te wa ikemasen) (2)

Describing a continuing state and Describing a habitual action

Roleplays in Japanese

A demonstration on usage of chopsticks and Japanese tea party

Total L: 45

TEXT BOOK:

REFERENCE:

OPEN ELECTIVES

MATHEMATICS

15OH01 ADVANCED LINEAR ALGEBRA

VECTOR SPACES: General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space. (8)

INNER PRODUCT SPACES: Inner products, length and angle in inner product spaces, orthonormal bases, Gram- Schmidt process, orthogonal matrices, QR decomposition, best approximation- least square. (12)

LINEAR TRANSFORMATIONS: General linear transformation - kernel and range, matrices of linear transformations, change of basis, rank and nullity. (12)

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors, diagonalization, orthogonal diagonalization, quadratic forms, application of conic sections, quadratic surfaces - discrete dynamical systems. (13)

TEXT BOOKS:

REFERENCES:

15OH02 ALGEBRAIC STRUCTURES

GROUPS: Groups, subgroups, permutation groups, cosets and Lagranges’s theorem, normal subgroups and quotient groups, homomorphisms, isomorphisms, Cayley’s theorem. (15)

CODING THEORY: Group codes, the communication model and basic notions of error correction, generation of codes by using parity checks - error recovery in group codes. (5)

RINGS: Rings, sub-rings, properties of rings, integral domain, ideals and quotient rings, polynomial rings. (12)

FIELDS: Fields, roots of polynomials, construction of straightedge and compass. (13)

TEXT BOOKS:

REFERENCES:
**15OH03 CALCULUS OF VARIATIONS AND TENSOR ANALYSIS 3 0 0 3**

**CALCULUS OF VARIATIONS:** Basic concepts, method of variations in problems with fixed boundaries - variation and its properties, Euler equation. (12)

**FUNCTIONALS:** Functional involving first and higher order derivatives, functionals dependent on the functions of several independent variables, variational problems in parametric form – applications: vibrating string and membrane. (12)

**VECTOR ANALYSIS:** Basic concepts - gradient, directional derivative, divergence, curl, potential vector field, solenoidal vector field, Laplacian vector field. Green’s theorem, Stoke’s theorem and Gauss divergence theorem (statement and concepts only) (7)

**TENSOR ANALYSIS:** Concepts of a tensor field – Ostrogradski’s theorem, field of tensor of rank 2 - flux, divergence and derivative in a direction of tensor field. Integral theorems - theorems related to Ostrogradski’s theorem – applications: equation of motion of a liquid, Archimedes’ law. (14)

**TEXT BOOKS:**

**REFERENCES:**

**Total L: 45**

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**15OH04 GRAPH THEORY AND ITS APPLICATIONS 3 0 0 3**

**GRAPHS AND DIGRAPHS:** Common families of graphs, degree sequence, handshaking lemma, Havel-Hakimi theorem (statement and concepts). Walk, trail and path, connected graph, distance, radius and diameter. Graph isomorphism. Representations of graphs – adjacency and incidence lists – adjacency and incidence matrices. (10)

**SPANNING TREES:** Cayley’s formula: Prufer encoding-decoding algorithm. Matrix tree theorem (statement and problems only). Depth-first and breadth-first search algorithms, minimum spanning tree – Prim’s and Kruskal’s algorithms, shortest-path problem – Dijkstra’s algorithm. (9)

**EULERIAN AND HAMILTONIAN GRAPHS:** Eulerian graphs – Konigsberg bridge problem; Eulerian tour algorithm, characterization of Eulerian graph, optimal postman tour. Hamiltonian graphs - non Hamiltonian graphs, sufficient conditions for Hamiltonian graphs (only statements and concepts). Traveling salesman problem - nearest neighbour algorithm. (10)

**VERTEX-COLORING:** Vertex-coloring - chromatic number of a graph, vertex coloring algorithms – sequential vertex coloring, largest degree first algorithm, applications - scheduling problem, assignment of radio frequencies, fast register allocation for computer programming. (8)

**NETWORK FLOWS AND APPLICATIONS:** Flows and cuts in networks, solving the maximum - flow problem – characterization of maximum flow (Max-flow Min-cut Theorem), algorithms - outline for maximum flow, finding an augmenting path, FFEK – maximum flow and examples. (8)

**TEXTBOOKS:**

**REFERENCES:**
2. Narsingh Deo, Graph Theory with Applications to Engineering And Computer Science, Prentice Hall, New Delhi 2010.

**Total L: 45**

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**15OH05 MATHEMATICAL FINANCE 3 0 0 3**

**FINANCIAL MATHEMATICS:** Basic terminology, assumptions, derivative securities. (6)

**FORWARD AND FUTURES CONTRACTS:** Forward contract, forward price formula, value of a forward contract, futures contract, futures pricing. (12)
OPTION PRICING: Definition and preliminaries, behavior of option prices with respect to variables, pay-off curves, single period and multi period binomial lattice models for option pricing, pricing American options: a binomial lattice model, Black-Scholes formula. (12)

RISK FREE ASSETS: Time value of money, Simple interest, periodic compounding, streams of payments, continuous compounding. Money market: zero coupon bonds, coupon bonds, money market account. (9)

PORTFOLIO MANAGEMENT: Risk and return, expected return standard deviation as risk measure, two securities, risk and expected return on a portfolio. (6)

TEXT BOOKS:

REFERENCES:

15OH06 MATHEMATICAL MODELING AND SIMULATION 3 0 0 3

SYSTEM MODELS AND STUDIES: System- continuous and discrete system, system modeling, types of models - static physical, dynamic physical, static mathematical, dynamic mathematical models, principles in modeling, corporate model, environment, production, management segment, system analysis – corporate model, system design – message processing in a computer, system postulation – function of liver in the human body. (10)

SYSTEM SIMULATION: Technique of simulation, Monte Carlo Method – area under a curve, estimate of \( \pi \), comparison of simulation and analytical methods, distributed lag models – national economy, cobweb Models – supply and demand, exponential growth and decay models, logistic curves, simple system dynamics diagrams – population, multi-segment models – product sales, representation of time delays, feedback in socio-economic systems, host and parasite fluctuation. (12)

STATIC SIMULATION: Basics and components of the simulation study. simulation as an analysis tool, static simulations - model for profit on a sale promotion, a financial model for an office building, Random number generation – linear congruential generator, Blum-Blum generator, random variates generation - Bernoulli, uniform, triangular, normal, exponential random variates, a model for loss ratio for an insurance agency. (15)

DYNAMIC SYSTEMS SIMULATION: Financial models and @risk - a model for the price of a stock, dynamic financial models of stock prices, correlated asset values, fitting a distribution to date. (8)

TEXT BOOKS:

REFERENCES:
1. Brian Albright, Mathematical Modeling with Excel, JonesBartlett publishers, Singapore 2010

15OH07 NUMBER THEORY FOR COMPUTING 3 0 0 3

DIVISIBILITY AND DIOPHANTINE EQUATIONS: Theory of divisibility - Basic concepts and properties of divisibility, fundamental theorem of arithmetic, Euclid’s algorithm, continued fractions. Diophantine equations - Linear Diophantine equations (8)

ARITHMETICAL FUNCTIONS AND DISTRIBUTION OF PRIME NUMBERS: Multiplicative functions – functions \( \tau(n) \), \( \sigma(n) \) and \( s(n) \) - functions \( \varphi(n) \), and \( \mu(n) \). Prime distribution function \( \pi(x) \), prime number theorem, the \( n^{th} \) prime. (10)

THEORY OF CONGRUENCES: Basic concepts and properties of congruences — linear congruences – Fermat’s Little theorem, Euler’s theorem, Chinese remainder theorem, Legendre and Jacobi symbols, primitive roots. (7)

COMPUTATIONAL NUMBER THEORY: Primality testing: Fermat’s pseudoprimitivity test, strong pseudoprimitivity test, integer factorization : trial division and Fermat method, quadratic and number field sieves. (10)
APPLICATIONS TO CRYPTOGRAPHY: Random number generation - linear congruential generator, basics of cryptography, public key cryptography; discrete logarithm based cryptosystems - RSA public-key cryptosystem. (10)

TEXT BOOKS:

REFERENCES:

15OH08 OPERATIONS RESEARCH


GAME THEORY: Two person zero sum game, pure and mixed strategies, dominance principle, graphical solution, linear programming solution. (7)

NON-LINEAR PROGRAMMING: Constrained NLPP - Lagrange's multipliers method, convex NLPP- Kuhn-Tucker conditions, Quadratic programming-Wolfe's method. (8)

QUEUING THEORY: Elements of queueing model, relationship between exponential and Poisson queueing models, (M/M/1), (M/M/c), (M/M/c/N) and self-service model. (9)

REPLACEMENT THEORY: Replacement of items that deteriorate, replacement of items that fail, group replacement. (7)

TEXT BOOKS:

REFERENCES:

15OH09 RELIABILITY AND QUALITY CONTROL

STATISTICAL PROCESS CONTROL: Chance and assignable causes of quality variation, statistical basis of the control charts - basic principles, choice of control limits, analysis of patterns on control charts. (7)

CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES: $\bar{x}$ chart, R chart, $s^2$ chart, p chart, np chart, c chart, and u chart. (10)

ACCEPTANCE SAMPLING: Types of sampling plans, lot formation, single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables, chain sampling, continuous sampling, skip lot sampling plans. (10)

BASIC RELIABILITY MODELS: The failure distribution, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability. Constant failure rate model: Exponential reliability function. Time - dependent Weibull failure model, Time - dependent normal failure model. (10)

RELIABILITY OF SYSTEMS: Serial configuration, parallel configuration, combined series, parallel systems - k out of n: system -system structure function, minimal cuts, minimal paths, common mode failures, three state devices. (8)

TEXT BOOKS:

REFERENCES:
15OH10 SOFT COMPUTING  

FUZZY SETS: Basic concepts, membership functions, basic operations on fuzzy sets, properties of fuzzy sets, fuzzy relations. Propositional logic and predicate logic, fuzzy If-then rules, fuzzy mapping rules and fuzzy implication functions. (15)

NEURAL NETWORKS: Basic concepts, neural network architectures - single layer, multilayer, recurrent networks, learning methods, back propagation network. (15)

GENETIC ALGORITHMS: Basic concepts, encoding, fitness function, reproduction, inheritance operators, cross over, inversion and deletion, mutation operator, bit-wise operators, generational cycle. (10)

HYBRID SYSTEMS: Genetic algorithm based backpropagation networks, fuzzy backpropagation networks. (5)

TEXT BOOKS:

REFERENCES:

15OH11 STOCHASTIC MODELS  

STOCHASTIC PROCESSES: Definition, Markov chains: Classifications of states, absorption probability, period, Chapman-Kolmogorov equations, steady state probabilities. (12)

CONTINUOUS TIME MARKOV CHAINS: Definition, Chapman-Kolmogorov equations, Kolmogorov forward and backward equations, steady-state probabilities, birth - death processes. (9)

BROWNIAN MOTION: First passage time distribution, maximum of a Brownian motion, zeros of Brownian motion, Brownian motion with drift, Geometric Brownian motion, applications to finance. (10)

QUEUEING MODELS: Basic definitions, steady-state solution: M/M/1, M/M/1/K, M/M/c, M/M/c/c, M/M/c/k Models, queues with unlimited service. (14)

TEXT BOOKS:

REFERENCES:

PHYSICS  

15OH20 ANALYTICAL TECHNIQUES FOR MATERIALS CHARACTERIZATION  


ELECTRON AND ION SPECTROSCOPIC TECHNIQUES: Mass spectroscopy and X-ray emission spectroscopy (Principle and limitations) - Quadrupole mass spectrometer. Special surface techniques: X ray photoelectron spectroscopy (XPS or ESCA)- photoelectron process of spectrum- elemental analysis-Instrumentation and applications, Auger electron spectroscopy (AES)-Basic principles-Information in Auger spectra-methods for surface and thin film characterization, Secondary ion mass spectrometry(SIMS) – Dynamic and static SIMS-common modes of analysis, Rutherford Backscattering Spectrometry (RBS), Field Ion Microscopy (FIM). (10)
SURFACE STRUCTURE ANALYSIS: The need for surface study. Surface chemical composition: The extension of bulk techniques to surface studies - Unit meshes of five types of surface nets - diffraction from diperiodic structures. Surface methods using electron, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED).


SANNING PROBE MICROSCOPY: Instrumentation, Scanning Tunnelling Microscopy, Tunneling current, probe tips and working environments, operational modes, typical applications, atomic force microscopy, near field forces, force sensors, operational modes, applications, image artifacts

REFERENCES:

TEXTBOOKS:

15OH21 LASER TECHNOLOGY

LASER CHARACTERISTICS: Einstein coefficients - negative absorption, shape and width of spectral lines, spontaneous and stimulated emission. Laser resonators, types of resonators, stability diagram. Spatial and temporal coherence.


DYE LASERS: Liquid lasers, dye lasers, fabrication and excitation mechanisms. Concept of Q-switching and mode-locking, second harmonic generation, theory and experiment, materials for optical SHG.

INDUSTRIAL APPLICATIONS: Laser cutting, drilling & Piercing. Laser welding, operating characteristics and applications. medical. Spectroscopic (qualitative), laser Raman effect, stimulated Raman effect - Brillouin scattering.


REFERENCES:

15OH22 MICRO ELECTROMECHANICAL SYSTEMS


Surface micromachining – process in general, problems in surface micromachining. The LIGA process – description, materials for substrates and photoresists, electroplating, the SLIGA process. (9)

**MICROSYSTEM PACKAGING:** The three levels of microsystem packaging – die level, device level and system level. Essential packaging technologies – die preparation – surface bonding, wire bonding and sealing. Three dimensional packaging. Assembly of Microsystems – selection of packaging materials (9)

**TEXTBOOKS:**

**REFERENCES:**

**15OH23  NANOMATERIALS AND APPLICATIONS**

**INTRODUCTION AND CLASSIFICATION:** Atoms, Clusters and Nanomaterials-Classification of nanostructures, nanoscale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures, vacancies in nanocrystals, dislocations in nanocrystals – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties. (11)

**NANOMATERIALS SYNTHESIS AND PROCESSING:** Top-down processes: Ball Milling, lithography, machining process; Bottom-up processes: i) Wet chemical synthesis of nanomaterials- sol-gel, liquid solid reactions; ii) Gas phase synthesis of nanomaterials-Furnace, Flame assisted ultrasonic spray pyrolysis; iii) Gas condensation processing; iv) Chemical vapour deposition (CVD)-plasma-assisted deposition process, MBE and MOVPE-Preparation, safety and storage issues -STM and AFM Techniques. 

(11)

**SEMICONDUCTOR NANOSTRUCTURES:** Quantum confinement in semiconductor nanostructures - Quantum wells, quantum wires, quantum dots, superlattices, band offsets and electronic density of states – Fabrication techniques – Requirements, epitaxial growth, cleared edge overgrowth – Growth on vicinal substrates, strain-induced dots and wires, electrostatically induced dots and wires, quantum well width fluctuations, thermally annealed quantum wells and self-assembly techniques. (11)

**GROWTH AND PROPERTIES OF INORGANIC NANOMATERIALS:** Introduction and classification-Thermodynamics and kinetics of phase transformation: Thermodynamics, homogenous nucleation, heterogeneous nucleation, Growth-Microstructure: grain and matrix strain, particle size measurement, grain boundary structure-Microstructural stability: grain growth, zener pinning, solute drag – Power consolidation: compaction of nanopowders, sintering, role of impurities, porosity. (12)

**TEXTBOOKS:**

**REFERENCES:**

**15OH24 PHYSICS FOR SOLAR PV SYSTEMS AND SOLID-STATE LIGHTING SYSTEMS**


**TYPES OF SOLAR ENERGY CONVERTORS:** Thermal and PV systems. Advantages of PV systems. Semiconductor PV systems. IV characteristics. Other electrical parameters. Conditions for maximum power transfer. Conversion efficiency. (8)

**PHYSICS OF SEMICONDUCTOR JUNCTIONS:** Elemental and compound semiconductors. Band structure of silicon p-n junctions and III-V compound semiconductor junctions. light emission and absorption. Creation and recombination of electron hole pairs. Lattice mediated recombination conservation of momentum. Direct and indirect band gap semiconductors. Structure of Solar PV devices and solid state lighting devices- LEDS. Factors limiting efficiency of conversion of light energy to electrical energy (PV) and vice versa (Lighting) High power LEDS (10)

**SOLID STATE LIGHT SOURCES:** IV characteristics of LEDS. Manufacturing spread in Cut-in voltage. Combination of LED units for higher power-special considerations. Series parallel combinations. Minimising thermal losses. Reflector surfaces for multiple sources. Uniformity of illumination. (9)

TEXT BOOKS:

REFERENCES:

15OH25 SENSORS FOR ENGINEERING APPLICATIONS

3 0 0 3

STRAIN AND PRESSURE MEASUREMENT: Resistance strain guage, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic methods. Pressure gauges Aneroid capacitance pressure gauge, ionization gauge, Using the transducers for applications.

MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup devices, piezoelectric devices. Rotary encoders.

LIGHT RADIATION: Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state transducers liquid crystal devices.

HEAT AND TEMPERATURE: Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector.

ELECTRONIC SENSORS: Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.

TEXTBOOKS:

REFERENCES:

15OH26 THIN FILM TECHNOLOGY

3 0 0 3


DEPOSITION MONITORING AND CONTROL: Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only).


DIELECTRIC PROPERTIES: DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity.


REFERENCES:

15OH27 NONLINEAR SCIENCE AND ENGINEERING APPLICATIONS

INTRODUCTION: Dynamical systems: Linear and Nonlinear Forces, Mathematical Implications of Nonlinearity- Linear waves-ordinary differential equations (ODEs)- Partial differential equations (PDEs)- Methods to solve ODEs and PDEs- Numerical methods – Linear and Nonlinear oscillations- Nonlinear waves- Quantitative features


REFERENCES:

15OH28 NONLINEAR FIBER OPTICS


OPTICAL SOLITONS AND DISPERSION MANAGEMENT: Soliton Characteristics - Soliton Stability - Bright and Dark Solitons – Other kinds of Solitons - Effect of Birefringence in Solitons - Solitons based Fiber Optic Communication System (Qualitative treatment) – Demerits - Dispersion Managed Solitons (DMS).

APPLICATIONS OF SOLITONS: DMS for single channel transmission – WDM transmission - Fiber Gratings- Fiber Couplers –Fiber Interferometers – Pulse Compression – Soliton Switching – Soliton light wave systems. (9)

TEXT BOOKS:

REFERENCES:

15OH29 CHAOTRONICS

3 0 0 3


TEXT BOOKS:

REFERENCES:

CHEMISTRY

15OH37 ENERGY STORING DEVICES AND FUEL CELLS

3 0 0 3

BATTERIES: Types-battery characteristics - voltage, current, capacity, electricity storage density, power, discharge rate, cycle life, energy efficiency, shelf life. Primary cells: Fabrication, performance aspects, packing and rating of zinc-carbon, alkaline-manganese, silver oxide cells. Lithium primary batteries. (9)

SECONDARY BATTERIES: Fabrication, performance aspects and rating of lead acid and sealed lead acid battery, nickel-cadmium, Ni-metal-hydride lithium ion batteries, Rechargeable Zinc alkaline batteries and thermal batteries. (9)

ADVANCED BATTERIES: Metal / air, zinc-bromine, sodium-beta alumina and lithium / iron sulphide batteries. Photogalvanic cells. Battery specifications for cars, heart pacemakers, torpedo batteries, satellite batteries. (9)

FUEL CELLS: Classification, working principle, components, applications and environmental aspects of alkaline, phosphoric acid, solid oxide, molten carbonate, direct methanol and proton exchange membrane fuel cells. (9)

HYDROGEN AS FUEL: Sources of hydrogen - Hydrogen production – electrolysis, thermochemical methods, fossil fuel

**TEXT BOOKS:**

**REFERENCES:**

**15OH41 POLYMER SCIENCE AND TECHNOLOGY**

**INTRODUCTION TO POLYMERS:** Classification, functionality of monomers, degree of polymerization, molecular weight of polymers. - number average and weight average, molecular weight distribution. Polymerisation reactions – chain – free radical, ionic, co-ordination polymerisations – condensation polymerisation, ring opening polymerisation. Polymerisation techniques - Addition polymerisation - bulk, solution, suspension and emulsion techniques. Condensation polymerisation - melt, solution and interfacial techniques.


**ADDITIVES AND PROCESSING:** Degradation mechanisms – thermal, mechanical and photo degradations. Fillers, plasticizers, anti aging additives, UV stabilizers, colouring agents, flame retardants, blowing agents, crosslinking agents and lubricants. Polymer processing - compression, injection, extrusion & blow moulding, calendaring, film casting, foaming and thermoforming.


**TEXT BOOKS:**

**REFERENCES:**

BASICS OF ANIMATION: Key frame animation - sequence - motion control methods - morphing - warping.


VR PROGRAMMING: VRML defining and using nodes and shapes - VRML browsers - Java 3D – visual object definition by shape 3D instances - ColorCube class - Geometric utility classes.

TEXT BOOKS:

REFERENCES:

15OH47 DATA AND FILE STRUCTURES 3 0 0 3


ARRAYS: Representation of linear and multi dimensional arrays – Operations - Applications.

STACKS: Representation - Operations - implementation - Applications: Recursion handling; Evaluation of expressions.

QUEUES: Representation - Operations - sequential implementation – Circular Queues-Priority Queues - Deque – Applications: Job Scheduling systems.


FILES: File Types – Basic file operations – Heap Organization- Sequential file organization – Indexed Sequential File – Direct file organization


TEXT BOOKS:

REFERENCES:

15OH48 DATABASE MANAGEMENT SYSTEM 3 0 0 3


DATAMODELING: Introduction to Hierarchical data model - Network data model- ER model: Entities, Attributes, relationships – Weak and strong entity types – Design of Entity Relationship data models.

RELATIONAL MODEL: Relational data model basics - properties of Relations- Domains and Key concept – Enforcing data integrity constraints - Relational algebra operations.

RELATIONAL DATABASE ManipULATION: Introduction to Structured Query Language(SQL) – SQL commands for defining database – Manipulations on database – Basic data retrieval operations - aggregate function- order by/group by clause- sub queries-in-any-all-views in SQL.
**DATA BASE DESIGN THEORY:** Functional dependencies - Normal forms – Normalization: 1NF to 5NF- Domain Key Normal Form – losses join and dependency preserving decomposition.

**DATABASE TRANSACTION & SECURITY:** - Transaction processing – properties - Concurrency control mechanism - security and integrity threats - Defense Mechanism.

**REFERENCES:**

**TEXT BOOKS:**

**REFERENCES:**

**15OH49  HIGH PERFORMANCE COMPUTING  3 0 0 3**

**MODERN PROCESSORS:** Stored-program computer architecture – General-purpose cache-based microprocessor architecture – Memory hierarchies - Multicore processors - Multithread processors - Vector processors - Optimization techniques for serial code - Common sense optimizations - Simple measures - large impact - Role of compilers.

**PARALLEL COMPUTERS:** Parallel architectures -Trends in architectures, CMPs, GPUs, and Grids, Multiprocessors, Multicomputers, Multithreading, Pipelining- Data access optimization - Balance analysis and lightspeed estimates - Storage order - Taxonomy of parallel computing paradigms - Shared memory computers - Distributed memory computers - Hierarchical systems –Networks - Basics of parallelization- Parallelism – Parallel scalability.


**PRINCIPLES OF PARALLEL ALGORITHM DESIGN:** Preliminaries - Decomposition techniques - Characteristics of tasks and interactions - Mapping techniques for load balancing - Methods for containing interaction overheads - Parallel algorithm models – Basic communication operations.

**SORTING AND GRAPH ALGORITHMS:** Dense matrix Algorithm: Matrix-vector multiplication - Matrix- matrix multiplication- Issues in sorting on parallel computing - Sorting networks - Bubble sorts and its variants - Quick sort - Graph algorithms - Definition and representation - Prims algorithm - Dijkstra's algorithm - All pairs shortest path - Transitive closure – Connected components.

**TEXT BOOKS:**

**REFERENCES:**

**15OH50 MAINFRAME SYSTEMS  3 0 0 3**

**EVOLUTION OF MAINFRAME:** Overview of Computer Architecture -Classification of Computers -micro, mini, mainframes and super computer - key features – benefits.

**MAINFRAME SYSTEM:** Attributes of Mainframes - Reasons for opting Mainframes - Users of Mainframes - Difference between Centralized and Distributed computing - Batch processing - Online/Interactive transactions.

**MAINFRAME WORKLOADS:** Concept - strategy and benefits of the z/OS environment - Application enablement in z/OS - Overview of e-business support in z/OS - Connectivity to the z/OS environment - Security support provided by z/OS

**SYSTEM MANAGEMENT:** Scalability – availability - backup and recovery features in z/OS - z/OS system services - zSeries processor configurations.

**COBOL:** Introduction to COBOL - Program Structure - Procedure Division - Table Handling - File Handling.
CASE STUDY: z/VM – Linux – zVSE – zTPF.

TEXT BOOKS:

REFERENCE:

15OH51 MOBILE APPLICATION DEVELOPMENT


BUILDING MENUS: Menus and types – Creating menus through XML – Creating menus through coding – Using the ActionBar – Drop-down List Action Bar.


PUBLISHING ANDROID APPLICATIONS: Setting versioning information – Signing and publishing the applications – Distributing applications - Monetizing the applications.

TEXT BOOKS:

REFERENCE:

15OH52 MULTICORE PROGRAMMING

BASICS OF MULTICORE : Definition - hybrid architectures - The software developer’s viewpoint - single core - multicore – Types: multicore designs.

CHALLENGES : Sequential model – Concurrency – software development - Processor architecture - Operating systems role.


COMMUNICATION AND SYNCHRONIZATION: Thread strategy approaches - Decomposition and encapsulation of work - Approaches to application design - PADL and PBS.

UML : Modelling the structure of a system - UML and concurrent behavior - Basic testing types - Defect removal for parallel programs - Standard software engineering tests.

TEXT BOOK:
REFERENCES:

15OH53 OBJECT ORIENTED PROGRAMMING


FUNCTIONS IN C++: Function Prototyping - Call by Reference - Return by reference - Inline functions – Default - Const Arguments 

CLASSES AND OBJECTS: Data members - Member functions - Nesting of Member functions - Private member functions - Memory allocation for Objects - Static data members - Static Member Functions - Arrays of Objects - Objects as Function Arguments - Friend Functions - Returning Objects. 


POLYMORPHISM: Compile and Run Time Polymorphism – Operators Overloading - Unary and Binary Operators Overloading - Function Overloading. 

TEXT BOOKS:

REFERENCE:

15OH54 PROGRAMMING IN PYTHON

BASICS : Python - Variables - Executing Python from the Command Line - Editing Python Files - Python Reserved Words - Basic Syntax-Comments - Strings and Numeric Data Types - Simple Input and Output. 


ERROR HANDLING: Run Time Errors - Exception Model - Exception Hierarchy - Handling Multiple Exceptions - Data Streams - Access Modes Writing - Data to a File Reading - Data From a File - Additional File Methods - Using Pipes as Data Streams - Handling IO Exceptions - Working with Directories. 


TEXT BOOKS:

REFERENCES:
15OH55 RESPONSIVE WEB DESIGN


CASCADING STYLE SHEETS: Introduction - Levels of Style Sheets - Style Specification Formats – Style Classes - Properties and Property Values - Color - The span and div Tags. (7)

HTML5: Media Queries supporting different viewports – Syntax - Fluid Layouts- Fluid Images- Serving Different Images for different screen sizes - HTML 5 for responsive designs - semantic elements in HTML5 – Embedding Media in HTML5. (10)

CSS3: Selectors - Typography and Color Modes – Aesthetics with CSS3 – Text shadows - Box shadows - Background Gradients – patterns - Multiple Background Images Transitions - Transformations and Animations Forms with HTML5 and CSS3. (12)


TEXT BOOKS:

REFERENCE:

15OH56 SOCIAL WEB MINING


SOCIAL NETWORK DATA AND REPRESENTATION: Structural – composition-affiliation variables-modes-boundary specification and sampling- type of networks- measurement and collection - Review of graph theory- Data set- Tools-Pajek, Netdraw, UCIinet (10)

STRUCTURAL PROPERTIES OF SOCIAL NETWORKS: Notions of centrality - cohesiveness of subgroups - roles and positions - structural equivalence - equitable partitions. (12)

WEB CONTENT MINING: Boolean model - vector space model - web search – feature enrichment of short texts- - automatic topic extraction from web document – opinion search and opinion spam. (5)

WEB LINKAGE MINING: Hyperlinks- co-citation and bibliographic coupling- page rank and HITS algorithm – web community discovery – web graph measurement and modelling - using link information for webpage classification. (9)

TEXT BOOKS:

REFERENCES:

15OH57 SOFTWARE ENGINEERING

INTRODUCTION: Software Characteristics-Comparison with other Engineering disciplines-Software Crisis and Myths-Software life cycle models-Selection of process models for projects- Agile methods- Software Engineering paradigms. (8)

REQUIREMENTS GATHERING: Requirements gathering tasks – Requirements Engineering Process - Qualities of good requirements-Types of Requirements-Requirements elicitation- Requirements documentation- Analysis Documentation. (7)

PROGRAMMING STANDARDS: Structured programming coding standards-Maintainability of code. (5)

SOFTWARE TESTING FUNDAMENTALS – Black-Box and White-Box testing – Basis Path testing – Requirements phase testing - Design phase testing - Program phase testing - Desk debugging and program peer view test tools - Evaluating test results - Installation phase testing - Acceptance testing – Testing GUI – Testing Web Applications (8)


REFERENCES:

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH58 JAVA PROGRAMMING

INTRODUCTION: Features of Java – Java Development Environment – Java Virtual Machine- byte codes in java - Naming conventions and Data Types - Operators - Control Structures - Arrays and Strings. (3+3)

OBJECT ORIENTED CONCEPTS: Classes and objects- creation- access specifiers- constructors – Methods - static-Inheritance -Composition-polymorphism -nested classes–wrapper classes- Abstract classes. (5+6)

PACKAGES AND INTERFACES: - Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface. (3+3)

EXCEPTION HANDLING: Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested try statements - throw - throws - Java Built-in Exception - Creating user defined exceptions- Assertions. (4+4)

INPUT/OUTPUT: Files – Stream classes – Byte Streams – Character Streams – Serialization. (3+3)

MULTI THREADED PROGRAMMING: Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Synchronization - Interthread Communication. (4+4)

GUI PROGRAMMING- AWT-Swing classes - Components - Labels, Buttons, Check Boxes, combo box- Controls Menus – Frames Event delegation model -listener and listener methods –Event classes- Applets. (5+4)

DATABASE CONNECTIVITY: Architecture – connect RDBMS – Exploring java.sql package. (3+3)

Total L: 30+T: 30 = 60

TEXT BOOKS:

REFERENCES:

15OH59 GEOGRAPHIC INFORMATION SYSTEM


66
DATA MANAGEMENT AND OUTPUT: Import / Export — Data Management functions - Raster to Vector - Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs Desktop GIS - Distributed GIS. (5+5)


TEXT BOOKS:

REFERENCES:

15OH60 PROGRAMMING FOR ROBOTICS

2 2 0 3

BASICS OF ROBOTICS: History – Definition – Components – Building a robot – The Robot drive mechanism. (3+2)

ROBOT SIMULATION: Mathematical modeling of the robot - Robot kinematics – Concepts of ROS and Gazebo. (4+4)

DESIGNING CHEFBOT HARDWARE: Specifications - Block diagram - Working with Robotic Actuators and Wheel Encoders - Interfacing DC geared motor with Tiva C LaunchPad - Interfacing quadrature encoder with Tiva C Launchpad - Working with Dynamixel actuators. (5+5)

WORKING WITH ROBOTIC SENSORS: Working with ultrasonic distance sensors - Working with the IR proximity sensor - Working with Inertial Measurement Unit. (4+4)

PYTHON AND ROS: Introduction to OpenCV, OpenNi, and PCL - Programming Kinect with Python using ROS, OpenCV, and OpenNi - Working with Point Clouds using Kinect, ROS, OpenNi, and PCL. (6+6)


TEXT BOOKS:

REFERENCES:

HUMANITIES

15OH61 AN INTRODUCTION TO INDIAN CONSTITUTION

3 0 0 3

PREAMBLE AND ITS PHILOSOPHY: Introduction and Evolution of Indian Constitution preamble and its Philosophy. (4)

CENTRE-STATE RELATIONS: Directive Principles of State Policy, Fundamental Rights and Duties, Centre-State Relations. (6)

UNION GOVERNMENT: Powers, Functions and Position of President, Vice-President and Council of Ministers. (6)


JUDICIARY: The Union Judiciary - Supreme Court and High Court. (9)

PUBLIC SERVICES: All India Services, Central Civil Services, State Services, Local Services and Training of Civil Services. (5)

INTERNATIONAL POLITICS: Foreign Policy of India, Foreign Policy of USA, International Institutions like UNO, WTO, SAARC and Environmentalism. (5)

Total L: 45
15OH62 ENTREPRENEURSHIP

**INTRODUCTION TO ENTREPRENEURSHIP:** Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Seminar in R5 & R6. (5)

**CREATIVITY AND INNOVATION:** The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. (6)

**DEVELOPING AN EFFECTIVE BUSINESS MODEL:** The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. (5)

**APPRaisal OF PROJECTS:** Importance of Evaluating Various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques. (8)

**FORMS OF BUSINESS ORGANIZATION:** Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. (4)

**FINANCING THE NEW VENTURE:** Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Case studies in Evaluating Financial Performance. (8)

**THE MARKETING FUNCTION:** Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. (5)

**INTELLECTUAL PROPERTY PROTECTION AND ETHICS:** Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges. (4)

**TEXT BOOKS:**

**REFERENCES:**

15OH63 HUMAN RESOURCE MANAGEMENT

**NATURE AND SCOPE OF HUMAN RESOURCE MANAGEMENT:** Meaning and Definition of HRM, Objectives and Functions of HRM, Models of HRM, HRM in a changing Environment, Human Resource Management in the wake of Globalization. (6)

**TRAINING AND DEVELOPMENT:** Principles of Learning, Objectives, Types and Training Methods, Management Development: Its Meaning, Scope and Objectives. (6)

**WAGE AND SALARY ADMINISTRATION:** Principles and Techniques of Wage Fixation, Job Evaluation, Incentive Schemes. (6)

**PERFORMANCE APPRAISAL:** Process, Methods, Factors that distort appraisal, Case studies in Methods to Improve Performance, Role of Performance in the Performance Management Process, Performance Appraisal Vs. Potential Appraisal. (5)

**MORALE AND MOTIVATION OF EMPLOYEES:** Morale-importance of Moral and Motivation Methods of Employees, Empowerment – Factors Affecting Empowerment – Process – Benefits. (6)

**WORK ENVIRONMENT AND TERMS AND CONDITIONS OF EMPLOYMENT:** Fatigue – Safety – Accident Prevention Accident Records – Factories Act of 1948 and pollution legislations. (4)
INTERNATIONAL HRM: Model, Variables that outline difference between local and International HRM approaches to IHRM, Linking HRM to International Expansion Strategies. (6)

TRENDS IN HR: HR Outsourcing – HRIS – Management of Turnover and retention – Workforce Rationalization – Managing Separation and Rightsizing – Case studies in Trends in Employee Engagement and Retention. (6)

TEXT BOOKS:

REFERENCES:

15OH64 INDUSTRIAL PSYCHOLOGY

INDUSTRIAL PSYCHOLOGY: Introduction – Concept and Meaning – Characteristics and Scope. (3)


PERCEPTION AND ATTITUDE: Importance of Perception – Need for Shaping Perception – Workplace Attitude. (3)


INTERPERSONAL RELATIONSHIP: Managing emotions – Emotional Intelligence – Building Interpersonal Relations– Managing the Boss – Dealing with Subordinates. (6)

STRESS: Dynamics – Types – Signs – Causes – Workplace Stress and Coping Strategies. (4)

ORGANISATION CULTURE: Meaning – Types – Importance – Changing Organizational Culture and Matching People with Organizational Culture – Working Environment. (5)

INDUSTRIAL FATIGUE BOREDOM: Types of Industrial Fatigue – Symptoms – Causes and Remedies of Industrial Fatigue Industrial Boredom – Causes – Effective Ways to Reduce Boredom. (8)

JOB SATISFACTION: Job Satisfaction – Consequences – Tips for Reducing Job Dissatisfaction. (3)

PERFORMANCE MANAGEMENT: Concept – Objectives – Process – Methods of Performance Evaluation. (3)

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH65 PRINCIPLES OF MANAGEMENT

PRINCIPLES OF MANAGEMENT: Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. (5)

ENGINEERS AND ORGANIZATIONAL ENVIRONMENT: Social, Economic, Technological and Political. Social Responsibility of Engineers. (3)

MANAGEMENT CONCEPTS: MBO, Theory Z, Kaizen, Six Sigma, Quality Circles and TQM. (Case Study) (5)

BUSINESS PROCESS REENGINEERING: Need for BPR, Various phases of BPR, Production and Productivity in six sigma and TQM – Factors Influencing Productivity. (7)
ORGANISATIONAL BEHAVIOUR: Significance of OB, Role of Leadership, Personality and Motivation, Stress, Attitudes, Values and Perceptions at work. (7)

INDUSTRIAL AND BUSINESS ORGANIZATION: Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources. (6)

MANAGING INFORMATION: Why Information Matters – Strategic Importance of Information – Cost of Useful Information – Getting and Sharing Information. (6)


TEXT BOOKS:

REFERENCES:

15OH66 BUSINESS STATISTICS

STATISTICS INTRODUCTION: Definition, Types of Statistics, Types of Variables, Descriptive Measures, Basic Definition and Rules of Probability, Independence of Events. (9)

DESCRIPTIVES MEASURES: Measures of central tendency, dispersion, Probability Distributions. (6)

SAMPLING: Definition, Selection of Statistical tools, Sampling Methods, Sampling Frame determining the sample size. (6)

HYPOTHESIS TESTING: ANOVA- Independent sample t test, Paired t test. (4)

PARAMETRIC TEST: Concept, Chi square tests for Association and homogeneity, One sample t test. (4)

CORRELATION AND REGRESSION: Karl Pearson Correlation, Linear regression (Both manual and software applications), Components, Trend-Methord of least squares and moving averages, seasonal variation-Simple average method only. (10)

STATISTICAL DECISION THEORY: Uncertainty and risk and Decision tree analysis (6)

TEXT BOOKS:

REFERENCES:

15OH67 DISASTER MANAGEMENT

INTRODUCTION: Disaster – Definition, Factors and Significance, Difference between Hazard and Disaster, History of Disasters and Types, Disaster Aids. (4)

NATURAL DISASTERS: Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche.(5)

MAN MADE DISASTERS: Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, Nuclear disaster.- Forest Fire-Oil fire –accident in Mines. (8)

GEO SPATIAL TECHNOLOGY: Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping. (8)

RISK ASSESSMENT AND MITIGATION: Hazards, Risks and Vulnerabilities. -Disasters in and India ,Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters-Mitigation through capacity building -Preparation of Disaster Management Plans. (8)
DISASTER MANAGEMENT: Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism.

GLOBAL PERSPECTIVE: Study of Environmental Impacts Induced by Human Activity, Industrial Accidents, Outbreaks of Disease and Epidemics, War and Conflicts.

TEXT BOOKS:

REFERENCES:

15OH68 FINANCIAL AND MANAGERIAL ACCOUNTING

INTRODUCTION TO ACCOUNTING: Meaning, Definition and significance of Accounting, Accounting Principles, Concepts and Conventions, Classifications of Accounts.


BASIC FINANCIAL STATEMENTS: Meaning – Types of Financial Analysis Income Statement, common analysis, trend analysis, ratio analysis, corporate cash flow, DuPont Model.

COST ACCOUNTING: Accounting for overheads, Cost sheet, Marginal and Absorption costing, Break even analysis, Effect on profits, Activity Based Costing system.

ACCOUNTING FOR DECISION MAKING: CVP Analysis - Relevant Costs and Revenue for Decision Making, Pricing Decisions, Operational Decisions, Exploring New markets, Make or buy decisions.

ACCOUNTING FOR PLANNING AND CONTROLLING: Budgets, Budgetary Control - Variance Analysis - Cost and Financial Variances.

TEXT BOOKS:

REFERENCES:

15OH69 MARKETING MANAGEMENT


COMPETITOR ANALYSIS: Analysis of Consumer & Industrial Markets, Building Competitive Advantage.


TEXT BOOKS:

REFERENCES:

15OH70 DEFENCE PRACTICES AND DISASTER MANAGEMENT

HISTORY & ENVIRONMENTAL AWARENESS: NCC- Army, Navy, Air force; Aim and Motto; Ranks and Equivalent Ranks; Honors and Awards; Organization; Training – Nation Building; Civil affairs; Social Service & Needs; Environment & Ecology; Pollution; Rain Water Harvesting; Law and Order; Corruption.

WEAPONS: Introduction; Types of Weapons; Armed Forces Fighting Arms; Service Corps; Section Formation & Types; Firing Order; Judging Distance; Types of Land; Working Principle of Rifle, Tank, Missiles; Characteristics of supporting Rifle and its ammunitions; Field Craft and Battle Craft; Fighting - Role of Fighting Arms and map reading.

DISASTER MANAGEMENT: Definition; Types of Disaster; Elements of Disaster Management, Foundations of Disaster Studies- Review of Concepts, Organizations – NDMA, NIDM, NDMRT, NEC; Disaster Mitigation, Disaster Preparedness, Disaster Relief, Reconstruction Planning, Economic and Social Rehabilitation, Globalization and Disaster Studies, Social Science and Domains Approach.

LIFE SKILL MANAGEMENT: Introduction; Concept of Life Skills; Internalizing of Life Skills; Self awareness and Empathy; Knowing Myself; Self care; Empathizing with others; Creative Thinking & Critical Thinking; Practicing Decision making & Problem Solving; Effective Communication – Inter Personal Relationship; Coping with Emotions & Stress; Facilitation skills – Verbal & Non verbal; Training Methodologies.

HEALTH AND HYGIENE: Anatomy, Physiology, Microbiology – Personal and Mental Health ; Infectious and Contagious Diseases, its prevention; First Aid in common Medical Emergencies; Basics of Home Nursing; Treatment and care of Wounds and Fractures.

FIELD TRAINING: Foot Drill; Handling-Inspection Training; MapReading; Physical Proficiency Training; Introduction to Yoga.

TEXT BOOKS:

REFERENCES:

ENGLISH

15OH75 ENGLISH AND SOFT SKILLS FOR EMPLOYABILITY

SELF MANAGEMENT AND ATTITUDES: Self Concept, Stress management, Positive attitude, Influential Skills, Initiative, Empathy, Social Etiquette

COMMUNICATION STYLES : Presentation Skills, Interpersonal Communication Skills, Interviewing Skills, Verbal and Nonverbal (body language) skills, Active Listening, Professional Writing, Effective email writing

TEAM WORK: Inter team cooperation, Intra team cooperation, Diversity, Productivity, Goal Setting and action

LEADERSHIP SKILLS : Empowerment, Planning, Establishing Credibility, Vision & direction, Supervision, Mentoring, Decision- making, Creativity, Flexibility, Team problem solving

MANAGING TIME AND PRESSURES: Managing Change, Time management, Effective meetings
EFFECTIVE AND EXCELLENT CUSTOMER SERVICE: Communication with the customer- telephonic and online services, Managing conflicts or Challenging communication, Setting and resetting customer expectations, Building customer confidence, Growing customer relationship, Opportunity management, Developing team approach to meet customer needs.

TEXTBOOK: 1. Monograph prepared by the Faculty, Department of English, 2015.


15OH76 ENGLISH FOR COMPETITIVE EXAMINATIONS

READING COMPREHENSION: Focus on different levels of Comprehension- Literal, Inferential, Analytical and Critical reasoning
Identifying key words and signal words, decoding the building blocks of a passage, understanding jargons and double distractors
LISTENING COMPREHENSION: Micro skills and Macro skills of Listening
Identifying tone and purpose, eliminating distracters in objective type questions
SPEAKING: Sub skills of speaking- Genre-specific oral communication
VERBAL ABILITY: Word formation and expansion, Selecting and ordering words - Identifying and correlating synonyms and antonyms - Collocations
Sentence Completion
Verbal analogies
Spotting and correcting errors
WRITING: Mapping ideas, developing points and employing Variety in sentence types
Referencing, Ellipsis and substitution in writing – Skillful paragraphing (unity, coherence and cohesion)
Register and Tone in Critical, Analytical writing -Useful Language for describing graphs -Expressing strong opinions

TEXTBOOK: Monograph prepared by the Faculty, Department of English, 2015


15OH77 GERMAN LANGUAGE – INTERNATIONAL LEVEL A1.1

GUTEN TAG! - LEARNING: To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages; Vocabulary: related to the topic; Grammar: W – Questions, Verbs & Personal nouns I.

FREUNDE, KOLLEGEN UND ICH - LEARNING: To speak about hobbies, jobs, learn numbers from 20; Vocabulary: related to the topic; Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural.

IN DER STADT – LEARNING: To know places, buildings, question, know transport systems, understand international words; Vocabulary: related to the topic; Grammar: Definite & indefinite articles, Negotiation, Imperative with Sie.

GUTEN APPETIT! – LEARNING: To speak about food, shop, converse; Vocabulary: related to the topic; Grammar: Sentence position, Accusative, Accusative with verbs.
TAG FÜR TAG – LEARNING: To learn time related expressions, speak about family, ask excuse, fix appointments on phone; Vocabulary: related to the topic; Grammar: Preposition – am, im, um, von... bis, Possessive articles, Modalverbs. (7.5)

ZEIT MIT FREUNDEN – LEARNING: To speak about birthdays, understand & write invitations, converse in the restaurant; Vocabulary: related to the topic; Grammar: Accusative personal pronouns and prepositions. (7.5)

TEXTBOOK:

REFERENCES:

15OH78 GERMAN LANGUAGE – INTERNATIONAL LEVEL A1.2

KONTAKTE - LEARNING: To arrange appointments, understand and give instructions, understand and reply letters, find information in the text, identify the situations and understand the conversation; Vocabulary: related to the topic; Grammar: Dative Preposition & Article, Accusative Possessive Article. (7.5)

MEINE WOHNUNG - LEARNING: To understand the advertisements related to flats/houses, describe a flat, write a text about a flat; Vocabulary: related to the topic; Grammar: Adjective with sein (sehr/zu), wechselpreposition with Dat. (7.5)

ALLES ARBEIT? – LEARNING: To describe daily routine, talk about the past, speak about jobs, position, advertisements, prepare telephone conversation; Vocabulary: related to the topic; Grammar: Conjuctions, Perfect tense (regular & irregular verbs). (7.5)

KLEIDUNG UND MODE – LEARNING: To speak about clothes, understand the conversation at shopping centers, about Berlin. Vocabulary: related to the topic; Grammar: Perfect tense (trennbare & nicht trennbare verbs), personal pronomen & verbs with Dat. (7.5)

GESUND UND MUNTER – LEARNING: To make personal statements, name body parts, understand sport activities, conversation with the doctor, get & give tips to healthy life, e mail writing; Vocabulary: related to the topic; Grammar: Imperative, Modalverbs. (7.5)

AB IN DEN URLAUB! – LEARNING: To suggest a city tour, describe the directions, write a postcard, describe the weather, make a complaint in the hotel, speak about the trips, letter writing; Vocabulary: related to the topic; Grammar: Adverbs (time). (7.5)

TEXTBOOK:

REFERENCES:

APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCES

15OH81 DATA STRUCTURES AND ALGORITHMS

INTRODUCTION: Data structures - Abstract Data Types - Basic data structures –Arrays, stacks, queues and linked lists- Operations and applications (5)

ALGORITHMS: Introduction-Analysis of algorithms - Best, worst and average case time complexities - notations. (2)

SORTING AND SEARCHING: Insertion sort, selection sort, heap sort, count sort and radix sort - searching, Linear Search. (4)

BINARY SEARCH TREES: Searching – Insertion and deletion of elements-Balanced BST- AVL trees-Definition – searching – insertion and deletion of elements, AVL rotations (4)

MULTIWAY SEARCH TREES: Indexed Sequential Access – m-way search trees – B-Tree – searching, insertion and deletion. (3)

GRAPHS: Definition – representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Graph search methods (Breadth first and depth first traversals) . (2)

DIVIDE AND CONQUER: Method – Merge sort, Quick sort, Binary Search. (3)

GREEDY METHOD: Optimization problems – method – examples – Minimum cost spanning tree (Kruskal’s and prim’s algorithms), Knapsack problem (3)

TUTORIAL PRACTICE:
Implementation of the following problems:
1. Sparse and dense Matrix operations using arrays.
2. Linked Lists: Singly linked, Doubly linked and Circular lists.
4. Problems using Queues.
5. Binary trees
6. Problems related to sorting and searching algorithms.
7. Binary search tree
8. Minimum cost spanning tree

Total L: 30+T:30 = 60

TEXT BOOKS:

REFERENCES:

15OH82 OPTIMIZATION TECHNIQUES  2 2 0 3

LINEAR PROGRAMMING: Graphical method for two dimensional problems – Central problems of Linear Programming – Definitions – Simplex Algorithm – Phase I and Phase II of Simplex Method. (8)

CONVEX OPTIMIZATION: Convex sets and cones- Convex functions- Convex optimization problems- linear and quadratic programs; second-order cone and semi-definite programs; quasi-convex optimization problems; vector and multi-criterion optimization. (5)


INTEGER PROGRAMMING: Gomory cutting plane methods for all integer and mixed integer programming problems - Branch and Bound method (Land – Dolg and Dakin algorithms) – Zero-One Implicit enumeration Algorithm. (5)


TUTORIAL PRACTICE:
1. Solving inequalities using Simplex, Two-phase, Dual simplex methods, Revised simplex method.
2. Finding initial basic feasible solution using (i) North-West corner rule(ii) Matrix minimum and (iii) Vogel’s approximation method and also perform optimality test using MODI method.
4. Gomory’s cutting plane methods for all IPP and mixed IPP.
6. Critical path for the given PERT and CPM networks.

Total L: 30+T:30 = 60
15OH83 DATA SCIENCE

INTRODUCTION TO DATA SCIENCE: Data wrangling, cleaning, and sampling to get a suitable data set - Mathematics for understanding the data – Descriptive statistics: Visualizing Data - Central Tendency – Variability – Standardizing - Normal Distribution - Sampling Distributions.

DATA MANIPULATION AT SCALE: Parallel databases, parallel query processing, in-database analytics, MapReduce, Hadoop, Key-value stores and NoSQL; tradeoffs of SQL and NoSQL.


COMMUNICATING RESULTS: Visualization - descriptive statistics and visualization, privacy, ethics – multivariate visualization.

SPECIAL TOPICS: Graph Analytics: structure, traversals, analytics, PageRank, community detection, recursive queries, Semantic web.

CASE STUDY: Community Detection – Collaborative Network – Opinion mining – Co-citation network.

TUTORIAL PRACTICE:
1. Introduction to R and problems using R.
2. Collect datasets from Kaggle and Data Analysis.
3. Implementation of various predictive models.
4. Generate the results using Confidence levels.
5. Implementation of SVD.

Total L: 30 + T: 30 = 60

TEXT BOOKS:

REFERENCES:

15OH84 DATA VISUALIZATION


STATIC DATA VISUALIZATION – tools – working with various data formats.


MAPS – Introduction to building choropleth maps.

TREES – Network visualizations – Displaying behavior through network graphs.

BIG DATA VISUALIZATION – Visualizations to present and explore big data – visualization of text data and Protein sequences.

TUTORIAL PRACTICE:
**Note:** Explore software like R, Python, Google Vision, Google Refine, and ManyEyes; Data sets are available on Gapminder, Flowing data.

1. Visualization of static data.
2. Visualization of web data.
3. Visualization of sensor data.
4. Visualization of protein data.

**15OH85 ARTIFICIAL INTELLIGENCE**

**INTRODUCTION:** The foundations of AI - The History of AI - Intelligent agents - Agent based system. (2)


**KNOWLEDGE REPRESENTATION AND REASONING:** Knowledge representation - Logics - First order logic - Inference in first order logic - Higher order logic - Markov logic. (5)

**UNCERTAIN KNOWLEDGE AND PROBABILISTIC REASONING:** Uncertainty-Probabilistic reasoning - Semantics of Bayesian network - Exact inference in Bayesian network - Approximate inference in Bayesian network - Direct sampling methods, Inference by Markov chain simulation - Probabilistic reasoning over time - Hidden Markov Models. (5)

**DECISION-MAKING:** basics of utility theory, sequential decision problems - decision network - policy - Decision process in infinite horizon: Optimal policy, Value iteration - policy iteration - Partially observable decision process - Decisions in Multi agent system: elementary game theory. (6)

**LEARNING:** Learning from observation - Knowledge in learning - Supervised Learning - Unsupervised and Reinforcement learning. (2)

**ROBOTICS:** Introduction. (2)

**TUTORIAL PRACTICE:**
Lab assignments will be provided for all the topics given below.
2. Hill climbing and genetic algorithm
3. Constraint satisfaction techniques,
4. Simple games - minimax and expectimax
5. Logic based exercises.
6. Implementing HMM models
7. Applications of sequential decision making and multi agent decision making
8. Implementing decision network and dynamic networks.

**TEXT BOOKS:**

**REFERENCES:**
15OH86 PERVERSIVE COMPUTING

INTRODUCTION: Past, present, future; the pervasive computing market, m-Business, challenges and future of pervasive computing - modeling key for pervasive computing - pervasive system environment interaction - architectural design for pervasive system, application examples of pervasive computing: Healthcare, Tracking, emergency information systems, home networking appliances and entertainment.

DEVICE TECHNOLOGY FOR PERVERSIVE COMPUTING: Hardware, computing devices and their characteristics - pervasive information access devices-smart identification, smart card, labels, tokens - embedded controls, smart sensors, actuators - Human-machine interfaces, Biometrics - Various operating systems for pervasive devices.


APPROACHES FOR DEVELOPING PERVERSIVE APPLICATIONS: categorization - smart services for pervasive application development - developing mobile applications - presentation transcoding - device independent view component - heterogeneity of device platforms - Context Awareness and Mobility to build pervasive applications.

CONTEXT AWARE SYSTEMS: Modelling - mobility awareness - spatial awareness - temporal awareness - ICT system awareness - Intelligent Systems - basic concepts- autonomous systems - reflective and self-aware systems - self management and autonomic computing - complex systems.


TUTORIAL PRACTICE:
1. Create application with onClick, onKeyDown, onFocusChanged Event Handlers.
2. Create application with Toast Notifications.
3. Create application with Android's Advanced User Interface Functions.
5. Create application to Create, Modify and Query an SQLite Database.
6. Create application that Works with an Android Content Provider.
7. Create application with Android's Advanced User Interface Functions.
8. Create Location-Aware application that uses Proximity Alerts and Google Maps API.
9. Implementation of small packages to demonstrate all APIs.
Note: All implementations using android.

Total L: 30+T: 30=60

TEXT BOOKS:

REFERENCES:

15OH87 PARALLEL AND DISTRIBUTED COMPUTING


PARALLEL COMPUTER MEMORY ARCHITECTURES: Shared Memory - Distributed Memory - Hybrid Distributed-Shared Memory Multiprocessors: Communication and Memory issues - Message Passing Architectures - Vector Processing and SIMD Architectures.

PARALLEL PROGRAMMING MODELS: Overview - Shared Memory Model - Threads Model - Message Passing Model - Data Parallel Model - Other Models.

Parallel Programming - Performance Analysis and Tuning - Parallel Examples - Array Processing - Compiler Transformation techniques for high performance computing: - Transformations for parallel Machines.  

**PRAALGORITHMS & BSP: PRAM** model of computation- Work-Time formalism and Brent's Theorem; algorithm design techniques-parallel prefix, pointer jumping.  

**HIGH PERFORMANCE COMPUTING ARCHITECTURES** - Latency Hiding Architectures - Multithreading Architectures - Dataflow Architectures.  


TUTORIAL PRACTICE:  
1. Basic Master – Worker program and send messages.  
2. Write a program to find the summation of largest number in a very larger array of integers. (The contents of the array should be equally distributed to all processes).  
3. Write a parallel program in SPMD to calculate the PI value using integral approximation method.  
5. Select your own choice of very dense computational problem having divide and conquer method and implement it in parallel algorithm. And produce the performance chart with 2, 4, 6 and 8 nodes.  

**TEXT BOOKS:**  

**15OH88 CYBER SECURITY**  

**INTRODUCTION:** Security Goals, Attacks, Services and Mechanisms – Techniques – Understanding Threats.  


**PROGRAM SECURITY:** Secure Programs – Buffer overflows – Malware – viruses and other malicious code – Targeted Malicious code – Defense Mechanism.  


**WEB SECURITY:** Overview, various types of web application vulnerabilities. Reconnaissance, Authentication, Authorization (Fuzzing and Privilege Escalation), Session Management, Cross Site Scripting (XSS), Cross Site Request Forgery (CSRF), SQL Injection and Blind SQL Injection.  

**OS SECURITY:** Memory and Address protection – Access Control – File protection mechanisms – User authentication – models of security – Trusted OS design.  

**TUTORIAL PRACTICE:**  
1. Design of a Client server application for a basic cryptosystem.  
2. Detection of a Buffer overflow attack.  
3. Packet Sniffing using Wireshark Tool to perform the traffic analysis attack.  
4. Key distribution using RSA (KDC) – Key hacking.
6. Password authentication.
7. Transaction security using SQL Injection attacks.
8. Port scanning tools.
9. Performing attacks and testing with attack tools.
10. Security testing for Web applications.

**TEXT BOOKS:**

**REFERENCES:**

**15OH89 RANDOMIZED ALGORITHMS**

**INTRODUCTION:** Randomized algorithms, randomized quick sort, Karger's min-cut algorithm Las Vegas and Monte Carlo algorithms, computational models and complexity classes.

**MOMENT, DEVIATION AND TAIL INEQUALITIES:** Occupancy problem, Markov and Chebyshev inequalities- randomized selection- coupon collector's problem, the Chernoff bound- routing in a parallel computer- a wiring problem.

**PROBABILISTIC METHODS:** Overview of the method – maximum satisfiability - finding a large cut, Expander graphs.

**MARKOV CHAINS AND RANDOM WALKS:** Markov chains, Random walk on graphs - connectivity in undirected graphs – Expanders and rapidly mixing random walks.

**DATA STRUCTURES AND GRAPH ALGORITHMS:** Random Treaps, hashing – hash tables – perfect hashing, skip lists - Fast min-cut.

**ONLINE ALGORITHMS:** Paging problem-adversary models- paging against an oblivious adversary-relating the adversaries-the adaptive online adversary, k-server problem.

**PARALLEL AND DISTRIBUTED ALGORITHMS:** Sorting on a PRAM – Maximal Independent sets.

**DERANDOMIZATION:** The method of Conditional Probabilities – Derandomizing max-cut algorithm – Constructing pairwise independent values modulo a prime - Pairwise independent – large cut.

**TUTORIAL PRACTICE:**
1. Implementation of randomized quick sort and solve real time problems using it.
2. Find solution for s-t min-cut problem adapting min cut algorithm.
3. Implementation of randomized selection and problems related to it.
4. Implementation of treap data structure.
5. Problems using randomized hash table.
6. Implement the shortest path and fast min-cut algorithms.
7. Implementation of randomized primality testing.

**TEXT BOOKS:**

**REFERENCES:**

**15OH90 APPROXIMATION ALGORITHMS**

**INTRODUCTION:** Definition-performance ratios, vertex-cover problem.

**COMBINATORIAL ALGORITHMS:** lower bounding techniques and Metric TSP, multiway cut problem, the minimum k-cut problem, FPTAS for knapsack, greedy algorithms for Makespan-PTAS for minimum Makespan, Euclidean TSP.
LINEAR PROGRAMMING RELAXATIONS: LP-duality, min-max relations and LP-duality, rounding applied to vertex cover-simple rounding algorithm-randomized rounding, primal dual method and vertex cover. (5)

CUTS, METRICAL RELAXATIONS AND EMBEDDINGS: multiway cut, sum multi-commodity flow, some applications of multicut, rounding for Sparsest Cut via L1 Embeddings. (5)

SEMIDEFINITE PROGRAMMING: Strict quadratic programs and vector programs, properties of positive semidefinite matrices, the semidefinite programming problem, randomized rounding algorithm, improving the guarantee for MAX-2SAT. (5)

HARDNESS OF APPROXIMATION: reduction, graphs, and hardness factors, the PCP theorem, hardness of MAX-3SAT. (5)

TUTORIAL PRACTICE:
1. Implementation of vertex-cover algorithm.
2. Implementation of Greedy algorithm for makespan.
3. Problems related to Euclidean TSP.
4. Implementation of different algorithms with rounding.
5. Implementation of applications of multicut.

Total L: 30+T:30 = 60

TEXT BOOKS:

REFERENCES:

15OH91 NETWORK SCIENCE

INTRODUCTION: Basics of networks and graphs, random network model - degree distribution, evolution, small world property, six degrees of separation, Watts-Strogatz model, local clustering coefficient, random networks and network science. (6)

BARABÁSI-ALBERT MODEL: Growth and preferential attachment, Barabási-Albert model, degree dynamics, degree distribution, diameter and the clustering coefficient, preferential attachment - absence of growth, measure, non-linearity, the origins. (6)

SCALE-FREE PROPERTY: Power laws and scale-free networks, Hubs, Universality, Ultra-small property, role of the degree exponent, Generating networks with a pre-defined degree distribution. (6)

EVOLVING NETWORKS: Bianconi-Barabási model, measuring fitness, Bose-Einstein condensation, evolving networks. (6)

DEGREE CORRELATIONS: Assortativity and disassortativity, Measuring degree correlations, Structural cutoffs, Degree correlations in real networks, Generating correlated networks, impact of degree correlations. (7)

Total L: 30+T:30 = 60

TUTORIAL PRACTICE:
1. Implementation of Barabási-Albert model.
2. Implementation of Watts-Strogatz model.
3. Implementation of Bianconi-Barabási model.
4. Obtaining Degree correlations in real networks.
5. Case studies of the theory concepts on real networks.

TEXT BOOK:

REFERENCES:

15OH92 APPLIED STOCHASTIC PROCESSES

STOCHASTIC PROCESSES: Introduction – Classification of Stochastic Processes – Markov Chain (2)


RANDOM WALK MODELS: Symmetric random walk – Random walk on graphs – Gambler's Ruin model (3)


GENERAL QUEUEING MODELS: Single and Multi server Poisson Queues - Single Server Queue with Poisson input and general service– General input and exponential service Queueing models

TUTORIALS PRACTICE:
1. Case Study for Markov Chain: Passport Credit Card Company, Manufacturing, Telecommunication
2. Case Study for generalized Markov Process: Healthy Heart Coronary Care Facility
3. Modeling Network Protocols using Queueing Models
4. Performance Evaluation of Communication Systems
5. Page Ranking Algorithms

TEXT BOOKS:

REFERENCES:

15OH93 MODELLING AND SIMULATION

PRINCIPLE OF COMPUTER MODELLING AND SIMULATION: Monte Carlo simulation. Nature of computer modeling and simulation LIMITations of simulation, areas of application.

SYSTEM AND ENVIRONMENT: Components of a system - discrete and continuous systems. Models of a system - A variety of modelling approaches.


DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS: Input - Output analysis - variance reduction techniques - Antithetic variables - verification and validation of simulation models.


SIMULATION LANGUAGES - GPSS - SIMSCRIPT - SIMULA - SIMPLE_1, Programming for Discrete event systems in GPSS, SIMPLE_1 and C.

CASE STUDIES: Simulation of LAN - Manufacturing system - Hospital system.

TUTORIAL PRACTICE:
1. Implement variance reduction.
2. Implement event scheduling.
4. Simulate a manufacturing system.

TEXT BOOKS:

REFERENCES:
15OH94 GRAPH ALGORITHMS


MATCHING: Maximum and perfect matchings, augmenting path, Berge’s, König’s and Tutte’s theorems, Hall’s theorem, Hungarian algorithm, Edmond-Blossom algorithm. Kuhn-Munkre’s algorithm for optimal assignment.


VERTEX COLORING: Vertex coloring and bounds. Sequential coloring, largest degree first algorithms. Maximum clique and vertex coloring, Mycielski’s construction for large chromatic number.

GRAPH ISOMORPHISM: Isomorphism, subgraph isomorphism, László Babai’s quasi-polynomial time solution for graph isomorphism problem.

PLANAR GRAPHS: Euler’s formula, dual graph, Kuratowski’s theorem, 4-color problem, Wagner’s theorem. Planarity testing – Hopcroft-Tarjan algorithm.

TUTORIAL PRACTICE:
1. VLSI Physical design – maximum Independent set, maximum clique and minimum coloring for interval graphs, Steiner minimum tree in routing.
2. Isomorphism/subgraph isomorphism problem in Data mining - common subgraph pattern in networks, chemical compound within a chemical database.
3. Link verification using Eulerian trails.
4. Network flow – finding maximum flow in network
5. Register allocation, frequency assignment using vertex coloring
6. Traveling salesman problem using Hamiltonian concept
7. Planar graph embedding
8. Solving optimal assignment problem

Total L: 30+T: 30=60

TEXT BOOKS:

REFERENCES:

PROFESSIONAL ELECTIVES

15Y001 PHASE TRANSFORMATIONS

INTRODUCTION: Time Scale for phase transformations, types of transformations – spinoidal, nucleation & growth, theory of transformation kinetics, kinetics of solid state reactions occurring at elevated temperatures , solid, liquid and dissociation reactions ; nucleation and growth – nucleation kinetics, homogeneous nucleation, heterogeneous nucleation, growth and overall transformation kinetics, sintering & crystallization in ceramics and glass forming systems.

THERMODYNAMICS OF PHASE EQUILIBRIUM: Introduction, criteria of phase equilibrium, criterion of stability, phase equilibria in single component system and multi component system; binary solutions – constant pressure system, constant
temperature system, partially miscible system, immiscible system, liquid-liquid equilibrium diagrams, Thermodynamics and stability of phases, Classification of phase transformations, Order of transformation. (10)

SOLID STATE DIFFUSIVE TRANSFORMATION: Classification, Nucleation and growth - homogeneous and heterogeneous mechanism, Precipitate growth under different conditions, Age hardening, Spinodal decomposition, Precipitate coarsening, Transformation with short range diffusion, Moving boundary transformations recrystallization, grain growth, eutectoid transformation, discontinuous reactions (10)


NON-DIFFUSIVE TRANSFORMATION: Characteristics of transformation, Thermodynamics and kinetics, Nucleation and growth, Morphology, Crystallography, Nonferrous martensite. (4)

PHASE TRANSITION IN CERAMICS AND POLYMERS: Phase changes in ceramics, glass transition, glass tempering, glasses, Phase change in polymers and amorphous materials. (4)

TEXT BOOKS:

REFERENCES:

15Y002 MASS AND HEAT BALANCE IN METALLURGY

BASICS OF MASS AND HEAT BALANCE: Law of conservation of mass and energy, Processes and their classification, Types of mass and heat balance, Mass and heat balance procedure-Basis and Units, Flowcharts, Degrees of Freedom analysis, Forming the materials balance equations, Numerical examples. (9)

EXTRACTION PROCESSES: Characterization of natural reserves of metal, Metal extraction requirements, Energy requirements for metal production, Sources of energy, Environmental issues. Slurry - Concentration of solids in slurry, Exercise Problems. Thermochemistry and Stoichiometry- Basics of stoichiometry, Ideal gas law, Excess and limiting reactants, Oxidation and reduction reactions, Exercise Problems. (9)


REFERENCE BOOKS / MATERIALS:

15Y003 CREEP AND FATIGUE

DEFORMATION AND FAILURE MECHANISMS: an overview on creep of solids, Phenomenology of creep-Temperature-stress-strain rate relations, Microstructural considerations in metals, alloys, ceramics and Composites. (5)

CREEP MECHANISMS: Dislocation (power-law) creep, Diffusion (linear, viscous) creep Deformation mechanism maps, Cavitation failure at elevated temperatures by the nucleation, growth and interlinkage of cavities. (8)
CREEP CRACK GROWTH: Crack-tip fields C(t) integral, transition time, steady-state creep parameter C*, v-C (v-K) curves.

SUPERPLASTICITY: Super plasticity in metallic alloys, ceramics and nano phase materials, Commercial applications and considerations.

DESIGNING CREEP-RESISTANT ALLOYS: Use of creep and stress rupture data for life prediction, Designing creep-resistant alloys.

CYCLIC FATIGUE FAILURE INTRODUCTION: Cyclic stress and cyclic strain controlled fatigue, Fatigue life estimation of notched components.

CRACK INITIATION: Fatigue initiation mechanism, Mechanistic aspects, Crack initiation models, ΔK/√p approach, Effects of different variables on fatigue life.

CRACK PROPAGATION: Fatigue crack propagation, Crack propagation Paris law (da/dN = CΔKm), cyclic plastic-zone size, load-ratio effects, ΔKth thresholds, Damage-tolerant design life prediction, Models for crack growth striation growth, Stress-strain/strain-life analysis role of mean stress, notches, etc. Miner's rule, Multiaxial fatigue equivalent stress models, mixed-mode crack growth microscopic fatigue mechanism, crack growth behavior at low, intermediate and high oxidation kinetics.


FATIGUE IN CERAMICS: Cyclic fatigue of ceramics mechanisms.

OTHER FATIGUE MECHANISMS: Corrosion fatigue, thermal fatigue, creep-fatigue interaction.

15Y004 SPECIAL FORMING PROCESSES


Severe plastic deformation – ECAP – types – microstructural variations with processing route – cryo rolling – process types – stress strain distribution


15Y005 FRACTURE MECHANICS AND FAILURE ANALYSIS

EVALUATION: Fracture toughness of different materials- size effect, control. Fracture toughness-Ductile fracture, probabilistic aspects of fracture mechanics - microstructure. (8)

FAILURE ANALYSIS: Fundamental sources of failures- Deficiency in design, material process in stages of failure analysis. Classification and identification of various types of fracture. (5)

FATIGUE FAILURE: General concepts, fracture characteristics research by microscopy facts aspects, fatigue life, some case studies (5)

CORROSION FAILURE: Analysis of corrosion failure. Overview of various types of corrosion -Stress corrosion cracking, procedure for analysis of stress corrosion cracking. Effect of environment. Analysis of different alloys (Ni base, Ti base alloys) and their corrosion characteristics in different environment. (5)

WEAR FAILURE: Types of wear- role of friction wear analysis of wear failure. (2)


FAILURE OF FORGINGS, CASTINGS AND WELDMENTS: Causes of failure in forgings, deficiencies on design, improper processing. Failure of iron and steel castings. Effect of surface discontinuities, and stress concentration. Failure in weldments. (5)

FAILURE IN HEAT TREATMENT: Effect of quenching, design and composition quenched defects. Improper heat treatment causing failure some examples of faulty HT and failure. (2)

TEXT BOOKS:

REFERENCES:

15Y006 METALLURGY OF CASTINGS  3003

SOLIDIFICATION OF METALS AND ALLOYS: Solidification of castings. Effect of composition on freezing pattern. Effect of moulding materials and cooling rate on freezing pattern. Shrinkage of casting and directional solidification of castings. (5)


STEELS: Effect of normal elements and alloying elements in steels. Compositional aspects and properties of alloy steels. melting procedure and composition control for carbon steels, low alloy steels and stainless steels. Simple problems in composition control, slag-metal reactions-desulphurization-dephosphorisation, specifications for carbon steels, low alloy steels and stainless steels as per ASTM, BS, EN and standards, modification and grain refinement of steels. (11)

NON-FERROUS CAST ALLOYS: Specifications, composition, properties and phase diagrams of Copper, Aluminium, Magnesium, zinc and Nickel base alloys, melting Procedure and composition control for Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys, modification and grain refinement of Al alloys, problems in composition control, specifications IS, BS, EN and ASTM standards. (3)

GASES IN METALS: Various degassing techniques for metals and alloys. (2)

FLUIDITY: Definition, factors affecting and measurement of fluidity. (2)

RESIDUAL STRESSES: Origin, effects and stress relieving operations. (3)

DEFECTS IN CASTINGS: Identification, their causes and remedies. fish bone diagram, FMEA and WHY analysis. (3)

Total L: 45
15Y007 SPECIAL CASTING TECHNIQUES 3003

INTRODUCTION: Various special casting techniques relative merits and demerits. (2)

SHELL MOULDING: Shell moulding machines-Pattern equipment-sands, resins and other materials used for shell moulding - application of shell moulding-advantages of shell moulding over other methods of moulding. (9)

CENTRIFUGAL CASTING: Types of centrifugal casting processes - calculation of mould rotary speeds-techniques, equipments and production processes-Advantages and limitations of centrifugal casting methods. Replicast (full mould). (9)

INVESTMENT CASTING: Introduction-pattern and mould materials used-techniques and production of investment moulds-shaw process-full mould process-applications of investment casting process. (8)

ORGANIC PROCESSES: Cold box and Hot box. No bake processes. (3)

DIE CASTING: Permanent moulding, LPDC, PDC. Die casting machines-operation and details-Die materials-metals cast by die casting method-advantages of die casting. (8)

OTHER PROCESSES: Fluid sand process, V process, squeeze casting. Rheo, Thixo and Compo casting processes-Graphite moulding process, Magnetic Moulding, Impulse moulding, high pressure moulding, ceramic moulding, cement bonded moulding. (6)

TEXT BOOKS:

REFERENCES:

Total L: 45

15Y008 WELDING PROCEDURES AND QUALIFICATIONS 3003


CODE PRACTICE: Familiarization of codes: Section IIC, Section IX of ASME B&PV Code, API 1100 and AWS D1.1. Essential variables, non-essential variables, Supplementary essential variables.WPS formats, PQR formats and WPQ formats. Test requirements. Range qualified for varying values of essential values. Preparation of WPSs, PQRs and Range Qualified tables. Preparation of WPQs. (9)

WELDING PROCEDURE SPECIFICATIONS (WPS) – FERRITIC STEELS
Preparation of WPS’s for metal joining for Process variation: SMAW, GTAW, GTAW+SMAW, GMAW, SAW, SMAW+SAW, GTAW+SAW
Material variation: Carbon steels, Low Alloy Steels, Cr-Mo Steels
Post Weld Heat Treatment: No PWHT, Stress Relieving, Other Heat Treatments
Thickness: 2 to 200 mm.
Totally about 75 WPSs to be prepared under this category. (9)

WELDING PROCEDURE SPECIFICATIONS (WPS) – STAINLESS STEELS AND NON-FERROUS ALLOYS.
Preparation of WPS’s for metal joining for Process variation: SMAW, GTAW, GTAW+SMAW, GMAW, SAW, SMAW+SAW, GTAW+SAW
Material variation: Stainless steels, Nickel alloys, Copper alloys, Titanium alloys, Al Alloys.

87
Preparation of WPS’s for dissimilar metal joining for
Process variation: SMAW, GTAW-SMAW
Material combination: Carbon steels to low alloy steels, Stainless steels to carbon steels,
Copper alloys to carbon steels, Low alloy steels to another low alloy steel.

Preparation of WPS’s for weld overlaying of
Stainless steels over carbon steel, Nickel alloys over carbon steels
Cu alloys over carbon steels, Stellite over carbon steels / stainless steels
Totally about 75 WPSs to be prepared under this category.

PQRS AND WPQS
Preparation of PQRS for selected WPSs. Totally about 25 PQRS to be prepared for WPSs for butt welding, fillet welding and weld overlay. Preparation of WPQS for selected WPSs for various processes, material thicknesses, positions for butt welding, fillet welding and weld overlay.

TEXT BOOK:

REFERENCES:
1. ASME B & PV Code Section IX and Section IIC
2. API Code 1100
3. AWS D1.1 Code

15Y009 ADVANCED SURFACE ENGINEERING

TRIBOLOGY: Introduction to Friction, wear and erosion. Wear and lubrication, types of wear and erosion-Testing methods. (6)

MATERIALS FOR WEAR: Development of materials, material and processing combination to resist wear. (3)

PLATING PROCESSES: Electro and Electroless coatings (Ni) (Cr, Ni, Rd), hydrogen embrittlement. (6)

CONVERSION COATINGS: Chemical conversion, anodizing, micro arc oxidations. (3)

DIFFUSION PROCESSES: Aluminising, chromising, siliconising, sursulf, plasma nitriding and carburising. (3)

THIN FILM COATINGS: CVD and PVD coatings. (3)

HIGH ENERGY SURFACE MODIFICATION: Electron beam hardening, glazing, laser beam glazing and ion implantation. (6)

THERMAL SPRAY PROCESSES: Wire arc, plasma spray, D-gun, HVOF and cold spray process. (9)

HARD FACING PROCESSES: Plasma transferred arc deposition and flame spray deposition. (3)

SPECIAL SURFACING PROCESS: Electro spark coatings, wear tiles, plates and sleeves. (3)

TEXT BOOKS:

REFERENCES:

15Y010 SELECTION OF MATERIALS

MATERIALS AND PROPERTIES: Classes of engineering materials - Evolution of engineering materials-Definition of materials properties- Design strengths and weakness of various materials and their processes, Displaying material properties using materials selection charts- Forces for change in materials selection and design, Materials and the environment. (8)


MATERIALS SELECTION: Materials selection strategy and methods: Screening and Ranking- weighted ranking, performance
indices- materials selection charts, deriving property limits and material indices, structural indices, Multiple constraints and multiple objectives, Role of local parameters, Post script on materials selection. (8)

PROCESS AND ITS SELECTION: Process classification, Systematic process selection, process selection diagrams, process cost, energy consumption for production, material and shape link with process, availability and environmental consideration, Screening, Ranking – Process cost and Supporting information. (8)

CASE STUDIES : Introduction, materials for tie rods, columns, beams, oars, flywheels, springs, safe pressure vessels, heat exchangers, disk brake caliber, connecting rods, automobile body, nuclear reactors, boat hulls, etc. (13)

TEXT BOOKS:

REFERENCES:

15Y011 METALLURGY OF TOOL MATERIALS


MANUFACTURE OF TOOL STEELS: Production techniques-problems in melting, refining methods like VAR, ESR, EBM. Powder Metallurgy route and forming of tool steels. (7)

METALLIC TOOL MATERIALS: Manufacturing, properties and applications of high carbon tool steels, high alloyed tool steels and maraging steels. (6)

HEAT TREATMENT OF TOOL STEELS: Selection of quenching and tempering. Parameters-precautions-effect or retained austenitic-Multiple tempering, sub zero treatment and cyano treatment surface treatment- defects in tool steels- Over heated and burnt structure- decarburization. (8)


ADVANCED TRENDS IN SURFACE TREATMENT AND COATING FOR TOOL STEELS: Sulphidising of tool steels-TiN coating by PVD coating of carbide tools-mono and multilayer coatings TiC, TiN, Alumina & DCC by PVD and CVD processing, Plasma Nitriding, Ti and face coating. Surfacing. (9)

TEXT BOOKS:

REFERENCES:

15Y012 METALLURGY OF STEELS AND NON FERROUS ALLOYS

MARAGING STEELS: Manufacture, structure, property, heat treatment and applications of maraging steels. (4)

HSLA AND MICROALLOYED STEELS: Melting, heat treatment of HSLA steels; the effect of microalloy additions; thermo mechanical processing; different strengthening mechanism; significance of grain refinement; applications. (5)

STAINLESS STEELS: Types of stainless steels; ferritic, martensitic, austenitic, precipitation hardening, duplex, heat resisting, their properties, structure and applications; nickel free stainless steels high nitrogen stainless steels-their manufacture, structure, properties and applications. Powder Metallurgy of stainless steels and high nitrogen stainless steels, Sensitization and the remedial measures for austenitic stainless steel. Steels for auto body sheets-recent developments. (9)

SILICON STEELS: Structure, properties and applications. (1)
HIGH MANGANESE STEELS: Structure, properties and applications.

STEELS FOR HIGH TEMPERATURE APPLICATIONS: Low alloy steels, creep resistance steels

NON-FERROUS ALLOYS: General overview

COPPER AND COPPER ALLOYS: Properties and applications of metallic copper; influence of alloying elements-brasses-Cu-Zn alloys.

BRONZES: Tin bronze, phosphor bronze, Al bronze, Be bronze; compositions, properties and uses; copper-nickel alloys; properties and applications; strengthening of copper alloys by mechanical alloying, OFHC copper and its applications; forging, extrusion, heat treatment of alloys of copper; welding, brazing and soldering.

ALUMINIUM: Properties and uses of metallic aluminium; classification of aluminium alloys, wrought and cast alloys; heat treatable and non-heat treatable alloys; physical metallurgy of Al alloys, strengthening mechanisms in non-heat treatable alloys and heat treatable alloys; effect of alloying elements and impurities; mechanical processing and properties; Al-Li alloys, super plastic forming of Al alloys; powder metallurgy and rapid solidification of Al alloys. Aerospace applications.

MAGNESIUM: Properties and applications of magnesium and magnesium alloys; casting processes; influence of alloying elements-Al, Mn, Zn, Si, Ag, Th, Zr; classification-cast alloys and wrought alloys-thermo mechanical processing; heat treatment; protective treatments.

TITANIUM: Introduction; Ti and its alloying capability, alloying elements – alpha stabilizers; beta stabilizers; alpha titanium alloys; beta titanium alloys; alpha-beta titanium alloys; structure-property correlations; melting, casting, welding of titanium alloys; thermo mechanical processing; near-net shape processing; super plastic forming and diffusion bonding of titanium alloys. Applications of commercial titanium and titanium alloys; powder metallurgy of titanium alloys; titanium aluminides.

NICKEL: Metallurgy of nickel base alloys-alloying elements and their effects-nickel base super alloys composition; melting, forging; solid solution alloys, precipitation hardenable alloys, ODS alloys heat treatment, properties and applications; nickel-iron base alloys, heat treatment, properties and applications; Ni base soft magnetic alloys, Ni base heating element alloys; Ni base controlled expansion alloys; nickel base, DS alloys and single crystals.

REFERENCES:

TEXT BOOKS:

15Y013 STRUCTURE AND PROPERTIES OF POLYMERS

INTRODUCTION TO POLYMERS: Polymers-thermoplastics and thermosets-examples, structure, properties and applications of important engineering plastics (polyethylene, polypropylene, polystyrene, poly vinyl chloride, poly tetrafluoroethylene, poly oxyethylene, poly phenyleneoxide, poly ether ketone, poly urethane and poly methyl methacrylate. Elastomers: engineering rubber, natural rubber, styrene-butadiene rubber, nitrile rubbers, silicones-structure, properties and applications.

BONDING IN POLYMERS: Basic concepts of macromolecules - Monomers- Functionality - Classification and nomenclature of polymers. Step growth polymerization - Chain length and degree of Polymerisation-simple problems.

STRUCTURE AND PROPERTY RELATIONSHIP: Structure and properties of polymers- Linear, branched, crosslinked, and network polymers-Homochain and hetero atomic chain polymers- Copolymers and its types- Linear and cyclic arrangement - Polymer properties estimation techniques, topological techniques- Volumetric properties - molar volume, density, Van der Waals volume - Coefficient of linear thermal expansion and volumetric thermal expansion - Pressure volume temperature. (PVT) relationship.

BEHAVIOUR OF POLYMERS: Transition temperature in polymers, glass transition (Tg), melt transition (Tm), relationship between Tg and Tm- viscoelasticity; concept of creep and stress relaxation in polymers. Introduction to yielding and fracture of polymers - crazing of polymers. Brief idea of fracture mechanics - problems.

PROPERTIES OF POLYMERIC MATERIALS: Mechanical properties - Stress-strain curve for different classes of polymers - Effect of polymer structure on modulus of elasticity, tensile strength, flexural strength, impact strength, yield strength, fracture toughness- Optical properties -Effect of polymer structure on optical properties -clarity, transparency, haze, transmittance, absorbance, reflectance, and gloss- Chemical Properties - Cohesive energy, cohesive energy density, solubility parameter, determination of solubility parameter of polymers - Prediction of solubility parameter.

SELECTION CRITERIA FOR POLYMERS: Polymers for specific application-General, engineering, aerospace, biomedical sports and aggressive environments.

Total L: 45

Total L: 45
TEXT BOOK:

REFERENCES:

15Y014 NANO MATERIALS TECHNOLOGY

3 0 0 3

STRUCTURE AND PROPERTIES OF NANOMATERIALS: Definition-classification of nano materials-structure of nano materials-comparison with conventional materials; basic concepts - relationship between grain size and properties - physical properties- color, conductivity, Thomson effect, optical properties - surface plasmon effect, chemical properties - reactivity, mechanical properties - strength, hardness of nano sized particles. (9)

SYNTHESIS OF NANOMATERIALS: Basic approaches-top down and bottom up approaches- various methods for producing nano materials – zero, one, two and three dimensional materials, solid State (mechanical) methods: Mechanical Alloying (MA) and Mechanical Milling (MM) - Severe Plastic Deformation (SPD); chemical synthesis: sol-gel method, combustion synthesis and co-precipitation techniques, Chemical Vapor Deposition (CVD); physical methods: Electrolysis, microwave and plasma synthesis, condensation, Physical Vapor Deposition (PVD)-thermal spray processing. (9)


CONSOLIDATION AND SPECIFIC NANOMATERIALS: Problems in consolidation, use of glove box, FAST technique – process variables, examples; High pressure shock consolidation-explosive forming, nano coatings-dip, plasma spray; assembly of nano structures, processing of semi conducting, metallic and magnetic nano particles, fullerenes, nano tubes, Quantum dots, GaN wires, nano TiO₂, nano ZnO – properties, applications and advantages. (9)

APPLICATIONS: Structural – Continuous coatings for corrosive environments, electronic and optical applications-thin and multi layer capacitors, sensors and quantum dots, energy storage devices - inorganic membranes for gas separation, fuel cells, catalysts, solar cells, efficient micro batteries, biomedical- valves for artificial hearts, internal drug release devices. (9)

Total L: 45

TEXT BOOKS:

REFERENCES:

15Y015 COMPUTATIONS IN METALLURGICAL ENGINEERING

2 2 0 3


FUNDAMENTALS OF DISCRETIZATION TECHNIQUE: Fundamentals of finite difference, explicit, implicit schemes, stability criteria, tri-diagonal matrix algorithm (TDMA), finite volume method - fundamentals, convergence, numerical schemes in FVM, pressure velocity coupling, Fundamental of Finite Element methods. (9+3)

APPLICATION OF DISCRETIZATION TECHNIQUES IN METALLURGY: Handling of non-linear source terms in metallurgical problems, dealing with space, temperature and/or composition dependent thermo-physical properties. Discretizing convective heat and mass transfer problems - upwind, hybrid schemes. Applications to metallurgical problems like heat treatment, reheating furnace, carburizing, precipitation and dissolution kinetics, quenching, liquid degassing, casting and welding. (9+6)
**COMPUTATIONAL PHASE DIAGRAM:** Introduction to CALPHAD approach, construction of binary and ternary phase diagrams using CALPHAD approach. (9+6)

**TUTORIAL COMPONENT**
7. Solving load transfer problems using finite element method.
8. Construction of binary phase diagrams using THERMOCALC software.
9. Introduction and selected case studies related to metallurgy with ANSYS FLUENT and Simulia Abaqus software packages.

**TEXT BOOKS:**

**REFERENCES:**

**15Y016 ADDITIVE MANUFACTURING**

**INTRODUCTION:** Overview, history, classification, Rapid Prototyping (RP) process chain - fundamental automated processes, process chain, additive manufacturing technology in product development, materials for additive manufacturing technology, tooling, advantages, disadvantages and applications. (5)

**CAD & REVERSE ENGINEERING:** Basic concepts, digitization techniques, model reconstruction, data processing for additive manufacturing technology - CAD model preparation, part orientation and support generation, model slicing, tool path generation, softwares for additive manufacturing technology - MIMICS, MAGICS. (8)

**LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS:** Classification - liquid based system - Stereolithography Apparatus (SLA) - Principle, process, advantages and applications, Solid Ground Curing (SGC), solid based system - Fused Deposition Modeling (FDM) - Principle, Process, advantages and applications, Laminated Object Manufacturing (LOM), Case studies in SLA, SGC, FDM, LOM systems. (12)

**POWDER BASED ADDITIVE MANUFACTURING SYSTEMS:** Selective Laser Sintering (SLS) - principles, process, advantages and applications, three dimensional printing - principle, process, advantages and applications, Laser Engineered Net Shaping (LENS), electron beam melting, overview of direct rapid tooling and indirect rapid tooling (15)

**RP APPLICATIONS:** Applications - material relationship, application in design, engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, RP in medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of biomolecules. (5)

**TEXT BOOKS:**

**REFERENCES:**

**15Y017 MATHEMATICAL MODELING IN METALLURGICAL ENGINEERING**

FORMULATING OF MODELS: Rate equations: - the motion of particles, chemical reaction kinetics. Transport equations:- Reynolds transport theorem. Deriving the conservation laws. Variation principles. Dimensional scaling analysis:-dimensional quantity, dimensional homogeneity and the process of non dimensionalization (6+2)


TEXT BOOKS:

REFERENCES:

15Y018 ATOMISTIC MODELING OF MATERIALS

INTEGRATED COMPUTATIONAL MATERIALS ENGINEERING: introduction to ICME, Project and Mission, Multiscale modeling in materials processing. ICME for materials design and manufacturing. (2)


PHONONS AND THERMODYNAMICS : Vibrations and phonons, Phonon density of states, Phonon DOS and pressure-temperature phase diagrams. Calculation of band structures using DFT. Pseudopotentials. (6+2)


PROPERTIES PREDICTION FROM MOLECULAR DYNAMICS: Caloric Curve , cohesive energy, bulk modulus, Thermal expansion coefficient, Structural information, Radial Distribution Function, Defect properties, Auto-correlation functions, Velocity Auto correlation function, Green-Kubo Equations, Mean Square displacement. (8+3)

MONTE CARLO METHODS. Importance Sampling, Random Number generation, Metropolis algorithm, Glauber Dynamics . Exchange Monte Carlo Monte - Kawasaki dynamics. Kinetic Monte Carlo-Gillespie algorithm. (8+3)

Total = L: 45 + T: 15 = 60

TEXT BOOK:
REFERENCES:

15Y019 COMPUTATIONAL THERMODYNAMICS

Concept of specific heat, enthalpy, entropy and free energy - Maxwell’s relations. Thermodynamics of pure systems - Gibbs’s free energy change with temperature in a single component system - Clausius Clapeyron equation - Surface Energy & under cooling. Nucleation – homogeneous & heterogeneous nucleation.


Brief introduction to experimental methods of determining thermodynamic parameters and phase diagrams. Phase diagram determination by the diffusion couple technique.


Total L: 45

TEXT BOOKS:

REFERENCES:

TUTORIALS
1. Construction of binary and ternary phase diagrams using THERMOCALC software
2. Analyzing thermodynamic parameters in unary system
3. Analysis of Gibbs energy functions in binary system
4. Construction of non-equilibrium phase diagram
5. Vertical section phase diagram for multi-component alloys
6. Property diagram for multi-component alloys
7. Scheil and equilibrium solidification simulation
8. Liquidus projections and monovariant reactions in ternary phase equilibria
9. Creation of user defined thermodynamic database – Single sublattice system
10. Creation of user defined thermodynamic database – Adoption of compound energy formalism
11. Creation of user defined thermodynamic database – Solid solution
12. Creation of user defined thermodynamic database – Stoichiometric compounds
13. Creation of user defined thermodynamic database – non-stoichiometric compounds

15Y020 MODERN TRENDS IN USAGE OF STEELS

STRUCTURAL STEELS: Role of different alloying elements and the role of microstructure in affecting properties- Development of steels for earthquake resistant- Currently where they are produced and their properties.
LINE PIPE STEELS FOR OIL AND GAS: Recent trend in the development of high strength line pipe steel with superior toughness at low temperature. Microstructure content in imparting the properties and the effect of processing parameter for controlling the precipitants size to control the grain size in the finished product. Microstructural engineering and Tundish metallurgy concept to produce steels having different strength and also having improved fracture resistance. (9)

STEELS FOR AUTOMOBILE APPLICATION: Hot rolled steel sheets, Ferrite Bainite, DP steel IF steel, TRIP steel and ToWIP and complex flow sheet. Metallurgical factors that improve the r value – high strength "T shed". IF steel with BH – Light weight steels (Fe Al, FeMn Al, 22Mn Bs steel) and the changes in properties during hot forming. (9)

ULTRA HIGH STRENGTH AND HIGH TOUGHNESS STEEL: Maraging steel and secondary hardening steels containing large amount of cobalt and Ni. Recent trends in the secondary hardening steel with low Co and Ni- Role of intermetallics. (9)

STAINLESS STEEL: Austenitic super ferritic, precipitation hardened, Duplex and high nitrogen containing austenitic steels. Recent trends in the production of high purity steels for nuclear and aerospace applications. (4)

ELECTRICAL STEELS: CRGO and CRNO. The technological trend in the production of higher grade CRGO steel – Magnetic ageing and core lose and how to evaluate the magnetic properties of the electrical steels. Role of textile in affecting the electrical properties. (4)

TOOL STEELS: The role of carbides and how to compare the high temperature properties and the effect of heat treatment in controlling the MC and M23C6 carbide phase. (4)

TEXT BOOKS:

REFERENCES:
2. Llywyn and Jones. “Steel properties and application” Institute of Metals, UK, 1992

OPEN ELECTIVES OFFERED BY ENGINEERING DEPARTMENTS

15AH06 MOTOR VEHICLE ENGINEERING


ENGINE BASIC THEORY: Engine types and their operation, classification, Properties of I.C. engine fuels, actual cycle, air fuel cycle, combustion charts (equilibrium), two stroke engines, four stroke engine, characteristics of engines, air capacity of engine, valve timing diagram. (9)

TRANSMISSION: Flywheel, clutch, gear box types, need, general functions and design characteristics, decoupling of power, speed and torque characteristics of power transmission system. transfer case - auxiliary gearbox, gear shifting mechanisms. Automatic Transmission - Need for fluid coupling and torque converters, Borg Warner type, control mechanisms, limitations. Transmission Electronics, Automatic Manual Transmission. (9)

DRIVELINE AND AXLE: Functional and design characteristics of propeller shaft, selection criteria for material and cross section of propeller shaft, need for differential and final drive. Axle – Live and dead axles, front axle and its types, stub axle and its types, rear axle and its types, fully floating, semi-floating and three quarter floating axles, two speed axles, twin axles, swing axles. Use of different types of wheels and tyres, specification, materials. (9)

CONTROL SYSTEM: Steering, Suspension and Brakes – Need, requirements, principle of working and types .Effort multiplication and geometry in steering, types of springs used in suspension system, need for damping, wheel locking and stopping distance, self energizing and self locking , Introduction to ABS. (9)

TEXT BOOKS:

Total L: 45
REFERENCES:

15MH02 TOTAL QUALITY MANAGEMENT

INTRODUCTION: Definitions of the terms – quality planning, quality control, quality assurance, quality management, total quality management as per ISO 8402 – overview on TQM – the TQM axioms – Commitment – scientific knowledge – involvement Consequences of total quality.


JURAN ON QUALITY: Developing a habit of quality – Juran quality trilogy – the universal break through sequence – comparison Juran and Deming approaches.

CROSBY AND THE QUALITY TREATMENT: Crosby’s diagnosis of a troubled company - Crosby’s quality vaccine - Crosby’s absolutes for quality management - Crosby’s fourteen steps for quality improvement.


Total : L : 45

TEXT BOOKS :

REFERENCES:

15MH03 INDUSTRIAL ENGINEERING AND MANAGEMENT


ORGANIZATIONAL BEHAVIOUR: Significance of OB, HR - Importance, Objectives and Functions, Job Analysis and Recruitment, Selection and Placement.


METHOD STUDY: Evolution of Industrial Engineering, Productivity definition, means of increasing productivity, Productivity and work study, work study - Definition, aims, procedure for method study, selection of jobs, recording techniques, micro motion study, therbligs, cyclograph and chronycle graph, principles of motion economy, design of work place layout, analysis in the form of chart, operation chart, flow process chart, flow diagram, string diagram, man machine chart, two handed chart, SIMO chart

Total : L : 45
TIME STUDY : Time study equipment, performance rating, allowances, number of cycles to be studied, determination of standard time. Work place design - Ergonomics. (5)

LAYOUT DESIGN: Manufacturing facility layouts – product, process, fixed position and cellular layouts. Group technology-Introduction, part classification and coding, assigning machines to groups- binary ordering algorithm. (7)

DESIGN OF AUTOMATED ASSEMBLY LINES: Assembly lines, Approaches to line balancing – largest candidate rule, Kilbridge and wester method, Ranked positional weight heuristic, COMSOAL. (7)

TEXT BOOKS:

REFERENCES:

15MH05 SIX SIGMA PROJECT METHODOLOGY

INTRODUCTION: Overview , six sigma defined – background, Methodology: DMAIC, DMADV phases, common terms, transactional vs. Manufacturing six sigma projects, Five laws of lean-six sigma. (6)

PREPARATION PHASE: Assessing organizational readiness – Pre-requisites for Six sigma implementation, internal communication strategy and tactics, Formal launch, organizational structure, six sigma training plan, team stages, characteristics of effective teams. (6)

DEFINE PHASE: Project selection, voice of the customer, CTQ – high level process map – Cost of quality – Cost of poor quality – Sigma level calculation - Project charter. (6)


IMPROVE PHASE: Overview – Creativity techniques - Brainstorming - generation & selection of improvement alternatives – TRIZ – PUGH Matrix. Introduction to failure mode and effects analysis - ROI analysis. – Process redesign principles (8)


TEXT BOOK:

REFERENCES:
INTRODUCTION: Importance. Cost to the nation-spontaneous nature. basic principles, environmental & metallurgical factors affecting corrosion of steel in water. classification of corrosion.

FORMS OF CORROSION: Brief description of eight forms of corrosion, their causes and remedial measures.

PREVENTIVE METHODS OF CORROSION: Painting, coating, materials selection, environmental treatment, inhibitor addition. water treatment, cathodic protection.

CORROSION BY SPECIFIC ENVIRONMENTS: Water, sea water, steam, air, marine, soil, acids, alkalies, gases O₂, CO₂, H₂S, Cl₂.

CORROSION IN SPECIFIC INDUSTRIES WITH CASE STUDIES: Oil & gas, oil refineries, fertilisers, chemical plants, petrochemicals, sugar, pulp and paper, general engineering, automobiles, aircrafts, boiler circuits, cooling water circuits, nuclear power stations.

CORROSION MONITORING AND ASSESSING TECHNIQUES: Weight loss coupons, electrical resistance probes, linear polarization probes, ultrasonic testing, eddy current testing radiography, liquid penetrant testing.

REFERENCES:


WELDING PROCEDURES AND QUALIFICATION OF WELDERS: Material properties for pressure vessels and piping ASME Sec IIA & C, Destructive testing of welds as per ASTM & AWS standards, Welding procedure qualification as per ASME section IX, Welder qualification—Practices Acceptance standards in welding.


REFERENCES:

Qualification and Requalification, Personnel Qualification, Procedure Qualification, Nondestructive Testing Agency Qualification.


LIQUID PENETRANT EXAMINATION: Scope, Classification of Penetrant Materials and Methods, Equipment, Miscellaneous Requirements, Technique, Calibration, Examination, Evaluation, requirements of a Liquid Penetrant Examination Procedure, Minimum Dwell Times, Special Requirements, cleaning of parts and materials.

Calibration, Examination, Evaluation, Documentation. (2)


ULTRASONIC EXAMINATION METHODS FOR MATERIALS AND WELDS: Scope, General Equipment, Miscellaneous Requirements, Standardization, Reference Standards, Search Units, Coupling Conditions, Distance-Amplitude Correction, Examination Procedures, Reflector Evaluation, Techniques, Calibration, IIW Type Reference Blocks, Checking the Search Units and Their Characteristics, Basic Reference Reflectors, Beam Spread, Examination, Evaluation, Ultrasonic Examination Procedure for Metallic Castings, welds, Procedure Qualification Requirements for Flaw Sizing and Categorization, Simulation, Phased array and TOFD procedure requirements and application. (3)

Case studies on Nondestructive Inspection of Castings, Forgings, Steel Bar, Wire, and Billets, Tubular Products, Boilers and Pressure Vessels. (2)

REFERENCES:
1. ASME SECTION V
2. ASTM 03-03 NDT
3. ASNT SNT-TC-1A

15YF04 BLAST FURNACE DESIGN AND CAST HOUSE PRACTICE 1001

DESIGN OF BLAST FURNACE: Furnace proper, bustle pipe, tuyere, tap hole, hearth cooling, masses and compounds for tap hole, ladles and cast house runners. (5)

CHARGE CALCULATIONS AND ANALYSIS: Sinter chemistry calculations, charge calculations for steel making requirements, top gas analysis, peripheral and skin temperatures analysis, calculations for oxygen enrichment and fuel injection. (3)

FURNACE ACCESSORIES: Pump house, cooling system, blower, hot metal transport and utilization, water requirements, gases required, man power requirements, automation. (3)

CAST HOUSE PRACTICE: Capital repairs - category 1, 2 and 3, modifications during repair, cast house equipment, runner design, runner making and maintenance, logistics, cast house related problems and remedies. (4)

REFERENCES:

HUMANITIES

15OF01 EXPORT - IMPORT MANAGEMENT 1001

INTRODUCTION: Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES: Obtaining an Export License – Export Credit Insurance – Procedures and Documentation. (4)

FOREIGN EXCHANGE: Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES: Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES: Incentives – Institutional Support. (2)

REFERENCES:

Total L: 15

15OF02 INSURANCE & RISK MANAGEMENT

INTRODUCTION TO RISK MANAGEMENT: Risk in Our Society. (2)
INSURANCE AND RISK: Client Side – Components of the Costs of Risk. (2)
MASS CONTROL: Insurance Intermediaries – Insurance Companies and their Role in Deducting Business / Role Risks. (4)
FINANCIAL RISKS: Shift of Risks – Risk Derivatives. (3)

REFERENCES:

Total L: 15

15OF03 VALUES AND ETHICS AT WORK PLACE

HUMAN VALUES AND ETHOS: Meaning and Significance of Values – Sources of Individual Values - Value crisis in the Contemporary Indian Society – Moral and Ethical Values. (4)
APPLICATION OF VALUES: Relevance of Values in Management – Personal Values and Values at Work place – Values for Managers. (2)
WORK ETHICS: Professional Values & Ethics – Need – Issues – Challenges – Ethical Leadership – Ethical dilemma - Case Study. (2)
SHARED VALUES IN THE ORGANIZATION AND ITS IMPACT: Need to identify and share values – the Value Construct and How to Promote Shared Values. (4)
UNIVERSAL VALUES: Cross Cultural Values - Impact of Culture on Organizations and Managing Workforce Diversity. (3)

REFERENCES:

Total L: 15

15OF04 DEVELOPMENT OF INDUSTRIALISATION

EVOLUTION OF MODERN ECONOMY: Colonialism, Capitalism and economic development. (2)
AMERICAN HISTORY: Before and After European arrival. (4)
ROLE SLAVERY and trade in America. (4)
INDIAN ECONOMY – Pre and Post Independence, (3)
INDUSTRIALIZATION IN ASIA AND AFRICA – Colonialism – anti-colonialism and Socialism. (2)

REFERENCES:

Total L: 15
15OF05 CREATIVITY AND SOCIAL ENTERPRISE

CREATIVITY - Understanding the creative skills
WAYS TO IMPROVE creativity and exercises.
INNOVATION – Process of Innovating new ideas - Importance of Innovation.
ENTREPRENEURIAL skills and development – Intrapreneurship.

REFERENCES:

Total L: 15

15OF06 SOCIAL AND PSYCHOLOGICAL WELL BEING

DEFINING SOCIAL PSYCHOLOGY and social influences on behavior.
ANALYSIS OF SOCIAL and psychological problems and the solutions to address social problems.
ROLE OF SPORTS AND GAMES, yoga practices, tracking and outdoor activities in addressing social and psychological problems.
ORIGINS OF PSYCHOLOGICAL DISORDER – roots of social anxiety - prevention of psychological disorders.
NATURE OF INTERVENTIONS – Evaluation of Interventions and implementing the interventions.

REFERENCES:

Total L: 15

15OF13 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

TYPES OF SECURITY: Trading – Orders, Margin Trading – Clearing and Settlement Procedures.
SECURITY ANALYSIS: Industry Analysis – Company Analysis.
PORTFOLIO: Measuring Risk and Returns and Treatment in Portfolio Management.

REFERENCES:

Total L: 15

15OF14 IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM

INTRODUCTION – Need for Quality – Definitions of Quality – Dimensions of Product and Service Quality – Basic Concept of TQM – Contributions of Deming, Juran and Crosby – Barriers to TQM.

Total L: 15
**STRATEGIC QUALITY PLANNING** – Quality Councils – Employee Involvement – Empowerment – Team and Team Work – PDCA Cycle – 5S – Supplier Selection and Supplier Rating. (4)


**PRODUCTION PLANNING & CONTROL** – Concepts of Productivity – Importance – Modes of Calculating Productivity – Cost of Quality - SERVQUAL – Quality Improvement Strategies. (3)


**REFERENCES:**

15OF15 **FINANCIAL MANAGEMENT**

**INTRODUCTION:** Meaning of finance - Definition of financial management - Scope of Financial Management - Functions of Financial Manager. (2)

**OBJECTIVE OF FINANCIAL MANAGEMENT:** Profit Maximization and Wealth Maximization. (4)

**CAPITAL STRUCTURE:** Designing of Capital Structure - Profitability and Liquidity Aspects. (4)

**DIVIDEND POLICY:** Determinants of Dividends- Bonus share – Tax aspects. (3)

**CORPORATE RESTRUCTURING:** Merger and Acquisition (M&A) - Case Studies. (2)

**REFERENCES:**

15OF16 **PERSONALITY DEVELOPMENT THROUGH TRANSACTIONAL ANALYSIS**

**EXPLORING THE PERSONALITY** - Structural Ego states - Functional Ego states. (2)

**MOTIVATION** – Strokes Maslow's Hierarchy of Needs. (4)

**INTERPERSONAL RELATIONSHIP** - Time Management – Transactions - Time Structuring. (4)

**STRESS MANAGEMENT** - Working Styles – Contamination. (3)

**ASSERTIVENESS AND LEADERSHIP SKILLS** - Life positions – Competency. (2)

**REFERENCES:**
ENGLISH

15OF10 CORPORATE COMMUNICATION

1 0 0 1


ORAL COMMUNICATION: Communicating in Organizational Settings - Recognizing effective Communication - Mastering Listening and Nonverbal Communication Skills - Overcoming Barriers to Communication - Communicating in Teams and adapting to Cross Cultural Communication contexts.

WRITTEN COMMUNICATION: Planning, Writing, and completing business messages - Writing messages for Electronic Media - Creating effective E-mail messages - Writing routine and positive and negative messages - Writing persuasive messages – Training on writing Reports and proposals – Mastering the Format and layout of Business Documents.

Presentation and Negotiation Skills.

Total: 15

REFERENCES:

15OF11 - INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION

1 0 0 1

UNDERSTANDING ORGANIZATIONAL COMMUNICATION: Communication Networks in an Organization; Intra-organizational communication; Inter-organizational communication; Flow Nomenclature; Workplace diversity and intercultural aspects of communication.

COMMUNICATION FUNCTIONS IN ORGANIZATIONS: Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills.

WRITTEN COMMUNICATION: Email Writing, Professional Reports, and Memos.

INTERPERSONAL SKILLS: Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence.

Total L:15

REFERENCES:

15OF12 – HUMAN VALUES THROUGH LITERATURE

1 0 0 1


DRAMA: Karnad, Girish, Tughlaq – Statesmanship and friendship.

ONE-ACT PLAY: Chekhov, Anton. The Bear – Love.


NOVEL: Murthy, Sudha. Gently Falls the Bakula – Gender equality.

Total L: 15 hrs

REFERENCES:
3. Additional readings on individual texts.
OFFERED BY THE DEPARTMENT OF MATHEMATICS

15OF21 PRINCIPLES OF BUSINESS ANALYTICS

PREDICTIVE ANALYTICS: CLASSIFICATION AND DISCRETE CHOICE PROBLEMS: Simple linear regression - multiple linear regression model development and diagnostics - analysis of transactional data using binary logistic and multinomial logistic regression models - discrete choice models, non-linear regression. Classification Trees, Classification and Regression Tree (CART) - forecasting.


REFERENCES: