AES211 INTRODUCTION TO AEROSPACE TECHNOLOGY 3 0 0 3

Unit 1
History of aviation, types of flying machines, major components of an aircraft and their functions.
Fundamental aerodynamic variables, aerodynamic forces, lift generation, airfoils and wings, behavior of lift and drag forces, high lift devices.

Unit 2
Moments produced by aerodynamic forces, aerodynamic center, criteria for longitudinal stability, role of the elevator in control.
Mechanism of thrust production, propellers, jet engines and their operation, elements of rocket propulsion.
Loads acting on an aircraft, load factor for simple maneuvers, v-n diagrams, methods of construction of the wing and fuselage.

Unit 3
The solar system and the Copernican model, Kepler's laws, orbital motion, orbital maneuvers and interplanetary transfer, satellite orbits, earth's outer atmosphere, the rocket equation, multistage rockets.

TEXTBOOKS:

1. *Anderson.J.D, Introduction to flight (Fourth edition), Mc Graw Hill, 2000*
2. *Anderson.D.F and Eberhatdt.S, Understanding flight, Mc Graw Hill, 2001*
3. *Kuhn.T.S, The Copernican revolution:Planetary Astronomy in the Development of Western Thought, Harvard University Press, 1956*
4. *Szebehely.V.G and Mark.H, Adventures in celestial mechanics, WILEY-VCH Verlag GmbH & Co, 2004*

REFERENCES:

1. *Turner.M.J, Rocket and Spacecraft Propulsion (Third edition), Springer, 2009*
2. *Curtis.H.D Orbital Mechanics for Engineering Students, Elsevier, 2005*

AES221 MECHANICS OF FLUIDS 3 1 0 4

Unit 1
Concept of a fluid; thermodynamic and secondary properties; Hydrostatics; Control volume; formulation of basic equations: Reynold's transport theorem, derivation of governing equations for mass, linear and angular momentum, energy in integral form, Bernoulli's equation.

Unit 2
Differential form of the basic equations. Boundary conditions. Eulerian and Lagrangian methods of describing fluid motion. Basic flow analysis techniques

and flow patterns: Streamlines, streak lines and pathlines. Stream function, vorticity. Potential flow with examples. Examples of laminar, viscous flow. Dimensional analysis and similarity: Pi theorem, use of dimensional analysis in modeling and experiments.

Unit 3
Elementary boundary layer theory: D'Alembert paradox, the concept of a boundary layer, Prandtl's boundary layer equations, similarity solution of flat plate boundary layer. Concept of boundary layer separation. Viscous flow in ducts - Reynolds number regimes, quantitative aspects of flow in pipes, qualitative introduction to turbulence, External flows, Reynolds number and geometry effects.

TEXTBOOK:

Frank M White, 'Fluid Mechanics', 4th Edition, Mc-Graw Hill International Edition

REFERENCES:

1. *Fox and McDonald, 'Fluid Mechanics', 3rd Edition, John Wiley.*
2. *Ronald L. Panton, 'Incompressible Flow', Wiley India, 2005*

AES222 FUNDAMENTAL OF AERODYNAMICS 3 1 0 4

Unit 1
Importance of aerodynamics; Classification and practical objectives. Review of aerodynamic forces and moments. Review of governing equations; conformal mapping: Plane potential flow, Complex functions, and Cauchy-Riemann criteria.

Unit 2
Elementary flow; Laplace equation, singularities and superposition; circulation and lift - Kutta-Joukowski theorem, non-lifting flow past arbitrary bodies - numerical source panel method and numerical vortex panel method.

Unit 3
Airfoil nomenclature, airfoil characteristics, Kutta condition, Kelvin's circulation theorem & starting vortex, classical thin airfoil theory, solutions of symmetric and cambered airfoils, flapped airfoils, effects of thickness.

TEXTBOOK:

John D Anderson, Fundamentals of Aerodynamics, McGraw Hill, 4th Edition.

REFERENCES:

1. *E.L. Houghton and P.W. Carpenter, Aerodynamics for Engineering Students, Butterworth-Heinemann, 5th edition*
2. *Milne-Thomson, Theoretical Aerodynamics, Dover 1973*

AES232 INTRODUCTION TO CONTROL THEORY 3 0 0 3

Unit 1
Basics of transducers, signals, block diagrams, feedback, signal flow graphs, mathematical modeling, examples of electrical, mechanical and electro-mechanical models. Review of Laplace transforms. Linear systems, impulse and step responses.

Unit 2
Definition of stability, tansfer functions and modeling of systems using block diagrams, response vs. pole locations, time domain specifications, system type and steady-state errors, PID controllers. Root-Locus design method - guidelines for sketching root-locus, dynamic compensation (Lead/Lag) using root-locus, Routh's stability criterion.

Unit 3
The frequency response design method - Bode plot techniques, stability, Nyquist criterion, stability margins (gain and phase), introduction to dynamic compensation, robust stability and robust performance. Introduction to state space design - state-space equations, controllability and observability. Introduction to state-feedback and estimator design.

TEXTBOOKS:

1. R.C. Dorf and R.H. Bishop, Modern Control Systems, 9th Edition, Prentice-Hall, 2001

2. Vegte, John Van de. Feedback Control Systems. 3rd ed. Prentice Hall, 1994.

REFERENCE:

Ogata, K. Modern Control Engineering. 3rd ed. Prentice Hall

AES241 MECHANICS OF MATERIALS 3 1 0 4

Unit 1
Introduction - deformation, strain, stress, stress-strain relation, elasticity and plasticity, Hooke's law, shear stress and shear strain, allowable stresses and loads. Axially loaded members - prismatic bars, normal stresses and strains, Poisson's ratio, bulk modulus, volumetric strain, modulus of rigidity, thermal stresses, relation between elastic constants, principal of super-position, Saint-Venant's principle, stress concentration, compound bar, varying cross sectional properties.

Unit 2
Introduction to energy methods - strain energy, potential energy, Castigliano's first and second theorems, principal virtual work, principal complementary virtual work, resilience, stresses due to suddenly applied and impact loads. Beams and bending - pure bending of symmetric beams, study of normal, bending and shear stresses,

composite beams - introduction, shear force and bending moment diagrams for various types of beams.

Unit 3
Deflection of beams, analysis of deflection and slope of beams - by McCaulay's method, Area-moment method, Conjugate-beam method and strain energy method. Biaxial stresses - stresses in thin walled cylindrical, spherical and conical vessels, stresses at a point on a plane, principal plane stresses, von-Mises stress, Mohr's circle of stress for 2D problems, failure criteria.

TEXTBOOK:

Irving H. Shames and James M. Pitarresi, 'Introduction to Solid Mechanics' third edition, Prentice-Hall of India Pvt. Ltd. 2006

REFERENCES:

1. James M. Gere, 'Mechanics of Materials' Sixth edition, Brooks/Cole, India edition. 2006

2. Egor P. Popov, 'Engineering Mechanics of Solids', Second edition, Prentice-Hall of India Pvt. Ltd., 2004

AES242 AEROSPACE STRUCTURES 3 1 0 4

Unit 1
Characteristics of aircraft structures: members used in aircraft structures, wing and fuselage details - introduction to elasticity: stresses and strains at a point, principal stresses and strains, linear stress-strain relations, elastic strain energy, governing equations - elastic buckling: Buckling on bars with different boundary conditions, bars of non-symmetric sections, elastic buckling of flat plates, local buckling of open sections.

Unit 2
Bending and flexural shear: Bernoulli-Euler and Timoshenko beam theories, bi-directional bending, transverse shear stresses: Narrow rectangular cross-section, general symmetric sections and thin-walled sections – torsion: Saint-Venant's principle, torsion in uniform bars, bars with circular and narrow cross sections.

Unit 3
Warping in open and closed thin-walled sections - flexural shear flow (FSF) in thin-walled sections: FSF in open thin-walled sections:- symmetric and non-symmetric thin-walled sections, shear center in open sections, closed thin-walled sections shear center.

TEXTBOOKS:

1. *C. T. Sun, "Mechanics of Aircraft Structures, Second Edition, John Wiley & Sons, New York, 2006*
2. *Megson, T.H.G., "Aircraft Structures for Engineering Students", Third Edition, Butterworth& Heinemann, New York, 2003*

REFERENCES:

1. *E.P Popov, "Engineering Mechanics "Prentice-Hall of India New Delhi, 2004*
2. *Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw–Hill, New York, 1993.*
3. *Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri – state off set company, USA, 1985.*
4. *Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw-Hill, 1993.*

AES291 MATERIALS TESTING LAB. 0 0 3 1

Tension test on materials, double shear test, static bending test on wood, compression test on wood, tensile test on thin wires, deflection test on beams, Rockwell hardness test, Brinell hardness test, spring test, impact test - Charpy and Izod.

AES292 MECHANICS OF FLUIDS LAB. 0 0 3 1

Flow experiments: Calibration of orifice meter, Venturimeter, V and rectangular notch, pipe friction. Verification of Bernoulli's theorem; Reynold's apparatus; Metacentric height; jet impact studies.

AES294 INSTRUMENTATION LAB. 0 0 3 1

Calibration exercises: Dead weight pressure gauge tester, dead weight vacuum gauge tester.
Measurement experiments: Torque, power using dynamometer; speed using stroboscope and magnetic pickup; temperature using thermocouple; Resistance and temperature detectors. Force using proving ring, vibration using piezo electric accelerometer. Strain gauges.

AES312 FLIGHT MECHANICS AND STATIC STABILITY 3 1 0 4

Unit 1
Equations of motion, forces acting on the aircraft, aerodynamic characteristics of the wing, compressibility effects, drag contribution from components, propulsion systems and their performance characteristics.
Airplane performance in steady flight, power available and maximum speed, climb, effect of altitude, performance and service ceiling, range and endurance, accelerated flight, load curves, take-off and landing performance.

Unit 2
Concept of static and dynamic stability, longitudinal stability, neutral point, stick fixed and stick free stability.
Longitudinal control, hinge moments, control power, directional stability and control, roll stability.

Unit 3
Introduction to rotor aerodynamics and performance of a helicopter.
Introduction to dynamic stability, some simple aircraft motions.

TEXTBOOKS;

1. *Anderson.J.D, Aircraft performance and design, Mc Graw Hill, 1999*
2. *Perkins.C.D and Hage.R.E, Aircraft performance stability and control, John Wiley and sons, 1940*
3. *Seddon.J, Basic helicopter aerodynamics (Second edition), Blackwell publishing, 2002*

REFERENCES:

1. *Nelson.R.C, Flight stability and automatic control, Mc Graw Hill, 1989*
2. *Russel.J.B, Performance and stability of aircraft, Butterworth-Heinemann, 1996*

AES321 COMPRESSIBLE FLUID FLOW 3 1 0 4
(Pre-requisite: MEC220)

Unit 1
Concept of continuum, equations governing the flow, Lagrangian and Eulerian forms, aspects of thermodynamics, energy equation, compressible flows. Isentropic flow, propagation of sound, Mach number, distinction between subsonic and supersonic flows, flow through varying area ducts, stagnation properties, the acoustic equation, finite waves, formation of shock waves.

Unit 2
Flow through a normal shock wave, oblique shock waves, shock polar, shock wave interactions, Prandtl Meyer expansion, effect of back pressure on nozzle flows. Estimation of drag force, supersonic wind tunnels, inlets and diffusers, measurement of pressure and temperature, optical techniques.

Unit 3
Fanno flow, Rayleigh flow, representation of shock waves on the T-S diagram. Small perturbation theory, similarity rules, introduction to the method of characteristics.

TEXTBOOK:

Liepmann.H.W and Roshko.A, Elements of gas dynamics, Dover, 2007

REFERENCES:

1. *Shapiro.A.H, The dynamics and thermodynamcis of compressible fluid flow, Vol.1, Ronald press company, 1953*

2. *Zucker.R.D and Biblarz.O, Fundamentals of gas dynamics (Second edition), John Wiley and sons, 2002*

AES322 COMPUTATIONAL AERODYNAMICS 3 0 3 4

(Pre-requisite: AES222)

Unit 1

Review of governing equations of fluid dynamics and relevant PDE theory, classification of PDE's and physical implications, special cases of Navier-Stokes and their classification. Introduction to numerical methods, properties of numerical solution methods: errors, consistency, accuracy, stability, convergence, conservation.
Lab components: Introduction to MATLAB and ANSYS fluent.

Unit 2

Panel methods, finite wing theory, simplified horseshoe vortex, Prandtl's lifting line theory, swept and delta wings, computational methods for finite wings. Introduction to the finite difference and finite volume discretization approaches.
Lab components: Computing panel methods and finite wing theory.

Unit 3

Introduction to grid generation, body conforming grids, algebraic and elliptic grids; 2D unstructured grids. Solution methods for incompressible flows; Solution methods for compressible flows. Examples: Incompressible Couette flow, numerical solutions of quasi - 1D nozzle flows, numerical solution of a two dimensional supersonic flow (Prandtl-Meyer expansion wave).
Lab components: Simulation of incompressible and compressible flow over external objects such as flow over cylinder, flow over airfoil, flow over nose cone based on Navier Stokes equation.

TEXTBOOKS:

1. *John D Anderson, Computational Fluid Dynamics – The Basics with Application, McGraw-Hill International Edition, 1995*
2. ***Joseph Katz, Allen Plotkin,*** *Low- Speed Aerodynamics : From Wing Theory to Panel Methods, Cambridge University Press, 2001*

REFERENCES:

1. ***Tuncer Cebeci, Max Platzer, Hsun Chen, Kuo-cheng Chang, Jian P. Shao,*** *Analysis of Low Speed Unsteady Airfoil Flows, Springer, 2005*
2. *Jiyauan Tu, Guan Heng yeoh, Chaoqun Liu, Computational Fluid Dynamics – A Practical Approach, Elsevier Publications, 2008*

AES331 INTRODUCTION TO AEROSPACE PROPULSION 3 1 0 4

(Pre-requisite: MEC220)

Unit 1

Momentum analysis of thrust generation, types of propulsion systems and their components, performance measures.
Actuator disc theory, performance co-efficients, pitch, constant speed propeller, the helicopter rotor.

Unit 2

Ideal cycle analysis of ramjets, turbojets and turbofan engines, component performance, analysis of real engines.
Chemistry of combustion, heat of combustion, reaction rate, flames, stability considerations, application to gas turbine combustion.

Unit 3

Rocket vehicle mechanics, multistaging, thermodynamics of the rocket engine, rocket engine performance, types of rocket engines.

TEXTBOOKS:

1. *Mattingly.Jack.D, Elements of propulsion: Gas turbines and Rockets, AIAA Education Series, 2006*
2. *Mukunda.H.S, Understanding Combustion (Second edition), Macmillan India Limited, 2007*

REFERENCE:

Truner.Martin, Rocket and spacecraft propulsion (Third edition), Springer, 2009

AES332 INTRODUCTION TO AVIONICS 2 0 0 2

Unit 1

Introduction: importance and role of avionics, the avionic environment, air & air data systems: air data information and its use, air data laws and relationships, air data sensors and computations.

Unit 2

Inertial sensors & systems: gyros, laser gyros and accelerometers, attitude/ heading reference systems, navigation systems: basic principles, inertial navigation, strapped-down inertial systems.

Unit 3

Navigation systems: GPS - Global Positioning Systems, display systems: HUD (head up displays), HMD (helmet mounted displays), head down displays, intelligent display managements.

TEXTBOOK:

R.P.G Collinson, "Introduction to Avionics", Springer, 2002.

REFERENCES:

1. *Kayton and Fried, "Avionics Navigation Systems", Wiley, 1997.*
2. *N.S.Nagaraja, "Elements of Electronic Navigation", Tata McGraw-Hill, 1976.*

AES344 FINITE ELEMENT ANALYSIS 3 0 3 4

Unit 1

Introduction to finite element method (FEM) - basic principles of structural mechanics: Equilibrium condition, strain-displacement relation, linear constitutive relations - basic steps in linear FEM formulations: domain discretization, types of elements, assembly procedures, boundary conditions - formulations: Potential energy method, variational formulation, weighted residual, Galerkin and Rayleigh-Ritz methods, weak formulations.

Unit 2

Coordinate systems, convergence criteria, 1D elements: Axial elements basic formulations, formations of shape functions, problems using 1D elements, beam (bending) element: formulations and formation of shape function and problems – 2D elements: Plane stress and plane strain element formulation, shape function development, problems using 2D elements - axi-symmetric elements- iso-parametric formulation of elements.

Unit 3

3D element formulations - FE formulation of plate bending and shell elements - numerical integration - solution techniques of the numerical equations, FEM application to heat transfer, dynamics - problems in solid mechanics, heat transfer and vibration analyses using FEM software.

TEXTBOOKS:

1. *S.S. Rao, "The Finite Element Method in Engineering", Butterworth-Heinmann Publisher.*
2. *J. N. Reddy, Introduction to the Finite Element Method, Third Edition, McGraw-Hill , New York.*

REFERENCES:

1. *C.S.Krishnamoorthy, "Finite Element Alalysis' , Tata McGraw-Hill Publishing Company Limite, New Delhi.*
2. *David V. Hutton, 'Fundamentals of Finite Element Analysis", Tata McGraw-Hill Publishing Company Limite, New Delhi.*
3. *Tirupathi R. Chandrapatla and Ashok D. Belegundu, "Introduction to Finite Element in Engineering", Prentice Hall of India, New Delhi.*

AES351 BOUNDARY LAYER THEORY 4 0 0 4

(Pre-requisite: AES221)

Unit 1

Fundamentals of boundary layer theory, field equations for flows of Newtonian fluids, general properties of the equation of motion, exact solution for the Navier Stokes equations.

Unit 2

Laminar boundary layer: Approximate methods for solving the boundary layer equations for steady plane flows, unsteady boundary layer, extension to Prandtl boundary layer theory. Laminar-turbulent transition: Fundamentals of Stability theory, Instability of the Boundary layer.

Unit 3

Turbulent boundary layer: fundamentals of turbulent flows, internal flows, axisymmetric and three-dimensional turbulent boundary layers, unsteady turbulent boundary layers, turbulent free shear flows.
Numerical integration of boundary layer equations.

TEXTBOOKS:

1. *Schlichting.H, Gersten.K, "Boundary Layer Theory", Springer, 2000.*
2. *Frank M. White, "Viscous Fluid Flow", McGraw-Hill Education, 2005.*

REFERENCE:

Stephen B. Pope, "Turbulent Flows", Cambridge University Press, 2000.

AES352 TURBULENT FLOWS 4 0 0 4

(Pre-requisite: AES221)

Unit 1

Governing equations; Averaging and correlations; Reynolds equations and Reynolds stresses. Free shear flows, turbulent jet, turbulent length and time scales, turbulent kinetic energy and kinetic energy dissipation and kinetic energy budget.

Unit 2

Kolmogorov's hypothesis and energy spectrum; Wall bounded flows, channel flow and boundary layer, viscous scales and law of the wall.

Unit 3

Turbulence modeling, gradient transport and eddy viscosity, mixing length model, two-equation models, Reynolds-stress model, and large-eddy simulation.

TEXTBOOKS:

1. *H. Tennekes, J.L. Lumley, "A First Course in Turbulence", MIT Press, 1972*
2. *Stephen Pope, "Turbulent Flows", Cambridge University Press, 2000.*
3. *David C. Wilcox, "Turbulence Modeling for CFD" DCW Industries, 2006.*

REFERENCES:

1. *P.A Davidson "Turbulence: An Introduction for Scientists and Engineers", Oxford University Press, 2004*
2. *Jean Mathieu, J. Scott, "An Introduction to Turbulent Flow", Cambridge University Press, 2001*

AES356 HEAT TRANSFER 4 0 0 4

Unit 1

Basic modes of heat transfer, one dimensional steady state heat conduction, composite medium, critical thickness, effect of variation of thermal conductivity in solids, extended surfaces, unsteady state heat conduction, lumped system analysis, heat transfer in semi infinite and infinite solids, application of numerical techniques.

Unit 2

Fundamentals of convection, physical mechanism, free convection in vertical flat plate, empirical relation in free convection, forced convection, laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe, applications of numerical techniques in problem solving. Introduction to physical mechanism, radiation properties, radiation shape factors, heat exchange between non black bodies, radiation shields.

Unit 3

Boiling and condensation, condensation heat transfer, classification of heat exchangers, temperature distribution, over all heat transfer coefficient, heat exchange analysis, LMTD method and E-NTU method.

Heat transfer in gas turbine combustion chambers, rocket thrust chambers, cryogenic systems, spray combustion, ablative heat transfer.

TEXTBOOKS:

1. *Yunus A. Cengel., "Heat Transfer – A practical approach", second edition, Tata McGraw-Hill, 2002.*
2. *Incropera.F.P. and Dewitt.D.P., "Fundamentals of Heat and Mass Transfer", fifth edition, John Wiley and Sons, New York, 2002.*
3. *Sutton. G.P., "Rocket Propulsion Elements", fifth edition, John Wiley and Sons, New York, 1986.*

REFERENCES:

1. *Holman. J.P., "Heat Transfer", sixth edition, McGraw-Hill book co., Inc., New York, 1991.*
2. *Sachdeva. S.C., "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern Ltd., New Delhi, 1981.*

AES357 ROCKET AND SPACECRAFT PROPULSION 4 0 0 4

(Pre-requisite: AES331)

Unit 1

Principle of rocket propulsion, the rocket equation, development of thrust, nozzle design, effect of atmosphere, thermodynamic thrust equation, characteristic velocity, performance parameters.

Unit 2

Liquid propellant rocket engine, basic configuration, types of propellants, propellant feed systems, combustion of liquid propellants, injectors and thrust chambers, combustion instability.

Solid propellant fundamentals, types of solid propellants, propellant processing and manufacture, grain configuration, Igniter hardware, combustion of solid propellants, hybrid rocket engines.

Unit 3

Electric propulsion, electrothermal and electromagnetic thrusters, applications of electric propulsion, electric power generation, nuclear propulsion - operational issues,

Practical approaches for single stage to orbit vehicles

TEXTBOOKS:

1. *Truner.Martin, Rocket and spacecraft propulsion (Third edition), Springer, 2009*
2. *Sutton.G.P, Biblarz.O Elements of rocket propulsion (Seventh edition), John Wiley & Sons Inc*

AES361 ANALYSIS OF AERO-STRUCTURES 4 0 0 4

(Pre-requisite: AES242)

Unit 1

Design of rivets and bolted, welded connections, design of springs, design of thick cylinder and spherical shells, analysis of statically indeterminate beams.

Unit 2

General structural design of aircraft, load factors, V-n diagram, stress resultants for swept and unswept wings, application of the following to aircraft design: modified beam theory, wing stress analysis methods, yield and failure under combined loading: initial buckling and failure loads for columns, plates and stiffened panels.

Unit 3

Airworthiness requirements; factors affecting wing design, constituents of wing structures, rib spacing; preliminary layout of wing, estimate of wing element cross-

sectional areas, wing stressing and margin of safety calculations. Stress analysis of aircraft components.

TEXTBOOKS:

1. *Megson, T.H.G., "Aircraft Structures for Engineering Students", Third Edition, Butterworth& Heinemann, New York, 2003.*
2. *S. Timoshenko," Theory of Plates and shells", McGraw-Hill Companies, Second Edition, 1964.*

REFERENCES:

1. *Daniel P. Raymer, Aircraft Design - A Conceptual Approach, AIAA Education series ,2006.*
2. *Egor P. Popov, 'Engineering Mechanics of Solids', Second edition, Prentice-Hall of India Pvt. Ltd., 2004*

AES362 ENGINEERING FRACTURE MECHANICS 4 0 0 4

(Pre-requisite:AES241)

Unit 1

Singular fields at a stationary crack tip, stress intensity factors for simple models of loading, weight function theory, elastic bimaterials crack tip analysis.

Unit 2

Energetics of crack propagation, path independent integrals in crack analysis, J integral and its applications, numerical techniques in Linear Elastic Fracture Mechanics (LEFM): Dugdale model.

Unit 3

Micromechanics of fracture - fracture at elevated temperature in metals and ceramics - fracture in cyclic deformation – introduction to fracture in composites and polymers.

TEXTBOOK:

Anderson, T.L., "Fracture Mechanics", 2nd Edition, CRC Press, 1995.

REFERENCE:

Ramesh, K., "e-book on Engineering Fracture Mechanics", IIT-Madras publisher.

AES363 VIBRATION ANALYSIS 4 0 0 4

Unit 1

Introduction to vibrations: Elementary parts of vibrating systems, degree of freedom, discrete and continuous system. Classifications of vibrating systems.

Single degree freedom of system: Free undamped vibrations, torsional vibrations, free damped vibrations and forced vibrations.

Unit 2

Multi-degree freedom systems: Vibration of systems with two degree of freedom, vibration of systems with more than two degree of freedom, determination of natural frequencies and mode shapes.

Unit 3

Introduction to Flow Induced Vibration (FIV), wing flutter. Finite difference method, central difference method and Runge Kutta method for single degree of freedom systems, central difference method and Runge Kutta method for multi degree of freedom systems.

TEXTBOOKS:

1. *Singiresu S.Rao, Mechanical Vibrations, Addison-Wesley Publications, 2000.*
2. *C. E Beards, Structural Vibration: Analysis and Damping, Butterworth-Heinemann Publications, 1996.*

REFERENCES:

Tomomichi Nakamura and Shigehiko Kaneko, Flow Induced Vibrations: Classifications and lessons form practical experience, Elsevier, 2008.

AES391 CONTROL LAB. 0 0 3 1

Control system exercises in MATLAB, open loop and closed loop responses in temperature, flow and level control systems, PID control, servo control, single axis stabilized platform, pendulum on a cart.

AES392 PROPULSION LAB. 0 0 3 1

Propeller Testing

Estimation of static performance of a propeller, variation of thrust as a function of rpm, estimating the figure of merit of the propeller-motor assembly.

Nozzle Testing

Effect of area ratio on thrust produced by a Laval nozzle, effect of back pressure on the flow inside a Laval nozzle.

Flame speed measurement

Measurement of flame speed using a flame tube apparatus, study of dependence of flame speed on the mixture ratio.

Study of free jet

Study of characteristics of a free jet, estimation of the jet velocity profile and a study of the entrainment process.

AES393 AERO-STRUCTURES LAB. 0 0 3 1

Testing of columns for buckling and axial strength for various end conditions. Unsymmetrical bending of beams.

Plotting of stress-strain curves for various materials and finding the Young's modulus yield and ultimate strengths.

AES394 LOW-SPEED AERODYNAMICS LAB. 0 0 3 1

Wind tunnel – similarity considerations – pressure and velocity measurements – force and moment measurements – hot-wire measurements – experiments designed to cover the above.

AES397 SEMINAR 0 0 3 1

AES411 FLIGHT DYNAMICS 3 1 0 4

Unit 1
Static and dynamic stability, concept and Introduction, Body axis, stability Axis, earth axis - advantages, Euler angles, transformation between axis, advantages of axis, aircraft equation of motion.

Unit 2
Small perturbation theory - linear equations of motion - stability derivatives, longitudinal and lateral modes, concept and physics, characteristic equation - transfer function approach, state space modeling and application to modes.

Unit 3
Rocket motion and performance: Rocket equation, multistaging, parallel staging, optimal staging, sensitivity ratios, vertical ascent trajectories, gravity turn trajectories, re-entry vehicles.

TEXTBOOKS:

1. *Warren F Philips, "Mechanics of Flight", John Wiley Publication, 2004.*
2. *Thomas R Yechout, Steven L Morris, David E Bossert "Introduction to aircraft flight mechanics", AIAA,2003.*
3. *Bandu N Pamadi "Performance, stability, dynamics and control of airplanes", AIAA, 2004.*
4. *Martin J.L. Turner, "Rocket and Spacecraft Propulsion: Principles, Practice and New Developments", Springer publication, 2008*

REFERENCE:

Robert C Nelson," Introduction to flight stability and automatic control", McGraw-Hill Science, 1997

AES451 HYPERSONIC FLOW THEORY 4 0 0 4
(Pre-requisite: AES321)

Unit 1
Introduction, basic considerations and definitions, hypersonic flight paths, inviscid hypersonic flow theory: Shock expansion method, surface inclination methods.

Unit 2
Small disturbance equations and approximate methods, similarity laws; Exact methods, method of characteristics.

Unit 3
Blunt body problem and solution, modern computational methods, introduction to viscous hypersonic flows.

TEXTBOOK:

John D. Anderson, Hypersonic and High Temperature Gas Dynamics. McGraw Hill, 2002.

REFERENCE:

Wallace D. Hayes & Ronald F. Probstein, "Hypersonic Flow Theory", Academic Press; 2nd Ptg. edition (1959).

AES453 ADVANCED COMPUTATIONAL FLUID DYNAMICS 2 0 0 2
(Pre-requisite: AES322)

Unit 1
Principles underlying the Navier-Stokes equations, numerical approximation of the equations describing compressible viscous flow with adiabatic, isothermal, slip, and no-slip wall boundary conditions.

Unit 2
High resolution schemes for capturing shock waves and contact discontinuities, upwinding and artificial diffusion, LED and TVD concepts; alternative flow splitting, discretization of Euler and Navier Stokes equations on unstructured meshes, the relationship between finite volume and finite element methods.

Unit 3
Acceleration of steady state calculations; residual averaging, automatic design; inverse problems and aerodynamic shape optimization via adjoint methods, applications to the Navier-Stokes equations, in two and three dimensions, at high Reynolds number.

TEXTBOOKS:

1. *Hirsch, "Numerical Computation of Internal and External Flows- Vol 1-2", Wiley, 1990.*
2. *Culbert Laney , "Computational Gasdynamics", Cambridge University Press, 1998.*

REFERENCES:

1. *T.J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 200.2*
2. *John Tannehill, Dale Anderson, Richard Pletcher, "Computational Fluid Mechanics and Heat Transfer", Taylor & Francis, 1997.*

AES456 AIR-BREATHING ENGINES 4 0 0 4

(Pre-requisite: AES331)

Unit 1

Classification of jet engines, thrust equation, the Brayton cycle, ideal cycle analysis, components of a jet engine and how they affect the engine performance.

Unit 2

Euler's turbo machinery equations, analysis of axial and centrifugal compressors, velocity diagrams, stage parameters, axial and centrifugal turbines, compressor turbine matching, surge control, thermal limits of blades and vanes, blade cooling.

Unit 3

Subsonic and supersonic inlets, inlet sizing, inlet performance, the combustion process, stability, length scaling, fuels, types of burners, combustor performance, afterburners, flame stabilisation, nozzles, thrust vectoring, nozzle performance.

TEXTBOOKS:

1. *Mattingly.Jack.D, Elements of propulsion: Gas turbines and Rockets, AIAA Education Series, 2006*
2. *Flack.R.L, Fundamentals of jet propulsion with applications, Cambridge University Press, 2005*

AES461 COMPOSITE MECHANICS AND MATERIALS 4 0 0 4

Unit 1

Composite materials and its characteristics, types of composites, manufacturing process of composites, micro and macro mechanical behavior of lamina, behavior of unidirectional composites, short fiber composites.

Unit 2

Analysis of laminated composites, physical and mechanical properties: Elastic modulus, tensile strength, elongation, fatigue and creep.

Unit 3

Testing of composites, failure criteria, application of composites in different fields, design of composites: determination of stresses and strains.

TEXTBOOKS:

1. *Mallick P.K., "Fiber- Reinforced Composites : Materials, Manufacturing and Design", Marcel Dekker, Inc,1993*
2. *Agarwal B.D. and Broutmen L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990*
3. *Jones R.M., "Mechanics of Composite Materials", Hemisphere Publishing Corporation, New York.*

REFERENCES:

1. *Happin J.C., "Primer on Composite Material Analysis", Techomic Publishing Co.,1984*
2. *F. L. Matthews and R. D. Rawlings, "Composite Materials: Engineering and Science", Chapman& Hall, London, 1994.*

AES462 AERO-ELASTICITY 4 0 0 4

(Pre-requisite: AES312)

Unit 1

Introduction to aeroelasticity, static aeroelasticity: Divergence of typical section, control surface reversal, divergence of 1-D structures (straight and swept wings), mode summation method, composite wings.

Unit 2

Airplane structure under dynamic loads: dynamic equilibrium of slender rotating beams in bending, dynamic equilibrium of slender beams in torsion, dynamic equilibrium of restrained airplane wing, dynamic equilibrium of unrestrained elastic airplane wing.

Unit 3

Aeroelastic flutter: Stability characteristics, aeroelastic analysis of a typical section, classical flutter analysis, engineering solution for flutter, unsteady aerodynamics, flutter prediction via assumed modes, flutter boundary characteristics.

TEXTBOOKS:

1. *Raymond L. Bisplinghoff, Holt Ashley, Robert L. Halfman, "Aeroelasticity", Dover Publications, 1996.*
2. *Dewey H. Hodges, G. Alvin Pierce, "Introduction to Structural Dynamics and Aeroelasticity", Cambridge University Press, 2002.*

REFERENCE:

Raymond L. Bisplinghoff, Holt Ashley, "Principles of Aeroelasticity", Dover Publications, 2002.

AES463 MATRIX METHODS IN STRUCTURAL ANALYSIS 4 0 0 4

Unit 1

Basic concepts in indeterminacy (static, kinematics), generalized measurements, degrees of freedom, behavior of structures, principle of superposition, stiffness and flexibility matrices in single, two and multi coordinates, structures with constrained coordinates, stiffness and flexibility coefficients.

Unit 2

Transformation of information: Determinate and indeterminate structures, transformation of element matrices to structures matrices, orthogonal transformations, flexibility method: Flexibility method applied to statically determinate and indeterminate structures (only 2-D structures - beams, trusses, frames subjected to external load only), choice of redundant.

Unit 3

Stiffness method: Development of the method, application to symmetrical structures, basic stiffness method and direct stiffness method, static condensation technique – computer programs for simple problems in 2-D beams, trusses and frames.

TEXTBOOK:

Weaver, J.R., and Gere, J.M., "Matrix Analysis of Framed Structures", CBS Publishers, New Delhi, 1986.

REFERENCE:

Fleming, J.F., "Computer Analysis of Structural Systems", McGraw Hill Book Co., 1989.

AES471 ADVANCED AVIONICS 2 0 0 2

(Pre-requisite: AES332)

Unit 1

Instrument landing system, microwave landing system, radio magnetic indicator, horizontal situation indicator, very high frequency OMNI range, automatic direction finder: ADF concept, principles of electromagnetic wave propagation, ADF theory.

Unit 2

Distance measuring equipments: DME concepts, pilot's perspective, electronic navigation, transponder, traffic alert and collision avoidance, long range navigation: theory of navigation, LORAN receiver, Omega navigation system (ONS).

Unit 3

Autopilots & flight management system: Autopilots, flight management systems, avionic system Integration: Introduction and background, data bus systems,

integrated modular avionics, commercial off the shelf (COTS), unmanned air vehicles: importance of unmanned air vehicles, UAV avionics.

TEXTBOOKS:

1. *Dale R. Cundy, Rick S. Brown, "Introduction to Avionics", Prentice Hall, 1996.*
2. *R.P.G Collinson, "Introduction to Avionics", Springer, 2002.*

REFERENCES:

1. *Kayton and Fried, "Avionics Navigation Systems", Wiley, 1997.*
2. *N.S.Nagaraja, "Elements of Electronic Navigation", Tata McGraw-Hill, 1976.*

AES472 SPACE FLIGHT MECHANICS 4 0 0 4

Unit 1

Basic physical principles: The two-body problem, orbit formulas and types of orbits, co-ordinate systems and transformation, orbits in three dimensions, orbit determination - Lambert's theorem.

Unit 2

Orbital maneuvers: Single-impulse orbit adjustments, multi-impulse orbit adjustment, Hohmann transfer, relative motion and rendezvous, interplanetary trajectories, satellite orbits, review of rigid body dynamics, Euler's equations.

Attitude dynamics and kinematics: Angular momentum and inertial matrix, rotational kinetic energy of rigid body, moment of inertia matrix in selected frame, Euler's moment equations, characteristics of rotational motion of a spinning body.

Unit 3

Satellite attitude dynamics: Torque free motion, stability of torque free motion, basic attitude control equation, attitude - measurement, control and stabilization, gyroscopic attitude control, gravity gradient attitude control, single and dual spin stabilization, attitude maneuvers in space, momentum biased attitude stabilization.

TEXTBOOKS:

1. *Orbital Mechanics for Engineers and Scientists, Howard Curtis, Elsevier, 2005*
2. *Marcel J. Sidi, "Spacecraft dynamics and control: A practical Engineering approach", Cambridge University Press, 2003.*
3. *James R Wertz, "Spacecraft Attitude Determination and Control", Kulwar Academic Publishers, 1990.*

REFERENCE:

Bong Wie, "Space vehicle dynamics and control", AIAA publications, 2008.

AES473 FLIGHT CONTROL SYSTEMS 2 0 0 2

(Pre-requisite: AES411)

Unit 1

Reviewof classical control theory and state space methods, longitudinal/Lateral modes; single, 2- and 3-degree approximations; flying and handling qualities.

Unit 2

Autopilots, stability - augmentation system (longitudinal and lateral control), fly-by-wire aircraft, active control system, control configured vehicles.

Unit 3

Introduction to relaxed static stability, gust load alleviation, smart airplanes, introduction to digital control and stability.

TEXTBOOKS:

1. Donald McLean, "Automatic Flight Control Systems", Prentice Hall International Ltd, 1990

2. Bandu N Pamadi," Performance, stability, dynamics and control of airplanes", AIAA, 2004.

REFERENCE:

Robert C Nelson," Introduction to flight stability and automatic control", McGraw-Hill Science, 1997.

AES476 MANUFACTURING PROCESSES 4 0 0 4

Unit 1

Casting, rolling, forging, extrusion, drawing and sheet metal working - types of defects and remedies.

Unit 2

Fusion, resistance and solid state processes and their applications. Welding defects: causes and remedies.

Definition and concept – production of metal powders - characteristics of metal powders - compaction - sintering – design consideration - process capability - applications.

Unit 3

Abrasive jet machining, ultrasonic machining, electro-discharge machining, electrochemical machining and laser beam machining. Surface modification processes - diffusion coating – electroplating – anodizing - conversion coating - hot dipping - ceramic and diamond coating.

Rapid prototyping & Its types, CNC and types of CNC's.

TEXTBOOKS:

1. Serope Kalpakjian and Steven R.Schmidt, 'Manufacturing Engineering and Technology', Pearson Education Asia, 2000 (fourth edition) (Indian Reprint 2000).

2. P.K. Mishra, 'Nonconventional Machining process', Narosa Publishing House, 2006.

REFERENCES:

1. Amitabha Ghosh and Asok Kumar Mallik, 'Manufacturing Science', East-West Press, 2001.

2. A.Azad, 'Fundamentals of Computer Aided Manufacturing', Jaico Publishing House, 2006.

AES477 MULTIDISCIPLINARY DESIGN OPTIMIZATION 4 0 0 4

Unit 1

Single variable optimization: Introduction to optimization, optimality criteria, bracketing methods: Exhaustive search method, bounding phase method, region elimination methods, golden section search method, point estimation methods, gradient based methods: Newton Raphson method, bisection method, secant method, cubic search method.

Multivariable optimization: Optimality criteria, gradient based methods: Steepest descent method, conjugate direction method, conjugate gradient method and Newton's method.

Unit 2

Constrained optimization - Karush-Kuhn-Tucker optimality criteria, direct methods, indirect methods, penalty function methods. Linear programming - introduction, geometry of linear programming problems, solution of a system of linear simultaneous equations, simplex method, two phases of simplex method, revised simplex method, duality in linear programming, transportation problems.

Unit 3

Global optimization: Simulated annealing, Nelder-Mead simplex, genetic algorithm, multiobjective optimization: Pareto optimality, global function / weighted sum, "Gaming" approach (e-constraint), Min-Max, goal attainment, Kreisselmeier-Steinhauser function, recent MDO techniques: Approximations, response surface methodology in MDO, collaborative optimization.

TEXTBOOKS:

1. Icase," Multidisciplinary Design Optimization: State of the Art", Soc for Industrial & Applied Math (February 1997)

2. Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and examples", Prentice Hall of India, New Delhi, 2004.

REFERENCE:

J. Arora, "Introduction to Optimum Design," 2nd ed., Elsevier Academic Press, San Diego, CA, 2004.

AES491 AERO-DESIGN LAB. 2 1 3 4

Conceptual aerodynamic design of an airplane to meet the prescribed mission requirements, collection of statistical data.
Preliminary weight estimation, selection of wing loading, thrust loading, wing section and plane form, and high lift devices, fuselage layout and weight balance, estimation of aerodynamic characteristics and performance evaluation.
Design of tail areas and control surfaces, Estimation of spanwise load distributions on the wing and tail. Airworthiness requirements, factors affecting wing design, preliminary layout of wing, estimate of wing element cross-sectional areas, wing stressing and margin of safety calculations.
Design of propulsion unit: propeller design, selection of IC engines/ electric motor. Testing of propulsion unit.
Calculating the overall performance of the aircraft and comparing with flight test data. Project involves design and fabrication & testing of a model aircraft for the given mission plan.

TEXTBOOKS:

1. *Daniel P. Raymer, Aircraft Design - A Conceptual Approach, AIAA Education series.*
2. *John D Anderson, Aircraft Performance and Design, McGraw Hill International Edition*
3. *Darrol Stinton, The Design of the Aeroplane, Blackwell Science LTD, 2001*

AES493 FLIGHT TESTING LAB. 0 0 3 1
(Pre-requisite: AES312)

Online measurement of flight dynamics parameters. Evaluation of glider drag polar. Evaluation of cruise and climb performance of a small aircraft. Determination of static and maneuver stability and control characteristics. Requires visits to institutes with flight testing facilities.

AES498 PROJECT - Phase I 3 cr

AES499 PROJECT - Phase II 9 cr

CHY100 CHEMISTRY 3 0 0 3

Unit 1

Water Technology: Hardness – units of hardness – alkalinity - dissolved oxygen. Boiler feed water – boiler compounds – boiler problems - internal conditioning - external conditioning – zeolite and ion exchange process. Municipal water treatment – desalination by RO and electro dialysis.

Phase rule: Phase rule – statement and explanation of terms–one component system – water-vapor-ice – thermal analysis – condensed phase rule - Two component system – Ag – Pb – simple Eutectic – compound formation - Cu – Au solid solution - Ellingham diagram and its application**.**

Unit 2

Spectroscopy: Significance of spectroscopy as analytical tool – Electromagnetic spectrum, intensities of spectral lines and the Beer-Lamberts law. Vibration of Diatomic molecules - Energy levels - Principles of selection rules - Introduction to IR spectrum – vibrational frequency – fundamental vibrations – IR instrumentation and its applications – Electronic spectra – types of electronic transition – chromophore concept – absorption and intensity shifts – conjugated dienes - solvent effects – UV Instrumentation and its applications. Principles of H-NMR – number of signals – chemical shift – splitting of the signals.
Chemistry of corrosion and its control: Chemical and electro chemical corrosion – Pilling Bed worth ratio – forms of corrosion.

Unit 3

Electrochemical series - galvanic series - corrosion potential – corrosion current – rate of corrosion – units of corrosion - rate determination – weight loss method. Corrosion control - cathodic and anodic protection.
Advanced Engineering Materials: Introduction to Nanoscience and Technology – significance of nano materials – methods of synthesis – Carbon Nanotubes - synthesis – properties and applications. Conducting polymers - mechanism of conduction - applications. Organic LEDs - their functioning - advantages and disadvantages over conventional LEDs - their commercial uses. Liquid crystals – positional and orientation order - classification of liquid crystals - requirement for substance to exhibit liquid crystalline state - chemical constitution - identification of liquid crystals - electro-optic effect in liquid crystals, application of liquid crystals.

TEXTBOOKS:

1. *Gordon M Barrow, "Physical Chemistry", 5th edition, Tata McGraw-Hill, (2007).*
2. *Jain P C & Monika Jain, "Engineering Chemistry", Dhanpatrai Publishing Co Ltd, New Delhi, (2005).*

REFERENCES:

1. *Fontana and Mars G, "Corrosion Engineering", 3rd edition, McGraw hill, (1987).*
2. *Robert M Silverstein and Francis X Webster, "Spectrometric Identification of Organic Compounds", 6th edition, Wiley & Sons, (2006).*
3. *Charles P Poole, Jr Franck J Owens, "Introduction to Nanotechnology", Wiley Interscience, (2003).*
4. *Chandrasekhar A, "Liquid crystals", Cambridge University Press, Cambridge, UK, (1992).*
5. *CNR Rao, "UV & Visible Spectroscopy – Chemical Application", Butter Worths.*
6. *CNR Rao, "IR Spectroscopy – Chemical Application", Academic Press*

CHY181 CHEMISTRY LAB. 0 0 3 1

1. Estimation of Hardness of sample water.
2. Estimation of alkalinity of sample water.
3. Estimation of Kinetics of Ion Exchange reactions.
4. Estimation of HCl and CH_3COOH by conductometric titration.
5. Estimation of Fe^{2+} by potentiometric titration.
6. Phase diagram of two component system.
7. Determination of Corrosion rate and Inhibitor efficiency by weight loss method.
8. One step preparation of simple organic/inorganic compound.
9. Determination of molecular weight of polymer by viscosity method.
10. Adsorption by Activated charcoal method.

(Any 9 experiments of the above list)

Experiments for Demonstration

11. Desalination by Reverse osmosis.
12. Estimation of Dissolved oxygen of sample water.
13. Spectrophotometric analysis of trace element (Fe) in water.

CHY250 CATALYTIC CHEMISTRY 3 0 0 3

Unit 1

Catalysis: Introduction, Industrial applications. Rates of reactions - equilibrium, energy of activation and the catalyst's role, Elementary reactions in catalytic transformations homogeneous and heterogeneous catalysis.

Catalysis in solutions: Acid-base catalysis - catalysis in the gas phase, catalysis in dilute aqueous solution, catalysis in concentrated strong acid solutions, catalysis by bases, catalysis by metal ions, catalysis by electron transfer, organometallic catalysis, catalysis in Ziegler Natta/Metallocene/Metathesis polymerization.

Unit 2

Catalysis by macromolecules, Phase transfer catalysis.

Catalysis by Enzymes: Introduction - kinetics of enzyme catalyzed reaction, catalysis through enzyme, organic catalysis, metalloenzyme catalysis, supported enzymes. Industrial applications of enzyme catalyst.

Catalysis by Polymers: Attachment of catalytic groups to polymer supports, Adsorption and the Kinetics of polymer-catalyzed reactions**.**

Unit 3

Catalysis in polymer gels, bifunctional and multifunctional catalysis, porous polymers, Applications of polymer catalysis.

Catalysis in Molecular scale cavities: Structures of crystalline solids, structure

of Zeolites, catalysis by Zeolites, catalysis by Zeolites containing metal complexes and clusters. Catalysis on surfaces – surface catalysis, catalysis on metal surfaces**.**

TEXTBOOKS:

1. *Bruce C Gates, "Catalytic Chemistry", John Wiley & Sons, Inc. USA, (1992).*
2. *Viswanathan B, Sivasankar S, Ramaswamy A V, "Catalysis, Principles and Applications", CRC Press, (2006).*

REFERENCES:

1. *James E House, "Principles of Chemical Kinetics", Academic Press, (2007).*
2. *Kuriacose J C, "Catalysis", Macmillan India Limited, New Delhi, (1991).*

CHY251 CHEMISTRY OF ENGINEERING MATERIALS 3 0 0 3

Unit 1

Chemical materials in Electronics and Electrical Engineering: Structural correlation to behavior of conducting polymers, Semi-conducting polymers - properties of organic polymers containing metal groups such as poly ferrocene - optical fibers - definition, principle and structure - characteristics of optical fibre - photo resist optical fibre - advantages of optical fibre - liquid crystalline - peizo and pyroelectric polymers - magnetic materials, hard and soft magnets – sensors (voltametric).

Nanomaterials: Nanotubes and Nanowires, Carbon nanotubes, single walled and multiwalled, aligned carbon nanotubes, doping with boron – applications - Nanostructured polymers.

Unit 2

Chemical aspects in biotechnology - Enzymes and bio reactors - Biotechnological processes – Bio-sensors - glucose biosensors, bio-filters and bio-membranes – Bio-fertilizers, Bio-surfactants.

Chemistry of Engineering Plastics: Preparation, properties and applications of ABS, Polycarbonates, Epoxy resins - Polyamides - Nylon and Kevlar.

Photochemistry in Electronics: Photochemical reactions - laws of absorption (Grothers - Draper law - Stark - Einstein's law) - Quantum efficiency - photochemical decomposition of HI and HBr - and Quantum yield.

Unit 3

Florescence and Phosphorescence - chemiluminescence - photo sensitization.

Chemistry of Toxic Materials and Toxicology: Principles of Toxicology - Volatile poisons - Gases CO, hydrocyanic acid - H_2S - PH_3 - CO_2 - SO_x - NO_x - Heavy metals - lead, arsenic, mercury, antimony, barium, bismuth, selenium, zinc, thallium - Pesticides - Food poisoning - Drug poisoning - barbiturates - narcotics - ergot - LSD - alkaloids - Radioactive Toxicology - Radiation hazards.

TEXTBOOK:

Kuriacose J C, Rajaram, "Chemistry in Engineering and Technology, Systematic Organic and Inorganic Chemistry and Chemistry of Materials (Vol 1 & 2)", Tata McGraw-Hill Publishing Company Limited, 1999.

REFERENCE:

Van Vlack, Lawrence H, "Elements of Material Science and Engineering" (6th edition), New York Addison-Wesley, 1989.

CHY252 CHEMISTRY OF ADVANCED MATERIALS 3 0 0 3

Unit 1

Chemistry of Engineering Plastics: Preparation, properties and applications of ABS, polycarbonates, epoxy resins - polyamides - Nylon and Kevlar.

Chemistry of Carbon nanotubes: Introduction, carbon nanotubes - fabrication, structure, electrical properties - vibrational properties - mechanical properties - applications of carbon nanotubes.

Unit 2

Electron transfer studies in salt based conductors and magnets: Introduction - definitions and units - ferro magnets and ferrimagnets. One-dimensional conductors - quasi one and two-dimensional super conductor. Fullerides - paramagnetic conductors and superconductors. Electron transfer salt based ferro magnets: nitroxide, metallocene and ferric magnet-based ferro magnets - weak ferro magnets. Nanopore containment of magnetic particles - nanocarbon ferromagnets.

Unit 3

Functional electro active polymers: Conjugated polymers - synthesis, processing and doping of conjugated polymers: polyacetylene, polyaniline, polythiophene, poly (p-phenylenevinylene) - ionically conducting polymers - applications of conjugated polymers. Semi-conducting, poly ferrocene - photo resist optical fibers and sensors, photo chromic & thermo chromic materials.

Photochemistry in Electronics: Laws of absorption - quantum efficiency and quantum yield - florescence and phosphorescence – photosensitization.

High energy materials: Preparation, properties and application of ammonium nitrate (AN), NH_4NO_3, ammonium perchlorate (AP), NH_4ClO_4, ammonium dinitramide (AND), $NH_4N(NO_2)_2$, hydrazinium nitroformate (HNF), $N_2H_5C(NO_2)_3$ etc.

TEXTBOOKS:

1. *Van Vlack, Lawrence H, "Elements of Material Science and Engineering", 6th edition, New York Addison, Wesley, (1989).*
2. *Chawla S, "A Textbook of Engineering Chemistry", Dhanpatrai & Co, Delhi, (2001).*

REFERENCES:

1. *Mark Ratner and Daniel Ratner, 'Nano technology - A gently introduction to the next big idea', Pearson Education, (2003).*
2. *Interrante L. V. and Hampden Smith M.J, 'Chemistry of Advanced Materials', Wiley-VCH, (1988).*

CHY253 ADVANCED POLYMER CHEMISTRY 3 0 0 3

Unit 1

Newer Polymers and Polymerizations: Polymeric Liquid Crystals - Inorganic and Organometallic polymers - Synthesis and reactions of Phosphorus - Nitrogen polymers - Boron - Silicone polymers. Cyclisation versus Linear Polymerization - Molecular weight control in linear polymerization - Molecular weight distribution in linear polymerization - Molecular weight distributions in nonlinear polymerization - Multichain Polymerization - Metallocene Polymerization.

Unit 2

Solid-state irradiation polymerization - Atom transfer radical polymerization - Plasma Polymerization - Zwitterionic Polymerization - Isomerization polymerization - Polymer supported solid phase reactions - Merrifield method.

Polymer degradation and stabilization: Mechanism of different types of degradation - Commonly used antidegradants and the mechanism of their stabilization**.**

Unit 3

Polymer solutions: Criteria for solubility - Heat of Dissolution and Solubility parameters - Conformation of polymer chains in solutions - Nature of polymer molecules in solution - Size and shape of macromolecules in solution - Thermodynamics of polymer solutions - Phase equilibria - Entropy and heats of mixing of polymer solutions - Effect of molecular weight on solubility - Solubility of crystalline and amorphous polymers - Flory Huggins theory of polymer solution, Equation of state theory, Flory Krigbaum theory and cluster type theory - Viscosity of dilute polymer solutions.

TEXTBOOKS:

1. *George Odian, "Principles of Polymerization", John Wiley & Sons Inc., New York, (1991).*
2. *Malcolm P.Stevens, "Polymer Chemistry", Oxford University Press, New York, (1999).*

REFERENCES:

1. *Harry R Allcock and Frederick W Lampe, "Contemporary Polymer Chemistry", 2nd edition, Prentice Hall, Inc., New Jersey, (1990).*
2. *Charles E Carraher, Jr., "Polymer Chemistry", 5th edition, Marcel Dekker Inc., New York, (2000).*
3. *Jayadev Sreedhar and Govariker, "Polymer Chemistry".*

CHY254 POLYMERS FOR ELECTRONICS 3 0 0 3

Unit 1

Conducting polymers: Conducting mechanisms - Electron transport and bipolar polymers - electrodepositable resists, resins. Applications - Organic light emitting diodes, Sensors, EMI shielding, printed Circuit Boards, Artificial nerves, Rechargeable Batteries, Electromechanical Actuators and switches.

Unit 2

Photoconductive polymers: Charge carriers, charge injectors, charge transport, charge trapping. Polymers for optical data storage - principles of optical storage, polymers in recording layer.

Nonlinear optics: NLO properties and NLO effects, wave guide devices, polymer optical fibers - through plane modulators.

Unit 3

Thermosensitive polymers: Applications - Mechanical actuators and switches - Tissue culture, Drug delivery, Photo resists - Types - Chemically amplified photoresists - Applications. Magnetic polymers - structure and Applications.

Liquid crystalline polymers: Fundamentals and process, liquid crystalline displays - Applications.

TEXTBOOK:

Kiichi Takemoto, Raphael M. Ottenbrite, Mikiharu Kamachi, "Functional Monomers and Polymers", CRC Press, (1997).

REFERENCE:

1. *A B Kaiser, "Electronic properties of conjugated polymers - basics, models and applications", Springer Verlag, (1987).*
2. *J. A. Chilton and M T Goosy, "Special polymers for electronics and optoelectronics", Kluwer Academic Publishers, (1995).*

CHY255 CHEMISTRY OF TOXICOLOGY 3 0 0 3

Unit 1

Introduction to Toxicology: Definition - scope - history - relationship to other sciences - dose-response relationship - sources of toxic compounds - Classes of Toxicants - broad overview of toxicant classes such as metals, agricultural chemicals, food additives - contaminants, toxins, solvents, drugs, and cosmetics - history, exposure route, and toxicity of the non-essential metals - cadmium, lead, and mercury - medical treatment of metal poisoning - classes of agricultural chemicals - Toxins - source, including microbial, fungal, algal, plant and animal - examples - Brief discussions - food additives and contaminants – solvents - therapeutic drugs - drugs of abuse - combustion products - cosmetics.

Unit 2

Exposure Classes, Toxicants in Air, Water, Soil, Domestic and Settings: Occupational Air, water and soil as primary media for human exposure to various classes of chemical toxicants in environmental, domestic, and occupational settings - historic and present status of air pollution and air quality - introduction to the major classes of soil and water pollutants - sources, exposure routes and potential adverse health effects - Classes of occupational toxicants - route of exposure and permissible levels - specific examples of concern.

Unit 3

Toxicant Analysis and Quality Assurance Principles: Introduction to procedures, principles and operation of analytical laboratories in toxicology. Summary of the general policies - analytical laboratory operation, analytical measurement systems, quality assurance (QA) - quality control (QC) procedures.

Environmental Risk Assessment: Environmental risk assessment procedures - particular environmental risk problem - appropriate endpoints - development of conceptual models, analyzing exposure – effects, information - characterizing exposure - ecological effects - management of risks.

Future Considerations for Environmental and Human Health: Changes in toxicology - evaluation of future risk assessment - more fundamental aspects of toxicology - in vivo and in vitro toxicity - biochemical toxicology - molecular toxicology - development of selective toxicants.

TEXTBOOK:

Ernest Hodgson, "Modern Toxicology", John Wiley & Sons, Inc., (2004).

REFERENCES:

1. *John Wright, "Environmental Chemistry", Routledge, (2003).*
2. *A K DE, "Environmental Chemistry", New Age International, (2003).*
3. *Fritz Helmet, "Environmental Chemistry", Sarup and sons (Delhi), (2003).*

CHY256 CHEMISTRY OF NANOMATERIALS 3 0 0 3

Unit 1

Introduction: Introduction to Nanomaterials: Size dependence of properties - Surface to volume ratio and Quantum confinement. Microscopic techniques to study nano structures - SEM, AFM - TEM and STM - Raman spectroscopy.

Synthesis of Nanomaterials: Synthetic approaches: Colloidal Self-Assembly (Self-assembled monolayers - SAMs) and electrostatic self-assembly, electrochemical methods, sol-gel deposition

Unit 2

Langmuir-Blodgett (LB) technique, chemical vapour deposition, plasma arcing and ball milling.

Carbon nanostructures: Carbon Clusters: Fullerenes, structure, synthesis, alkali doped C_{60} - superconductivity in $C_{60,}$ applications of fullerenes. Carbon nanotubes: Classification, properties, synthesis, characterization, and potential applications, growth mechanism of carbon nanotubes.
Other Nanostructures: Quantum Dots: Preparation, properties and applications of Au, CdS and CdSe quantum dots,

Unit 3
Fabrication and applications of conducting polymer nanotubes, TiO_2 and metallic nanotubes.
Molecular Electronics and Machines: Molecular electronics: Working of Molecular and supramolecular switches, transistors and wires. Molecular machines: Working of Molecular motors, rotors, cars, elevators and valves.

TEXTBOOKS:

1. *Charles P Poole Jr, Frank J Ovens, "Introduction to Nanotechnology", Wiley Interscience, (2003).*
2. *Alexei Nabok, "Organic and Inorganic Nanostructure", Artech House, Inc. (2005).*
3. *Peter J F Harris, "Carbon Nanotube Science: Synthesis, Properties and Applications", Cambridge University Press, (2009).*
4. *Balzani V, Credi A, Venturi M, "Molecular devices and machines - A journey in to the Nanoworld", Wiley VCH, (2003).*

REFERENCES:

1. *Rao C N R, Muller A, Cheetham A K (Eds.), "The Chemistry of Nanomaterials: Synthesis, Properties and Applications", WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, (2004).*
2. *Zhong Lin Wang, "Characterization of nanophase materials", Wiley VCH, (2000).*
3. *Massimiliano Di Ventra, Stephane Evoy, James R Heflin, "Introduction to nanoscale science and technology", Kluwer Academic Publishers, (2004).*
4. *William A Goddard, III, Donald W Brenner, Sergey Edward Lyshevski and Gerald J. Iafrate, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, (2003).*
5. *Balzani V, Credi A, Venturi M, "Molecular devices and machines- A journey in to the Nanoworld" Wiley VCH (2003).*
6. *Bharat Bhushan, "Hand book of Nanotechnology", Springer, (2004).*

CHY257 BIOMATERIALS SCIENCE 3 0 0 3

Unit 1
Introduction: Bulk properties, Surface properties and characterization - polymers, silicone biomaterials, medical fibres and biotextiles - Smart polymers - bioresorbable and bioerodible materials - natural materials, metals and ceramics - physicochemical surface modification.
Biocompatibility concepts : Introduction to biocompatibility - cell material interaction – types of materials - toxic, inert, bioactive - long term effects of materials within the body - cell response.

Unit 2
Chemical and biochemical degradation of polymers - degradation of metals and ceramics - calcification of biomaterials.
Host reactions and their evaluation: Inflammation and foreign body response - adaptive immunity - systemic toxicity and hypersensitivity - blood coagulation and blood materials interactions - device related infections.

Unit 3
Biological testing of biomaterials: Invitro and invivo assessment of tissue compatibility - evaluation of blood materials interaction - microscopy in biomaterials.
Practical aspects of biomaterials: Bioelectrodes, biomedical sensors and biosensors - sterilization of implants - implant failure - implant retrieval and evaluation - legal aspects, ethical issues and regulation aspects.

TEXTBOOK:

Buddy D Ratner, Allan S Hoffman, "Biomaterials Science - An introduction to materials in Medicine", Elsevier academic press, (2004).

REFERENCES:

1. *Jonathan Black, "Biological Performance of Materials: Fundamentals of Biocompatibility", 4th edition, CRC Press, (2006).*
2. *John D. Enderle, Susan M. Blanchard, Joseph D. Bronzino, "Introduction to Biomedical Engineering", 2nd edition, Elsevier Academic Press, 2005.*

CHY258 ENVIRONMENTAL CHEMISTRY 3 0 0 3

Unit 1
Air and air pollution (earth's atmosphere): Regions - ozone - CFC and other chemicals - catalytic decomposition of ozone - 'ozone hole' formation - Air pollution due to gas emission from industries - Atmospheric aerosols – dust, combustion products, aerosol concentration and lifetimes - Automobile exhausts, smog and effects - Acid rain - chemistry of acid rain, roll of meteorology, greenhouse gases and global warming - air pollution due to jet engines.
Water and water pollution (hydrosphere): Physical and chemical properties of water- microbiological processes - carbon, nitrogen cycles - Water pollution - polluting agents - indices of pollution, heavy metal pollution and toxicity - BOD and COD determination - suspended solids - determination of other ions by photometric methods - Chemistry of anaerobic process, use of Effective Microorganisms.

Unit 2
Aerobic processes - wastewater treatment systems (brief description only) - anaerobic and aerobic - sewage treatment, primary, secondary and tertiary processes - water reuse and recycle. Eutrophication of lakes, nitrogen and

phosphorus in effluents - Drinking water standards - sources - fluoride and arsenic in water, purification, sterilization - chemistry of chlorination - water purification for domestic use - reverse osmosis -nano filters and membranes.

Industrial Pollution and its control: Industrial pollution and waste waters from various types of industries - environmental pollution due to paper mills, textile mills etc., and its control. Solid waste disposal - methods - solid waste from mining and metal production and its disposal - Electrochemical treatment of pollution control, electro-coagulation and flocculation - Green chemical processes and green solvents-reaction conditions to control industrial pollution.

Unit 3

Other types of pollution: Soil pollution - agricultural pollution - use of chemical fertilizers - Organic chemicals and environment, dioxins and furans - chemistry of some of the pesticides, insecticides and herbicides, ill effects due to uncontrolled use - Bulk storage of hazardous chemicals and disasters, Radioactive pollution, radiation units, sources - exposure and damage - safety standards - radioactive wastes and their disposal - Toxicological substances, testing of toxic substance, enzyme inhibition and biochemical effects of toxic chemicals on humans.

Sampling and Measurements of Pollutants: Sampling and analysis techniques of air pollutants (brief outline only) - analysis of particulate matter and lead - Sampling and measurements of water pollutants - organic loadings, phosphates and nitrogen compounds - monitoring of water quality - water test kits, various analytical methods (brief outline only).

TEXTBOOKS:

1. *Gary W.VanLoon and Stephen J.Duffy, "Environmental Chemistry", Oxford University Press, (2000).*
2. *Ajay Kumar Bhagi and G.R.Chatwal, "Environmental Chemistry", Himalaya Publishing House, (2003).*

REFERENCES:

1. *John Wright, "Environmental Chemistry", Routledge, (2003).*
2. *A K De, "Environmental Chemistry", New Age International, (2003).*
3. *Fritz Helmet, "Environmental Chemistry", Sarup and sons (Delhi), (2003).*
4. *Clair N Sawyer, Perry L McCarty and Gene F Parkin, "Chemistry for Environmental Engineering", McGraw Hill, (1994).*
5. *Jack Barrett, "Chemistry in your Environment", Albion Publishing Ltd., (1994).*
6. *Thomas G Spiro and William M Stigliani, "Chemistry of the Environment", Prentice Hall, (2002).*
7. *Kudisia VP and Ritu, "Environmental Chemistry", Pragati Prakashan, Meerut, (2000).*

CHY259 INSTRUMENTAL METHODS OF ANALYSIS 3 0 0 3

Unit 1

Error Analysis and Sampling: Accuracy - Precision - Classification of Errors - Minimization of errors - Standard deviation - Coefficient of variance - F-test - t-test - Significant figures. Sampling - Basis of sampling, Sampling and physical state - Safety measures of sampling.

Separation Techniques: Brief out line of column, paper and thin layer chromatography - Ion exchange methods - principle and application – HPLC.

Unit 2

Gas chromatography - principle and applications – gel chromatography.

Electro analytical techniques: Potentiometry - Potentiometric titration - determination of equivalence point - acid base, complexometric, redox and precipitation titrations - merits and demerits. Voltammetry - Cyclic voltammetry - basic principle and application - Polarography - introduction - theoretical principles - migration current - residual current - half wave potential - instrumentation - analytical applications.

Unit 3

Spectro-chemical techniques: UV-VIS spetrophotometry - principle - Beer's Law application - photometric titration - single and double beam spectrophotometer - instrumentation of IR - sample handling - IR applications - H - NMR - Instrumentation and applications - principle - instrumentation - applications of atomic absorption spectroscopy.

Thermal and Diffraction techniques: Principles and applications of DTG - DTA - DSC - X-ray - Electron Diffraction Studies - SEM, TEM.

TEXTBOOKS:

1. *Willard H W, Merritt JR, "Instrumental Methods of Analysis", 6th edition, Prentice Hall, (1986).*
2. *Skoog Douglas A, West Donald, "Fundamentals of Analytical Chemistry", 7th edition, New York Addison, Wesley, (2001).*

REFERENCES:

1. *"Vogel's Textbook of Quantitative Chemical Analysis", 5th edition, ELBS, (1989).*
2. *Kaur.H, "Instrumental Methods of Chemical Analysis", Goel Publisher, (2001).*

CHY260 ORGANIC SYNTHESIS AND STEREOCHEMISTRY 3 0 0 3

Unit 1

Nomenclature of Organic compounds: Polyenes, Alkynes with and without functional groups by IUPAC nomenclature. Aromatic and Heteroaromatic systems - nomenclature of heterocycles having not more than two hetero atoms such as oxygen, sulphur, nitrogen.

Stereochemistry: Tacticity, R/S system of nomenclature of central and axial molecules.

Unit 2

Atropisomerism - isomerism of biphenyls - allenes and spiranes - ansa compounds - Geometrical isomerism, E, Z Isomerism. Asymmetric synthesis.

Conformational Analysis: Optical activity and chirality - Conformational Analysis of cyclic and acyclic system - Conformational effects on reactivity of acyclic systems only.

Unit 3

Asymmetric synthesis: Stereo selective - Stereo specific - Regioselective and Regiospecific reactions. Principle of protection of alcohol, amine, carboxyl and carbonyl groups - Functional group inter conversions - Disconnection approach - Reversal of polarity - reagents in synthesis.

TEXT BOOKS:

1. *E. L. Eliel, "Stereochemistry of Carbon Compounds", Mc Graw-Hill Book Co, (2000).*
2. *Jerry March, "Advanced Organic Chemistry", 4th edition, John Wiley & Sons, (1992).*

REFERENCES:

1. *S. Warren, "Designing Organic Synthesis", Wiley & Sons, (1998).*
2. *Finar I.L, "Organic Chemistry: Stereochemistry and the Chemistry of Natural Products", 5th edition, ELBS, (2000).*

CHY261 UNIT PROCESSES IN ORGANIC SYNTHESIS 3 0 0 3

Unit 1

Application of Thermodynamics in Organic Unit Processes: free energy, bond energies and entropy. Concepts of aromaticity - Huckel's rule - anisotropy. Intermediates - carbocations, carbanions, free radicals, carbenes and nitrenes. Reagents in organic synthesis: Grignard reagents, Organolithium reagents, selenium dioxide, chromium trioxide, lead tetraacetate, sodium borohydride, lithium borohydride, sulphur carbanions.

Unit 2

Organic reactions and mechanisms: Substitution reaction - aliphatic nucleophilic, aromatic elecrophilic and nucleophilic substitution. Elimination and addition reaction - Halogenation .Nitration – aromatic nitration – mechanism – Technical nitration – mixed acid nitration. Hydrocarbon synthesis and Hydroformylation (Catalysis) Various catalysts used – technology of Fischer - Tropsch operation – methanation - Hydroformylation, Monsanto acetic acid, Wacker process and synthetic gasoline. Alkylation – types – alkylating agents – factors controlling alkylation – technical alkylation.

Unit 3

Sulphonation and sulfation: Sulphonating and sulphating agents – their principal applications – chemical and physical factors in sulphaonation and sulphation – kinetic, thermodynamics and mechanism – the desulphonation reaction.

Amination: Amination by reduction – methods of reduction – catalytic, metal and acid, sulphide and electrolytic reductions – amination by ammonolysis- aminating agents – catalysts used in amination reactions – technical manufacture of amino compounds – ammonia recovery system.

Catalysis by organometallic compounds: Synthesis gas (Ruthenium and Rhodium metal catalyst).

TEXTBOOK:

P.H.Groggins, "Unit Processes in Organic synthesis", Mc Graw Hill, (Fifth edition), 1952.

REFERENCES:

1. *B C Bhattacharya, C M Narayanan, "Unit Operations and Unit Processes", Mc Graw Hill, (1994).*
2. *Dryden, "Dryden's Outlines of Chemical Technology", East West, (1988).*
3. *Carey. F and Sundberg R, "Advanced Organic Chemistry, Part A & B", Kluwer, (2000).*

CHY262 MEDICINAL ORGANIC CHEMISTRY 3 0 0 3

Unit 1

Medicinal Chemistry: Introduction, drugs - classification of drugs - mechanism of drug action. Drug-receptor complex nomenclature - agonist, antagonist.

Physicochemical properties in relation to biological action: solubility, partition coefficient, dissociation constant, hydrogen bonding, ionization, drug shape, surface activity, complexation, protein binding, molar refractivity, bioisosterism - Stereo chemical aspects of drug action-stereo isomerism-optical isomerism.

Unit 2

Enzymes and hormones: Enzymes - nomenclature, classification and characteristics of enzymes - mechanism of enzyme action, factors affecting enzyme action, cofactors and co-enzymes, enzyme inhibition, enzymes in organic synthesis. Hormones and vitamins - representative cases.

Medicinal agents from natural products: Natural products as therapeutic agents, medicinal plants, animal products as medicine, isolation methods of alkaloids, terpenes, anti-oxidants.

Unit 3

Medicinal agents: Medicinal agents belonging to steroids, polypeptides, modified nucleic acid bases, sulphonamide and sulpha drugs, antibiotics, antifungal, antiseptics and disinfectants, anesthetics, antihypertensive drugs, analgesics, histamine and anti-histamine agents.

TEXTBOOKS:

1. *Rama Rao Nadendla, "Principles of Organic Medicinal Chemistry", 1st edition, New age internationals (P) limited, (2005).*

2. *Thomas Nogrady and Donald F. Weaver, "Medicinal chemistry: A Molecular and Biochemical Approach", 3rd edition, Oxford university press, (2005).*

REFERENCES:

1. *Wilson C O, Gisvold O and Deorge R F, "Text book of organic, medicinal and Pharmaceutical chemistry", 7thedition, J.B.Lippincott company, Philadelphia, (1977).*
2. *Burger A, "Medicinal Chemistry", 3rdedition, Wiley Interscience, Newyork, (1970).*
3. *Graham L P, "An Introduction to Medicinal Chemistry", 3rdedition, Oxford university Press, (2005).*

CHY263 ORGANIC REACTION MECHANISMS 3 0 0 3

Unit 1

Introduction to organic chemistry: Lewis structure and formal charges of organic compounds - electro negativities and dipoles, resonances, aromaticity and anti aromaticity - equilibrium, tautomerism and hyper conjugation - acidity and basicity - pKa, nucleophiles and electrophiles - hydrogen bonding - different types of organic reaction - addition, substitution, elimination and rearrangement - oxidations and reductions - general principles of writing organic reaction mechanism - reactive intermediates.

Reaction of nucleophiles and bases: Nucleophilic substitution - S_N1 and S_N2 reactions, nucleophilic substitution at aliphatic sp2 carbon and aromatic carbon - nucleophilic addition to carbonyl compounds - addition of grignard and organo lithium reagents - reactions of nitrogen containing nucleophiles with aldehyde and ketones - aldol condensation.

Unit 2

Michael and 1,4-addition reaction - Favorskii rearrangement - benzilic acid rearrangement - reaction mechanism in basic media - Mannich reaction - enols and enolates.

Reaction involving acids and other eletrophiles: Carbocations - formation and rearrangements - cationic rearrangement involving electron deficient nitrogen atom - Beckmann rearrangement - Curtius, Lossen and Schmidt rearrangement - electrophilic additions - acid catalyzed reaction of carbonyl compounds - hydrolysis of carbocyclic acid derivatives - electrophilic aromatic substitution - carbenes and benzynes - Baeyer-Villeger reactions - Dienone-phenol rearrangement - pinacol rearrangement.

Unit 3

Radical and radical ions: Formation of radicals, radical chain processes, radical addition, reaction with and without cyclisation - fragmentation reaction - rearrangement of radicals - S_{RN} 1 reaction - radical ions - Birch reduction - Hofmann-Loffler-Freytag reaction - Barton reaction - McMurry reaction.

Pericyclic reaction: Representative of molecular orbitals of ethylene, butadiene and hexatriene molecules - Woodward - Hofmann rules of symmetry - electrocyclic reaction, cycloadditions - diels-Alder reaction - other thermal cycloadditions - photochemical [2+2] cycloaddition - 1,3-dipolar cycloadditions - Sigmatropic reactions, notations and directions of [3,3] sigmatropic rearrangements - Cope and oxy-Cope rearrangement [2,3] sigmatropic reaction - ene reaction.

TEXTBOOK:

Jerry March, "Advanced Organic Chemistry", 4th edition, John Wiley & Sons, (1992).

REFERENCES:

1. *Carey F and Sundberg R, "Advanced Organic Chemistry - Part A & B", Kluwer, (2000).*
2. *Peter Sykes, "Organic reaction mechanism", 6th edition, Pearson education (Singapore) Pte. Ltd.,(2005).*
3. *Michael B.Smith, "Organic Synthesis", 2nd edition, Mc Graw Hill, (2004).*

CHY264 GREEN CHEMISTRY AND TECHNOLOGY 3 0 0 3

Unit 1

Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990, USA, Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock,.

Unit 2

Greener strategies of the synthesis of ibuprofen synthesis, teriphthalic acid etc. phase behavior and solvent attributes of supercritical CO_2, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO_2 fixation, green plastics, green oxidations, etc.

Unit 3

Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

REFERENCES:

1. *Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.*
2. *Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., New York, 1998.*
3. *Matlack, A. S. Introduction to Green Chemistry Marcel Dekker: New York, NY, 2001.*

CHY270 CORROSION SCIENCE 3 0 0 3

Unit 1

Basic principles: Free energy concept of corrosion - different forms of corrosion - Thermodynamic & Kinetic aspects of corrosion: The free energy criterion of corrosion possibility - Mechanism of Electrochemical corrosion - Galvanic and Electrochemical series and their significance.

Corrosion Control: Materials selection - metals and alloys - metal purification - non metallic - changing medium.

Unit 2

Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.

Corrosion protection by surface treatment: CVD and PVD processes - Arc spray - Plasma spray - Flame spray.

Corrosion Inhibitors: Passivators - Vapour phase inhibitor.

Unit 3

Stress and fatigue corrosion at the design and in service condition - control of bacterial corrosion.

Corrosion protection: Automobile bodies – engines – building construction.

TEXTBOOKS:

1. *Fontana and Mars G, "Corrosion Engineering", 3rd edition, Mc Graw-Hill, (1987).*
2. *Uhlig H H and Reviees R W, "Corrosion and its Control", Wiley, (1985).*

REFERENCES:

1. *ASM Metals Handbook, "Surface Engineering", Vol 5, ASM Metals Park, Ohio, USA, (1994).*
2. *ASM Metals Handbook, "Corrosion", Vol 13, ASM Metals Park, Ohio, USA, (1994).*
3. *Brain Ralph, "Material Science and Technology", CRC Series, Boston, New York.*

CHY271 ELECTROCHEMICAL ENERGY SYSTEMS AND PROCESSES 3 0 0 3

Unit 1

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and

ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account) Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3

Reserve batteries and Fuel cells: Reserve batteries - water activated, electrolyte activated and thermally activated batteries - remote activation - pyrotechnic materials. Fuel Cells: Principle, chemistry and functioning - carbon, hydrogen-oxygen, proton exchange membrane (PEM), direct methanol(DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

TEXTBOOKS:

1. *Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, (1993).*
2. *Dell, Ronald M Rand, David AJ, "Understanding Batteries", Royal Society of Chemistry, (2001).*

REFERENCES:

1. *Christopher M A, Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, (2004).*
2. *Watanabe T, "Nano-plating: microstructure control theory of plated film and data base of plated film microstructure", Elsevier, Oxford, UK (2004).*

3. *Kanani N, "Electroplating and electroless plating of copper and its alloy", ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Lindon David, "Handbook of Batteries", McGraw Hill, (2002).*
5. *Curtis, "Electroforming", London, (2004).*
6. *Rumyantsev E and Davydov A, "Electrochemical machining of metals", Mir, Moscow, (1989).*

CHY272 COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING 3 0 0 3

Unit 1

Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes - Born - Haber cycle – Energetic – kinetics - Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involving iterative methods, matrix algebra, Curve fitting.

Molecular mechanics: Basic theory - Harmonic oscillator – Parameterization - Energy equations - Principle of coupling - Matrix formalism for two masses - Hessian matrix - enthalpy of formation-enthalpy of reactions.

Introduction to Quantum mechanics - Schrodinger equation - Position and momentum - MO formation - Operators and the Hamiltonian operator - The quantum oscillator - Oscillator Eigen value problems - Quantum numbers - labeling of atomic electrons.

Unit 2

Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

Huckel's MO theory: Approximate and exact solution of Schrodinger equation - Expectation value of energy - Huckel's theory and the LCAO approximation - Homogeneous simultaneous equations - Secular matrix - Jacobi method - Eigen vectors: Matrix as operator - Huckel's coefficient matrix - Wheeland's method - Hoffmann's EHT method - Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

Unit 3

Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess - Thermodynamic functions - Koopman's theorem - Isodesmic reactions, DFT for larger molecules - Computer aided assignments/mini projects with softwares - Introduction to HPC in Chemical calculations.

Molecular modelling software engineering - Modeling of molecules and processes - Signals and signal processing in Chemistry - QSAR studies and generation of molecular descriptors - Applications of chemical data mining - Familiarization with open source softwares useful for molecular modeling - Introduction to molecular simulation - M.D. simulation.

TEXTBOOKS:

1. *Namboori P.K., Deepa Gopakumar and K.I. Ramachandran (In press) "Computational Chemistry and Molecular Modeling", Krishnan.*
2. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*
3. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

1. *James B Forseman and Aeleen Frisch-Gaussian, "Exploring Chemistry with Electronic Structure Method", Inc., Pittsburgh, PA, 2nd edition, (2006).*
2. *A C Philips, "Introduction to Quantum mechanics", Wiley, (2003).*
3. *Wolfram Koch, Max C. Holthausen, "A Chemist's guide to Density Functional Theory", Wiley, VCH, 2nd edition, (2001).*

CHY273 FUEL CELLS - PRINCIPLES AND APPLICATIONS 3 0 0 3

Unit 1

Introduction: relevance, importance and classification of fuel cells.

Background Theory: Thermodynamic aspects of electrochemistry energy conversion and its efficiency - factors affecting the efficiency - electrode kinetics of electrochemical energy conversion.

Unit 2

Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Proton Exchange Membrane Fuel cells: basic aspects - working and high temperature operation – recent development in technology.

Unit 3

Hydrogen: sources of hydrogen and preparation - clean up and storage - use as fuel in cells.

Energy and Environment - future prospects: Renewable energy and efficiency of renewable fuels - economy of hydrogen energy - life cycle assessment of fuel cell systems.

TEXTBOOK:

M.Aulice Scibioh and B.Viswanathan? "Fuel Cells – principles and applications", University Press, India, (2006).

REFERENCES:

1. *F. Barbir, "PEM fuel cells: theory and practice", Elsevier, Burlington, MA, (2005).*
2. *J.S. Newman and K.E. Thomas-Alyea, "Electrochemical systems", 3rd edition, Wiley, Hoboken, (2004).*
3. *G. Hoogers, "Fuel cell handbook", CRC, Boca Raton, FL, (2003).*

CHY274 SOLID STATE CHEMISTRY 3 0 0 3

Unit 1

Symmetry in Crystal Systems: Types of symmetry, plane, axis and centre of symmetry, crystal systems and symmetry elements. Law of rational indices, miller indices, Weiss indices - plane systems, space lattices, unitcells - unitcell dimension, determination. Space lattice - definition and types Bravais lattice - kinds of bravais lattices, number of atoms in SC, BCC, FCC lattices, void space, Radius ratio rule and application. Crystal defects - types of defects in crystals - stoichiometric defect - schottky and frenkel defects - Non-stoichiometric defects - metal excess and metal deficiency defects, influence of defects on the properties of solids.

Unit 2

Electrical and Magnetic Properties: Development of free electron theory to band theory of solids - metals and their properties; semiconductors - extrinsic and intrinsic, Hall effect; Insulators - dielectric, ferroelectric, pyroelectric and peizoelectric properties and the relationship between them. Dia, para, ferro, ferri, antiferro and antiferri magnetic types - selected magnetic materials such as spinels, garnets and perovskites, superconductors.

Diffraction Methods: X-ray diffraction - various methods of X-ray analysis of structure-ray diffraction pattern, X-ray scattering factor. Results and uses of X-ray diffraction. Limitations of X-ray diffractions.

Unit 3

Neutron diffraction - principles, electron diffraction patterns, limitations - applications of electron diffraction - structural elucidation. Distinction between X-ray, Neutron and electron diffraction. Structure factor - definition, factors influencing structure factor. Uses of structure factor. Fourier synthesis - definition, applications of fourier synthesis in crystal structure analysis of S-Tetrazine. Structure of Rutile, Fluorite, Antifluorite, Zinc blende, Wurtzite, diamond and graphite.

REFERENCES:

1. *Cotton F.A, Wilkinson G and Gaus P, "Basic Inorganic Chemistry", 3rd edition, John Wiley and Sons, (2003).*
2. *Shriver D.F and Atkins P.W, "Inorganic Chemistry", 3rd edition, ELBS, Oxford University Press, Oxford, (2004).*
3. *Huheey J.E, Keiter E.A and Keiter R.L, "Inorganic Chemistry", 4th edition, Addison-Wesley Pub. London, (1993).*

4. *Cotton F.A, Wilkinson G, Murillo C.A and Bochmann M, "Advanced Inorganic Chemistry", 6th edition, John Wiley and Sons, New York, (2003).*
5. *Jolly W.L, "Modern Inorganic Chemistry", 2nd edition, McGraw-Hill, Inc., (1991).*
6. *Miessler G.L and Tarr D.A, "Inorganic Chemistry", 3rd edition, Pearson Education, Singapore, (2004).*

CSE100 COMPUTER PROGRAMMING 3 0 0 3

Unit 1

Introduction to problem solving - algorithm development, flowcharting. C fundamentals, datatypes, variables, constants, enumerations, operators, bitwise operators, expressions, type cast, data input and output statements - formatted & unformatted, control structures - if, if else, switch.. case, while loop, do.. while, for loop, continue, break, goto. Arrays – defining an array, processing an array, multidimensional arrays.

Unit 2

Strings, string handling functions. User defined functions - defining a function, function prototypes, calling a function, passing arguments to a function, recursion. Variable scope - auto, extern, static, register. Pointers - declarations, call by reference, functions returning pointer, pointer arithmetic. Pointer to pointer, pointers and arrays - pointer to array, array of pointers, dynamic memory allocation - malloc(), calloc(), free().

Unit 3

Structures - declaration, initialization, bitfields, operations on structures. Arrays, pointers and structures as members of structure. Array of structures, structures and functions, pointers to structures. Files - file operations for binary and text files, file I/O statements - fscanf, fprintf, fread, fwrite. Random file access - rewind, ftell, fseek. Command line arguments. Preprocessor - macros.

TEXTBOOK:

Byron S Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", Second Edition, TMH publishers, 1996.

REFERENCES:

1. *Herbert Schildt, "The Complete reference, C" Fourth Edition, Tata-McGraw-Hill, 2000.*
2. *Kernighan Brian W and Ritchie Dennis M, "C Programming language", Second Edition, TMH, 1992.*
3. *Yashavant Kanetkar, "Let us C", Second Edition, TMH, 1996.*
4. *Cooper Herbert,"Spirit of C: Introduction to modern Programming", TMH, 1983.*

CSE180 COMPUTER PROGRAMMING LAB. 0 0 3 1

1. Programs using various input/output statements (scanf, printf, getchar, gets, puts, putchar)
2. Programs using bitwise operators and enumerated data types
3. Programs using control structures (if, if else, switch, & loops)
4. Programs using numeric one dimensional array
5. Programs using numeric multidimensional array
6. Programs using strings & string handling functions
7. Functions using static, external and auto variables
8. Programs using recursive functions
9. Programs using call by reference and pointer arithmetic
10. Pointer to array & array of pointers using dynamic memory allocation
11. Structures – arrays, structure within structure
12. Array of structures, unions
13. Programs using text files
14. Programs using binary files
15. Programs using random access of files
16. Programs using command line arguments

CUL101 CULTURAL EDUCATION I 2 0 0 2

Unit 1
Introduction to Indian Culture; Introduction to Amma's life and Teachings; Symbols of Indian Culture;

Unit 2
Science and Technology in Ancient India; Education in Ancient India; Goals of Life – Purushurthas; Introduction to Vedanta and Bhagavad Gita;

Unit 3
Introduction to Yoga; Nature and Indian Culture; Values from Indian History; Life and work of Great Seers of India (1)

TEXTBOOKS:

1. *The Glory of India (in-house publication)*
2. *The Mother of Sweet Bliss, (Amma's Life & Teachings)*

CUL102 CULTURAL EDUCATION II 2 0 0 2

Unit 1
Bhagavad Gita and Life Management; Historicity of Ramayana and Mahabharata; Overview of Patanjali's Yoga Sutras;

Unit 2
Highlights of Indian Mythology; Indian Society: Its Strengths and Weaknesses; Role & Position of Women in Indian Society;

Unit 3
Indian Models of Economy, Business and Management; Health and Lifestyle related issues; Conservation of cultural heritage; Life and work of Great Seers of India (2)

TEXTBOOKS:

1. *The Glory of India (in-house publication)*
2. *Sanatana Dharma (A compilation of Amma's teachings on Indian Culture)*

CUL151 ACHIEVING EXCELLENCE IN LIFE - AN INDIAN PERSPECTIVE 1 0 2 2

Objectives: *The course offers to explore the seminal thoughts that influenced the Indian Mind on the study of human possibilities for manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspective of Personality Enrichment through pragmatic approach of self analysis and application.*

Unit 1
Goals of Life – Purusharthas
What are Purusharthas (Dharma, Artha, Kama, Moksha); Their relevance to Personal life; Family life; Social life; & Professional life; Followed by a Goal setting workshop;
Yogic way of Achieving Life Goals – (Stress Free & Focused Life)
Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop);
Experiencing life through its Various Stages
Ashrama Dharma; Attitude towards life through its various stages (Teachings of Amma);

Unit 2
Personality Development
What is Personality – Five Dimensions – PanchaKosas (Physical/ Energy/Mental/ Intellectual/ Bliss); Stress Management &Personality; Self Control & personality; Fundamental Indian Values & Personality;
Learning Skills (Teachings of Amma)

Art of Relaxed Learning; Art of Listening; Developing 'Sraddha' – a basic qualification for obtaining Knowledge;
Communication Skills - An Indian Perspective;

Unit 3
Developing Positive Attitude & Friendliness- (Vedic Perspective);
Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma);
Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);

REFERENCE BOOKS:

1. *Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9*
2. *Complete works of Swami Vivekananda (Volumes 1 to 9)*
3. *Mahabharata by M.N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)*
4. *Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modern needs) by Swami Ranganathananda. (Volumes 1 to 3)*
5. *Message of Upanishads, by Swami Ranaganathananda published by Bharatiya Vidya Bhavan, Bombay.*
6. *Personality Development – Swami Vivekananda published by Advaitha Ashram, Kolkatta.*
7. *Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development- Swami Budhananda published by Advaitha Ashram, Kolkatta*
9. *Ultimate Success - Swami Ramakrishnananada Puri published by Mata Amritanandamayi Math, Kollam*
10. *Yoga In Daily Life - Swami Sivananda – published by Divine Llife Society*
11. *Hindu Dharma - H.H. Sri Chandrasekharandra Saraswati published by Bharatiya Vidya Bhavan, Bombay*
12. *All about Hinduism – Swami Sivananda - Published by Divine Life Society*
13. *The Mind and its Control by Swami Budhananda published by Advaitha Ashram, Kolkatta*
14. *Krida Yoga - Vivekananda Kendra, Publication.*
15. *Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi*
16. *New perspectives in Stress Management - Dr H R Nagendra & Dr R Nagaratna published by Swami Vivekananda Yoga Prakashana, Bangalore.*
17. *Mind Sound Resonance Technique (MSRT) published by Swami Vivekananda Yoga Prakashana, Bangalore.*
18. *Yoga & Memory - Dr H R Nagendra & Dr.Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.*

CUL152 EXPLORING SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 1 0 2 2

Objectives: *This course offers a journey of exploration through the early developments in India of astronomy, mathematics, technologies and perspectives of the physical world. With the help of many case studies, the students will be equipped to understand concepts as well as well as actual techniques.*

Unit 1
1. General introduction: principles followed and sources;
2. Astronomy & mathematics from the Neolithic to the Indus civilization;
3. Astronomy & mathematics in Vedic literature;
4. *Vedanga Jyotisha* and the first Indian calendars;
5. *Shulba Sutras* and the foundations of Indian geometry;

Unit 2
6. Astronomy & mathematics in Jain and Buddhist literature;
7. The transition to the Siddhantic period; Aryabhata and his time;
8. The *Aryabhatiya*: concepts, content, commentaries;
9. Brahmagupta and his advances;
10. Other great Siddhantic savants;
11. Bhaskara II and his advances;

Unit 3
12. The Kerala school of mathematics;
13. The Kerala school of astronomy;
14. Did Indian science die out?;
15. Overview of recent Indian scientists, from S. Ramanujan onward;
16. Conclusion: assessment and discussion;

TEXTBOOK:

Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao

REFERENCE*:*

IFIH's interactive multimedia DVD on Science & Technology in Ancient India.

CUL153 EXCELLENCE IN DAILY LIFE 1 0 2 2

Unit 1
1 The anatomy of 'Excellence'. What is 'excellence'? Is it judged by external factors like wealth?
2 The Great Flaw. The subject-object relationship between individual and world. Promote subject enhance excellence.

3 To work towards excellence, one must know where he is. Our present state.. An introspective analysis. Our faculties within.

Unit 2

4 The play of the mind. Emotions – convert weakness into strength.
5 The indispensible role of the intellect. How to achieve and apply clear thinking?
6 The quagmire of thought.. the doctrine of Karma – Law of Deservance.
7 Increase Productivity, reduce stress.. work patterning.

Unit 3

8 The art of right contact with the world.. assessment, expectations.
9 Myths and Realities on key issues like richness, wisdom, spirituality.
10 Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:

The Bhaja Govindam and the Bhagavad Gita.

CUL154 YOGA PSYCHOLOGY 1 0 2 2

Objectives: *This course offers the foundation necessary to understand Eastern approaches to psychology and spirituality. The course includes experiential components centering on meditation and spiritual practice.*

Unit 1

Introduction

Introduction to Modern Psychology

A short history of Modern Psychology - Major Schools of Modern Psychology - The three major forces in Western Psychology - Freudian Psychoanalysis; Behaviourism; Humanistic Psychology.

Introduction to Indian Psychology

What is Yoga? - Rise of Yoga Psychology tradition - Various schools of Yoga Psychology - Universal Goal of all Yoga-schools.

Patanjali Yoga Sutra – 1

Introduction to Rishi Patanjali - Bird view of Yoga-Sutra - Definition of Yoga – Vrittis.

Patanjali Yoga Sutra – 2

Five Kinds of Vrittis - Pramanam - sources of right knowledge - Viparyayah – unfolded belief - Vikalpah – Unfolded belief - Smriti – Memory.

Unit 2

Patanjali Yoga Sutra – 3

Two formulae - Necessity of Abhyasah and Vairagyah - Foundation of Abhyasah - Foundation of Vairagyah.

Patanjali Yoga Sutra – 4

Introduction to Samadhi - Samprajnata-Samadhi - Reasoning in Samprajnata-Samadhi - Reflection in Samprajnata-Samadhi - Bliss in Samprajnata-Samadhi - Sense of Individuality in Samprajnata-Samadhi.

Patanjali Yoga Sutra – 5

Main obstacles in the path of Yoga - other obstructions - removal of obstacles by one – pointedness; by controlling Prana - by observing sense experience - by inner illumination - by detachment from matter - by knowledge of dream and sleep - by meditation as desired.

Patanjali Yoga Sutra – 6

How to make mind peaceful? - Cultivating opposite virtues: happiness – friendliness - misery – compassion - virtue – gladness - vice – indifference.

Patanjali Yoga Sutra – 7

Five causes of Pain - avidya – ignorance (Root Cause) - asmita – 'I-Feeling' - raga – attraction - dwesha – repulsion - abhinivesha – clinging to life.

Unit 3

Patanjali Yoga Sutra – 8

Necessity of Yoga practice - eight parts of Yoga practice - five Yamas: ahimsa – satya – asteya – brahmacharyam – aparigraha.

Patanjali Yoga Sutra – 9

Five Niyamas: Soucha – Santhosha – Tapas – Swadyah – Ishwara - Pranidhanam.

Patanjali Yoga Sutra – 10

Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery over the senses.

Report review

Conclusion

REFERENCES:

- *The course book will be "The four chapters of Freedom" written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.*
- *"The message of Upanishads" written by Swami Ranganathananda. Published by Bharathiya Vidya Bhavan.*
- *Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttaranjal.*
- *'Hatha Yoga Pradipika' Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India*

ECE100 ELECTRONICS ENGINEERING 3 0 0 3

Objective: *To understand the working of basic electronic devices such as diodes, BJTs and FETs; Introduce the student to the operation and design of fundamental building blocks of*

electronic systems like power supplies, amplifiers and oscillators; Develop skills to analyze specifications of simple electronic circuits and carry out their design.

Unit 1

Physics of conductors and semiconductors: conductors, semiconductors, silicon crystals, intrinsic semiconductors, two types of flow, doping a semiconductor, two types of extrinsic semiconductors, unbiased diode, forward bias, reverse bias, breakdown, barrier potential and temperature, reverse biased diode, diode approximations.

Rectifiers and diodes: half wave, full wave and Bridge rectifiers. Filters, choke input filter, capacitor input filter, PIV and surge current, Zener diode, loaded Zener regulator, LED, photo diodes, Schottky diode, Varactor diode.

Unit 2

Basics of amplifiers: Introduction to BJT and FET, BJT characteristic curves and regions of operation, emitter and voltage divider bias of BJT, BJT as a switch, LED drivers, JFET characteristics, JFET biasing in Ohmic and active regions, transconductance, JFET amplifiers, depletion mode and enhancement mode MOSFET, CMOS.

Unit 3

Operational amplifiers and linear ICs: differential amplifier, introduction to Opamps, inverting and non-inverting amplifier, comparators, instrumentation amplifier, summing amplifier, voltage follower.

Oscillators: Theory of sinusoidal oscillations, Wein Bridge oscillator, Colpitts oscillator, Quartz Crystal oscillator, introduction to 555 Timer, astable and monostable operation.

TEXTBOOK:

A.P Malvino, "Electronic Principles", Seventh Edition, TMH, 2007

REFERENCES:

1. *J. Millman and C C Halkias, "Electronics Devices & Circuits", TMH Edition, 2005*
2. *David. A. Bell, "Electronics Devices and Circuits", Fifth Edition, Oxford University Press,2008*
3. *I. J. Nagrath, "Electronic Devices and Circuits", Prentice-Hall of India, 2007*

EEE100 ELECTRICAL ENGINEERING 3 0 0 3

Unit 1

Introduction to electrical engineering. System of units. Electric current, Coulomb's law, Ohm's law, Faraday's law of electromagnetic induction, Kirchoff's laws, Ampere's law.

Ideal independent current and voltage-sources; Reference directions and symbols, energy and power; R, L and C- parameters; Series and parallel combination of resistances, capacitances and inductances, series-parallel circuits, superposition theorem, conversion of a voltage source to current source and vice versa, voltage divider and current divider rule. Network reduction by star–delta transformation, analysis of dc circuits by Mesh-current and nodal methods.

Unit 2

Transient analysis with energy storage elements (for RC-, RL- circuits with DC excitations): Writing differential equations for first order circuits, steady state solution of circuits containing inductors and capacitors, initial and final conditions, transient response of RL and RC circuits (rise and decay).

Sinusoidal steady state analysis: Generation of sinusoidal functions, average and effective values of periodic functions, instantaneous and average power, power factor, phasor representation of sinusoids, response of single elements (R, L and C) for sinusoidal excitation; phasor concept and phasor diagram; Impedance and Admittance concepts; The series RL, series RC and series RLC circuits, complex power and power triangle. Introduction to 3-phase systems; Balanced 3-phase systems (STAR and DELTA connections).

Unit 3

Magnetic circuits: MMF, magnetic flux, reluctance, flux density, analogy with electric circuits, analysis of magnetic circuits, self and mutual induced emfs, energy stored in a magnetic circuit.

Transformers; construction and principle of operation of transformers, Emf equation.

Three phase Induction motor: Types, construction, rotating magnetic field, principle of operation, slip, rotor induced emf.

Measuring instruments, Different types of instruments to measure voltage, current power and energy.

TEXTBOOK:

Vincent Del Toro, 'Electrical Engineering Fundamentals', Second Edition, Prentice Hall of India Private Limited, 2003.

REFERENCES:

1. *Giorgio Rizzoni, 'Principles and Applications of Electrical Engineering', Fourth Edition, Tata McGraw-Hill Publishing Company Limited, 2003.*
2. *Hughes, 'Electrical Technology' Seventh edition, Pearson Education Asia, 2000.*

EEE180 WORKSHOP B 1 0 2 2

Electrical workshop:

Study of safety devices such as fuse, MCB, ELCB & earthing – electrical power distribution in domestic installations, study of tools and accessories used in electrical

wiring – wiring practice for staircase circuit, fluorescent lamp, hospital wiring and godown lighting – study of domestic appliances like Mixie, fan, Electric iron, Air conditioner, Refrigerator – study of different types of electric lamps like Incandescent lamp, Fluorescent, CFL, Metal halide, Mercury vapour, Sodium vapour and halogen lamp.

Personal computer hardware workshop:

Study of basic components in a computer - study of basic components in a network – study of diagnostic tools for system and study of floppy disk controller – study of hard disk controller – drivers for different components – trouble shooting in printer – communication between two computers with null modem – transferring characters from PC to LCD.

Electronics and basic microprocessor workshop:

Identification of electronic components and study of measuring instruments – PCB fabrication and soldering practice – study of intel 8085 microprocessor trainer kit concepts.

PIC microcontroller workshop:

Introduction to MP lab simulator. Simulating and burning simple programmes on PIC 16F877A.

ENG111 COMMUNICATIVE ENGLISH 2 0 2 3

Objectives:

To make the students communicate their thoughts, opinions, and ideas freely and naturally.
To make them understand the different styles in communication
To make the students understand the aesthetics of reading and writing
To bring in a spirit of enquiry
To motivate critical thinking and analysis
To help them ruminate on human values

Unit 1

Reading: Different styles of communication – reading comprehension - critical thinking and analysis – note-making.

Unit 2

Writing: Prewriting techniques - kinds of paragraphs - basics of continuous writing; Grammar and usage – topics including spelling and number rules (Workbook).

Unit 3

Practical sessions (listening & speaking)**:** Introduction to English pronunciation including minimal pairs and word stress – differences between British and American English – listening comprehension and note-taking.

Activities: Short speeches, seminars, quizzes, language games, debates, discussions and book reviews, etc.

TEXTBOOKS:

1. *Language through Reading: Anthology compiled by Amrita;*
2. *Language through practice: Work book compiled by Amrita*

REFERENCES:

1. *Raymond Murphy. "Murphy's English Grammar", Cambridge Univ. Press, 2004.*
2. *Michael Swan. "Practical English Usage", Oxford Univ. Press, 2000.*
3. *Daniel Jones. "Cambridge English Pronouncing Dictionary" Ed. Peter Roach, Jane Setter and James Hartman, Cambridge Univ Press, 2006.*

ENG112 TECHNICAL COMMUNICATION 2 0 2 3

Objectives:

To introduce the students to the elements of technical style
To introduce the basic elements of formal correspondence
To introduce technical paper writing skills and methods of documentation
To improve oral presentation skills in formal contexts

Unit 1

Mechanics of writing: Grammar rules – punctuation - spelling rules - tone and style - graphical representation.

Unit 2

Different kinds of written documents: Definitions – descriptions – instructions – recommendations - manuals - reports – proposals; Formal correspondence: Letter writing, including job applications with resume.

Unit 2

Technical paper writing: Library research skills - documentation style - document editing – proof reading – formatting.

Practice in oral communication: Group discussion, interviews and technical presentations.

REFERENCES:

1. *Hirish, Herbert. L "Essential Communication Strategies for Scientists, Engineers and Technology Professionals". II Edition. New York: IEEE press, 2002*
2. *Anderson, Paul. V. "Technical Communication: A Reader-Centred Approach". V Edition. Harcourt Brace College Publication, 2003*
3. *Strunk,William Jr. and White. EB. "The Elements of Style" New York. Alliyan & Bacon, 1999.*
4. *Riordan, G.Daniel and Pauley E. Steven. "Technical Report Writing Today" VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.*

ENG250 PROFESSIONAL COMMUNICATION 1 0 2 2

Unit 1

Reading Comprehension: Focus will be on understanding of the given information, vocabulary, inference, logical thinking, and decision - making.

Unit 2

Work place Communication: Writing suggestions, recommendations - reports like, incident report, progress report, trip report, feasibility report – resume writing - formal and business letters – memos, circulars, notices - agenda, meetings, minutes.

Unit 3

Practical: Telephonic conversations, interviews, group and panel discussions, and oral presentations.

REFERENCES:

1. *Davis Homer & Peter Strutt. "Words at Work", CUP, 1996.*
2. *Simon Sweeney. "Communicating in Business", CUP, 2000.*
3. *Leo Jones & Richard Alexander. "New International Business English" CUP, 2003.*
4. *Raymond V Lesikar & Marie E. Flatley. "Basic Business Communication", Tata McGraw-Hill Pub. Co. New Delhi, 2005. Tenth Ed.*

ENG251 BUSINESS COMMUNICATION 1 0 2 2

OBJECTIVES:

To introduce business vocabulary
T o introduce business style in writing and speaking
To expose students to the cross-cultural aspects in a globalised world
To introduce the students to the art of persuasion and negotiation in business contexts.

Unit 1

Writing – English grammar & business vocabulary - drafting – notice – agenda – minutes – reports – proposals – memos – letters - writing press releases.

Unit 2

Reading – scanning – comprehension – inference - error detection - listening – pronunciation – information & reporting.

Unit 3

Speaking – conversational practice – telephonic conversations – addressing a gathering – conducting meetings - negotiation & persuasion techniques.

Activities - case studies & role-plays

BOOKS RECOMMENDED:

1. *Jones, Leo & Richard Alexander. New International Business English. CUP. 2003.*
2. *Horner, David & Peter Strutt. Words at Work. CUP. 1996.*
3. *Owen, Roger. BBC Business English. BBC. 1996.*
4. *Henderson, Greta Lafollette & Price R Voiles. Business English Essentials. 7th Edition. Glencoe / McGraw Hill.*
5. *Sweeney, Simon. Communicating in Business. CUP. 2000.*

ENG252 INDIAN THOUGHT THROUGH ENGLISH 1 0 2 2

Objectives:

To expose the students to the greatness of Indian Thought in English
To develop a sense of appreciation for the lofty Indian Thought
To develop an understanding of the eclectic Indian

Unit 1

Poems: Toru Dutt – The Casuarina Tree; Sri Aurobindo – The Tiger and the Deer; Nissim Ezekiel – Farewell Party to Miss Pushpa T S;
Rabindranath Tagore – Upagupta.

Unit 2

Essays and short stories: Jawaharlal Nehru – at Harrow; Swami Vivekananda – The Ideal of a Universal Religion; Dr. S. Radhakrishnan –Philosophy of life; Gita Hariharan – The Remains of the Feast; Anita Desai – The Winterscape; R.K Narayan – The Blind Dog; Jim Corbett – Lalaji; Ruskin Bond – The Night Train at Deoli; Tagore – The Postmaster.

Unit 3

Drama and Speech: Rabindranath Tagore – Chandalika; Mahashwetadevi – Bayen; Swami Vivekananda – Chicago Address; J.Krishnamurthy / C.N.R Rao - Audio speech.

Short Story:

REFERENCES:

1. *"The Golden Treasury of Indo-Anglian Poetry", Ed. V.K. Gokak (1923-1965)*
2. *"Ten Twentieth Century Indian Poets", by R. Parthasarathy, OUP, 1976.*
3. *"The Remains of the Feast" by Gita Haiharan from In Other Words; New Writing by Indian Women, ed. Urvashi Butalia and Ritu Menon, The Women's Press Limited, 34,Great Sutton Street, London.*

4. "Three Plays of Rabindranath Tagore", OUP, Madras, 1979.
5. "An anthology of Popular Essays and Poems". Ed. A.G. Xavier, Macmillan India Ltd., 1988.
6. "Hymns of Darkness", 1976.
7. "Letters from a Father to His Daughter", Allahabad Law Journal Co. Ltd., Allahabad.
8. Vidya, intranet, Amrita Vishwa Vidyapeetham.
9. "Mashi" and Other Stories, Rupa and Co. Paperback – 2002.
10. "My India", Oxford University Press, New Delhi – 2000- paperback.
11. "Prison and Chocolate Cake", Victor Gollencz, London. Indian Edition, Jaico Publishing, Bombay
12. "Twelve Modern Short Stories", Macmillan Publication.
13. "Malgudi Days", R.K. Narayan, Indian Thought Publications, 1996, 23rd reprint 2007.
14. Diamond Dust and Other Stories, Anita Desai, Published by Vintage, 2001.
15. The Complete Works of Swami Vivekananda, Advaita Ashram, Calcutta.

ENG253 INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE 1 0 2 2

(Pre-requisite: Nil;Equivalent course in 2007 curriculum: Nil)

Objectives -

· *to expose the students to different genres of Literature*
· *to inculcate reading skills*
· *to provide deeper critical and literary insights*
· *to enhance creative thinking*
· *to help the student develop critical and analytical skills*
· *to promote the aesthetic sense*

Unit 1

Poetry

Seamus Heaney – Digging; Philip Larkin – Ambulances; W.B.Yeats - Prayer for my daughter; W. H Auden - Miss Gee; Peter Porter - Your Attention Please; Rabindranath Tagore 's poems "Defamation" and "Playthings".

Unit 2

Drama

Oscar Wilde - Importance of Being Earnest; Anton Chekov – Proposal; Scenes from the great tragedies of Shakespeare.

Unit 3

Essays

Bibhuti Mishra "When I took over from her"; R.K.Narayan "Junk"; M K Naik " The Postman's Knock",

Practical:

Reviews of novels and short stories; Presentations, Review of Literature, Discussions, Role plays.

REFERENCES:

1. Gupta, Balram. G. S. Srinath. C. S. ed. Indian Humorous Essays. Chennai: Emarald. 2008. Print.
2. Indira . C T. ed. The Pleasures of Poetry. Madras: 2001. Print.
3. Rabindranath Tagore et al. Collected Poems and Plays of Rabindranath Tagore. Macmillan India Ltd. 1999. Print.
4. Sachithanandan , V. ed. Six English Poets.Madras: Macmillan . 1994. Print.
5. Vishwanathan, R. ed . ViewlessWings. Calicut: CU. 1991. Print.
6. Wilde, Oscar. The Importance of Being Earnest. Ed. Dr S Sreenivasan. Kollam: Century.2005. Print.

ENV200 ENVIRONMENTAL STUDIES 3 1 0 4

Unit 1

Overview of the global environmental crisis; Biogeochemical cycles; Climate change and related international conventions and treaties and regulations; Ozone hole and related international conventions and treaties and regulations; Overpopulation; Energy crisis; Water crisis, groundwater hydrogeology, surface water resource development .

Unit 2

Ecology, biodiversity loss and related international conventions, treaties and regulations; Deforestation and land degradation; Food crisis; Water pollution and related international and local conventions, treaties and regulations; Sewage domestic and industrial and effluent treatment; Air pollution and related international and local conventions, treaties and regulations; Other pollution (land, thermal, noise).

Unit 3

Solid waste management (municipal, medical, e-waste, nuclear, household hazardous wastes); Environmental management, environmental accounting, green businesses, eco-labeling, environmental ethics, environmental impact assessment; Constitutional, legal and regulatory provisions; Sustainable development;

TEXTBOOK:

"Environmental Studies - From Crisis to Cure" by R. Rajagopalan, Oxford University Press.2005,ISBN 0-19-567393-X.

REFERENCE BOOKS:

1. G.T. Miller Jr., "Environmental Science", 11th Edition, Cenage Learning India Pvt. Ltd., 2008.
2. Benny Joseph "Environmental Studies", Tata McGraw-Hill Publishing Company Limited, 2006.

FRE201 PROFICIENCY IN FRENCH LANGUAGE (LOWER) 1 0 2 2

Unit 1 Population - Identity
How to introduce yourself (name, age, address, profession, nationality); Numbers; How to ask questions;
Grammar – Pronouns - subjects; Regular verbs of 1st group (er) in the present; Être (to be) and avoir (to have) in the present; Interrogative sentence; Gender of adjectives.

Unit 2 The suburbs - At the train station
Introduce someone; Buy a train ticket or a cinema ticket; Ask for information; Official time; Ask for a price; The city (church, town hall, post office…)
Grammar – Pronouns - subjects (continuation); Gender of adjectives (continuation); Plural of nouns and adjectives; Definite and indefinite articles; Interrogative adjectives; I would like (Je voudrais).

Unit 3 Paris and the districts - Looking for a room
Locate a room and indicate the way; Make an appointment; Give a price; Ordinal numbers; Usual time; Ask for the time.
Grammar - Imperative mode; Contracted articles (au, du, des); negation.

TEXTBOOK:
Metro St Michel - Publisher: CLE international

FRE202 PROFICIENCY IN FRENCH LANGUAGE (HIGHER) 1 0 2 2

Unit 1 The first room of a student
A party to celebrate the 1st room; Description of a room; furniture; Locate objects: prepositions (devant, derrière, dans…), Read advertisement; Appreciation (I like, I prefer,).
Grammar - Perfect past tense with *avoir;* Possessive adjectives (*mon, ton, son*…); Demonstrative adjectives (*ce, cet, cette*); Yes (*oui, si*).

Unit 2 Small jobs
Conversation on the phone; Give Time indications; Answer a job offer; Describe a job; Suggest a meeting time.
Grammar - Perfect past tense with *être* and *avoir* (continuation); Possessive adjectives (*notre, votre, leur*); Prepositions (*à, pour, avec* …); Pronoun as direct object (*le, la, l', les*).

Unit 3 University Restaurant
Inquiry; Express an opinion; Ask questions (continuation); Food, meals, taste, preferences; Nutrition, diet, choose a menu or diet, Expression of quantities

(*beaucoup, peu*).
Grammar - Partitif (expressing quantity) (*du, de la, pas de*….); Comparison (plus ...que, moins….que, autant …que); Interrogation (continuation), inversion, *Est-ce que, qu'est-ce que ?.*

TEXTBOOK:
Metro St Michel - Publisher: CLE international

GER201 PROFICIENCY IN GERMAN LANGUAGE (LOWER) 1 0 2 2

To have an elementary exposure to German language; specifically
1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;
4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.
(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.)

Some useful websites will be given.

GER202 PROFICIENCY IN GERMAN LANGUAGE (HIGHER) 1 0 2 2

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavour of this course is to activate this knowledge and develop the skill of communication.

Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

Past and future tenses will be introduced. Applying genitive, dative and accusative.

Some German culture. Films.

GER211 GERMAN FOR BEGINNERS I 1 0 2 2

Unit 1
Greetings; Introducing one-self (formal and informal context), saying their name, origin, living place, occupation.

Numbers 1-100; Saying the telephone number.
Countries and Languages.
Grammar: Structure – W - Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.
Vocabulary: Professions.

Unit 2
Giving the personal details. Name, age, marital status, year of birth, place of birth, etc.
Numbers till 1000. Saying a year.
Alphabets – spelling a word.
Filling up an application form; In the restaurant – making an order.
Grammar: Definite, indefinite and negative article in nominative. Accusative: indefinite and negative Article
Vocabulary: Food items

Unit 3
Number above 1000. Orientation in Shopping plazas: asking the price, where do I find what, saying the opinion.
Grammar: Accusative – definite article. Adjectives and plural forms.
Vocabulary: Furniture and currencies.

GER212 GERMAN FOR BEGINNERS II 1 0 2 2

Unit 1
Shopping and orientation in supermarket; Conversation between the customer and salesman; Where one finds what in supermarket; Asking for requests and suggestions.
Grammar: Dative of personal pronouns. Imperative form.
Vocabulary: Consumables and measurements;

Unit 2
Appointments; Work and leisure time activities; Time, weekdays, months and seasons; saying the date; fixing up an appointment.
Grammar: Model verbs; Prepositions with time and place; Ordinal numbers.
Vocabulary: Leisure activities, weekdays, months and seasons.

Unit 3
Family and household; Family and relations; household and daily routine.
Grammar: Possessive articles; Divisible and indivisible verbs.
Vocabulary: Family circle; Household articles.

HUM250 INDIAN CLASSICS FOR THE TWENTY-FIRST CENTURY 1 0 2 2

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads

Unit 2
The relevance of these classics in a modern age –

Unit 3
Goals of human life-existential problems and their solutions in the light of these classics etc.

REFERENCE:
The Bhagavad Gita, Commentary by Swami Chinmayananda

HUM251 INTRODUCTION TO INDIA STUDIES 1 0 2 2

Preamble:
This paper will introduce the students to the multiple dimensions of the contribution of India to the fields of philosophy, art, literature, physical and social sciences. The paper intends to give an insight to the students about the far-reaching contributions of India to world culture and thought during the course of its long journey from the hoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride and reverence towards the achievements that lays the foundation for its all-round progress.

Unit 1
A brief outline of Indian history from prehistoric times to the present times.
Contributions of India to world culture and civilization:
Indian Philosophy and Religion; Art and Literature; Physical and Social Sciences.

Unit 2
Modern India: Challenges and Possibilities –
Scientific and technological progress in post-independence era; Socio-cultural and political movements after independence; Challenges before the nation today - unemployment – corruption – degradation of cultural and moral values - creation of a new system of education; Creation of a modern and vibrant society rooted in traditional values.

Unit 3
Modern Indian Writing in English: Trends in Contemporary Indian Literature in English

TEXTBOOK:

Material given by the Faculty

BACKGROUND LITERATURE:

1) *Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture (Kolkata) publication.*
2) *Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.*
3) *Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.*
4) *Outlines of Indian Philosophy, M. Hiriyanna, MLBD.*
5) *An Advanced History of India, R. C. Majumdar et al, Macmillan.*
6) *India Since 1526, V. D. Mahajan, S. Chand & Company*
7) *The Indian Renaissance, Sri Aurobindo.*
8) *India's Rebirth, Sri Aurobindo.*
9) *On Nationalism, Sri Aurobindo.*
10) *The Story of Civilization, Volume I: Our Oriental Heritage, Will Durant, Simon and Schuster, New York.*
11) *Eternal Values for a Changing Society, Swami Ranganathananda, Bharatiya Vidya Bhavan.*
12) *Universal Message of the Bhagavad Gita, Swami Ranganathananda, Advaita Ashrama.*
13) *Awaken Children: Conversations with Mata Amritanandamayi*
14) *Indian Aesthetics, V. S. Seturaman, Macmillan.*
15) *Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.*
16) *Web of Indian Thought, Sister Nivedita*
17) *Essays on Indian Nationalism, Anand Kumaraswamy*
18) *Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi*
19) *The Invasion That Never Was, Michel Danino*
20) *Samskara, U. R. Ananthamurthy, OUP.*
21) *Hayavadana, Girish Karnard, OUP.*
22) *Naga-Mandala, Girish Karnard, OUP.*

HUM252 GLIMPSES OF ETERNAL INDIA 1 0 2 2

Unit 1

Introduction

A peep into India's glorious past

Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramarajya – Yudhisthira's ramarajya; Sarasvati - Sindhu Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmanya Dharma and the rise of Jainism and Buddhism – the sixteen Mahajanapadas and the beginning of Magadhan paramountcy – Kautilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2

India's contribution to the world: spirituality, philosophy and sciences

Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.

The arrival of Europeans, British paramountcy and colonization

What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wrecked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

Unit 3

Women in Indian society

The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadarnyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kautilya's Arthasastra and Mrichchhakatikam of Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

Modern India

The national movement for freedom and social emancipation; Swami Vivekananda, Sri Aurobindo, Rabindranath Tagore; Understanding Mahatma Gandhi; A new nation is born as a republic – the pangs of birth and growth; India since Independence – the saga of socio-political movements; Problems facing the nation today; Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion

The Wonder that was India; The 'politics' and 'purpose' of studying India

REFERENCES:

1. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
2. *Somayaji, D.A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
3. *Sen, S.N. & K.V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
4. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
5. *Bose, D.M. et. al. A Concise History of Science in India. New Delhi: 1971.*
6. *Bajaj, Jitendra & M.D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
7. *Bajaj, Jitendra & M.D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
8. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies,2008.*

9. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
10. *Vivekananda, Swami. Selections from the Complete Works of Swami Vivekananda. Kolkata: Advaita Ashrama.*
11. *Mahadevan, T.M.P. Invitations to Indian Philosophy. Madras: University of Madras.*
12. *Hiriyanna, M. Outlines of Indian Philosophy. Motilal Banarsidass.*
13. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
14. *Majumdar, R.C. et. al. An Advanced History of India. Macmillan.*
15. *Mahajan, V.D. India Since 1526. New Delhi: S. Chand & Company.*
16. *Durant, Will. The Case for India. Bangalore: Strand Book Stall, 2008.*
17. *Aurobindo, Sri. The Indian Renaissance / India's Rebirth / On Nationalism.*
18. *Nivedita, Sister. The Web of Indian Life. Kolkata: Advaita Ashrama.*
19. *Durant, Will. The Story of Civilization. Volume 1 – Our Oriental Heritage. New York: Simon & Schuster.*
20. *Ranganathananda, Swami. Eternal Values for A Changing Society. Bombay: Bharatiya Vidya Bhavan.*
21. *Ranganathananda, Swami. Universal Message of the Bhagavad Gita. Kolkata: Advaita Ashrama.*
22. *Seturaman, V.S. Indian Aesthetics. Macmillan.*
23. *Coomaraswamy, Ananda K. The Dance of Shiva. New Delhi: Sagar Publications.*
24. *Coomaraswamy, Ananda K. Essays on Indian Idealism. New Delhi: Munshiram Manoharlal.*
25. *Danino, Michel. The Invasion That Never Was.*
26. *Kautilya. Arthasastra.*
27. *Altekar, A.S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
28. *Altekar, A.S. The Position of Women in Hindu Civilization. New Delhi: Motilal Banarsidass.*
29. *Sircar, D.C. Studies in the Religious Life of Ancient and Medieval India. New Delhi: Motilal Banarsidass.*
30. *Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times.New Delhi: Motilal Banarsidass.*
31. *Madhavananda, Swami & R.C. Majumdar eds. The Great Women of India. Kolkata: Advaita Ashrama.*
32. *Dutt, R.C. The Economic History of India. London, 1902.*
33. *Dharampal. Collected Works.*
34. *Dharampal. Archival Compilations (unpublished)*

HUM253 GLIMPSES INTO THE INDIAN MIND: THE GROWTH OF MODERN INDIA 1 0 2 2

Unit 1

Introduction

General Introduction; 'His + Story' or 'History'?; The concepts of 'nation', 'national identity' and 'nationalism'; Texts and Textualities: Comparative Perspectives

Unit 2

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:

Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak; Rabindranath Tagore;

Unit 3

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:

Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao; V.S. Naipaul.

Conclusion

REFERENCES:

1. *Tilak, Bal Gangadhar. The Orion / Arctic Home in the Vedas.*
2. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
3. *Vivekananda, Swami. "Address at the Parliament of Religions"/"The Future of India"/"In Defence of Hinduism" from Selections from the Complete Works of Swami Vivekananda.*
4. *Aurobindo, Sri. The Renaissance in India / On Nationalism.*
5. *Coomaraswamy, Ananda K. Essays in Indian Idealism (any one essay) / Dance of Shiva.*
6. *Nivedita, Sister. "Noblesse Oblige: A Study of Indian Caste" / "The Eastern Mother" from The Web of Indian Life.*
7. *Gandhi, Mahatma. Hind Swaraj.*
8. *Nehru, Jawaharlal. "The Quest" from Discovery of India.*
9. *Ambedkar, B.R. "Buddha and His Dhamma" from Collected Works.*
10. *Saraswati, Chandrasekharendra. "The Sastras and Modern Life" from The Hindu Dharma.*
11. *Dharampal. Bharatiya Chitta, Manas and Kala / Understanding Gandhi.*
12. *Naipaul, V.S. India: A Wounded Civilization / India: A Million Mutinies Now.*

HUM254 GLIMPSES OF INDIAN ECONOMY AND POLITY 1 0 2 2

Unit 1

Introduction

General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.

Ancient India – up to 600 B.C.

Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusarthas; The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King (Sri Rama) and the ideal state (Ramarajya) – Yudhisthira's ramarajya;

Sarasvati - Sindhu civilization and India's trade links with other ancient civilizations; Towards chiefdoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of the Indo-Gangetic plain.

Unit 2

Classical India: 600B.C. – 1200 A.D.

The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya's *Arthasastra;* Of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India's maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas

Medieval India: 1200 A.D. – 1720 A.D.

Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacy in the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.

Unit 3

Modern India: 1720 - 1947

the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was 'traditional' or 'Indian') – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance: banking and other business undertakings by the natives (the members of the early Tagore family, the merchants of Surat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern banking system; Glimpses into British administration of India and administrative models; The National movement and nationalist undertakings in business and industry: the Tatas and the Birlas; Modern India: the growth of large-scale industry – irrigation and railways – money and credit – foreign trade; Towards partition – birth of two new nations – division of property; The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place.

Independent India – from 1947

India since Independence – the saga of socio-political movements; Indian economy since Independence – the fiscal system – the five year plans – liberalisation – the GATT and after; Globalisation and Indian economy; Impact of science and (new/ emerging) technology on Indian economy; Histories of select Indian business houses and business entrepreneurship.

Conclusion

REFERENCES:

1. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
2. *Kautilya. Arthasastra.*
3. *Altekar, A.S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
4. *Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times. New Delhi: Motilal Banarsidass.*
5. *Dutt, R.C. The Economic History of India. London,1902.*
6. *Dharampal. Collected Works (Volumes IV & V).*
7. *Dharampal. Archival Compilations (unpublished).*
8. *Bajaj, Jitendra & M.D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
9. *Bajaj, Jitendra & M.D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
10. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
11. *Tripathi, Dwijendra. The Oxford History of Indian Business. New Delhi: Oxford University Press, 2004.*
12. *McGuire, John, et al, eds. Evolution of World Economy, Precious Metals and India. New Delhi: Oxford University Press, 2001.*
13. *Tripathi, Dwijendra and Jyoti Jumani. The Concise Oxford History of Indian Business. New Delhi: Oxford University Press, 2007.*
14. *Kudaisya, Medha M. The Life and Times of G.D. Birla. New Delhi: Oxford University Press, 2003.*
15. *Raychaudhuri, Tapan and Irfan Haib, eds. The Cambridge Economic History of India. Volume 1. New Delhi: Orient Longman, 2004.*
16. *Kumar, Dharma, ed. The Cambridge Economic History of India. Volume 2. New Delhi: Orient Longman, 2005.*
17. *Sabavala, S.A. and R.M. Lala, eds. J.R.D. Tata: Keynote. New Delhi: Rupa & Co., 2004.*
18. *Mambro, Arvind ed. J.R.D. Tata: Letters. New Delhi: Rupa & Co., 2004.*
19. *Lala, R.M., For the Love of India: The Life and Times of Jamsetji Tata. New Delhi: Penguin, 2006.*
20. *Thapar, Romila. The Penguin History of Early India: From the Origins to AD 1300. New Delhi Penguin, 2002.*
21. *Majumdar, R.C., et. al. An Advanced History of India. Macmillan.*

HUM255 SCIENCE AND SOCIETY – AN INDIAN PERSPECTIVE* 1 0 2 2

Unit 1

Introduction

Western and Indian views of science and technology

Introduction; Francis Bacon: the first philosopher of modern science; The Indian tradition in science and technology: an overview.

Unit 2

Indian sciences

Introduction; Ancient Indian medicine: towards an unbiased perspective;

Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD
Science and technology under the British rule
Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

Unit 3
Science and technology in Independent India
Introduction; An assessment of traditional and modern energy resources; Green revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.
Building upon the Indian tradition
Introduction; Regeneration of Indian national resources; *Annamahatmyam and Annam Bahu Kurvita:* recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration of Indian agriculture to ensure food for all in plenty.
Conclusion

REFERENCES:

1. *Joseph, George Gheverghese. The Crest of the Peacock: Non-European Roots of Mathematics. London: Penguin (UK),2003.*
2. *Iyengar, C.N. Srinivasa. History of Hindu Mathematics. Lahore: 1935, 1938 (2 Parts).*
3. *Amma, T.A. Saraswati. Geometry in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
4. *Bag, A.K. Mathematics in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
5. *Sarma K.V. & B.V. Subbarayappa. Indian Astronomy: A Source-Book. Bombay: Nehru Centre, 1985.*
6. *Sriram, M.S. et. al. eds. 500 Years of Tantrasangraha: A Landmark in the History of Astronomy. Shimla: Indian Institute of Advanced Study, 2002.*
7. *Bajaj, Jitendra & M.D. Srinivas. Restoring the Abundance: Regeneration of Indian Agriculture to Ensure Food for All in Plenty.Shimla: Indian Institute of Advanced Study, 2001.*
8. *Bajaj, Jitendra ed. Report of the Seminar on Food for All: The Classical Indian Discipline of Growing and Sharing Food in Plenty. Chennai: Centre for Policy Studies, 2001.*
9. *Bajaj, Jitendra & M.D. Srinivas. Annam Bahu Kurvita: Recollecting the Indian Discipline of Growing and Sharing Food in Plenty. Madras: Centre for Policy Studies, 1996.*
10. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
11. *Somayaji, D.A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
12. *Sen, S.N. & K.V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
13. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
14. *Bose, D.M. et. al. A Concise History of Science in India. New Delhi: 1971.*
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16. *Bajaj, Jitendra & M.D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*

17. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
18. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*

** The syllabus and the study material in use herein has been developed out of a 'summer programme' offered by the Centre for Policy Studies (CPS), Chennai at the Indian Institute of Advanced Study (IIAS), Rashtrapati Nivas, Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M.D. Srinivas (Chairman) and Dr J.K. Bajaj (Director) of the CPS.*

JAP201 PROFICIENCY IN JAPANESE LANGUAGE (LOWER) 1 0 2 2

This paper will introduce the basics of Japanese language. Students will be taught the language through various activities like writing, reading, singing songs, showing Japanese movies etc. Moreover this paper intends to give a thorough knowledge on Japanese scripts that is *Hiragana* and *Katakana*. Classes will be conducted throughout in Japanese class only. Students will be able to make conversations with each other in Japanese. Students can make self-introduction and will be able to write letters in Japanese. All the students will be given a text on Japanese verbs and tenses.

Students can know about the Japanese culture and the lifestyle. Calligraphy is also a part of this paper. Informal sessions will be conducted occasionally, in which students can sing Japanese songs, watch Japanese movies, do *Origami* – pattern making using paper.

JAP202 PROFICIENCY IN JAPANESE LANGUAGE (HIGHER) 1 0 2 2

Students will be taught the third and the most commonly used Japanese script, *Kanji*. Students will be taught to write as well as speak.

Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.

By the end of the semester they the students will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

MAT111 CALCULUS, MATRIX ALGEBRA AND ORDINARY DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1

Linear systems of equations, Gauss elimination, rank of a matrix, linear dependence. Solutions of linear systems: existence, uniqueness, general form, eigen values, eigen vectors, some applications of eigen value problems, symmetric, skew-symmetric and orthogonal matrices, complex matrices: Hermitian, Skew Hermitian, unitary, similarity of matrices, basis of eigen vectors, diagonalization. (Sections: 6.3, 6.4, 6.5, 7.1, 7.2, 7.3, 7.4, and 7.5)

Limits and continuity. (Sections (in textbook 1): 2.2, 2.3, 2.4, 2.5, 2.6)

Unit 2

Derivatives, curve sketching, improper integral. (Sections (in textbook 1): 3.1, 4.1, 4.3, 4.4, 8.8)

Basic concepts and ideas, exact differential equations, integrating factors, orthogonal trajectories of curves. (Sections: 1.1, 1.5, 1.8)

Unit 3

Review of linear differential equations and Bernoulli equation, modelling: mixing problem, electric circuits. Review of homogeneous linear equations of second order, Euler-Cauchy equations, solution by undetermined coefficients, solution by variation of parameters. System of linear equation, basic concepts and theory, homogeneous systems with constant coefficients, phase plane, critical points. Criterion for critical points and stabilty. (Sections: 1.6, 1.7, 2.1, 2.2, 2.3, 2.6, 2.9, 2.10, 3.1, 3.2, 3.3, 3.4)

TEXTBOOKS:

1. *'Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.*
2. *'Advanced Engineering Mathematics', E Kreyszig, John Wiley and Sons, 2002, Eighth Edition.*

MAT112 VECTOR CALCULUS, FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1

Vector and scalar functions, derivatives, curves, tangents, arc Length, curves in mechanics, velocity and acceleration, gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field. (Sections: 8.4, 8.5, 8.6, 8.9, 8.10, 8.11)

Line integral, line integrals independent of path (Sections: 9.1, 9.2)

Unit 2

Green's theorem in the plane, surfaces for surface integrals, surface integrals, triple integrals – Gauss divergence theorem, Stoke's theorem. (Sections: 9.4, 9.5, 9.6, 9.7, 9.9)

Unit 3

Periodic functions, trigonometric series, Fourier series, functions of any period p = 2L, even and odd functions, half range expansions (theorem statement only), complex Fourier series, applications of Parseval's identity. (Sections: 10.1 to 10.5)

Basic concepts, modeling; vibrating string, wave equation, separation of variables, use of Fourier series, d'Alembert's solution of the wave equation, heat equation; solution by Fourier series. (Sections: 11.1 to 11.5)

TEXTBOOK:

'Advanced Engineering Mathematics', E Kreyszig, John Wiley and Sons, 2002, Eighth Edition.

MAT211 INTEGRAL TRANSFORMS AND COMPLEX ANALYSIS 3 1 0 4

Unit 1

Complex numbers, complex plane, polar form of complex numbers. Powers and roots, derivative. Analytic functions, Cauchy-Riemann equations, Laplace equation, conformal mapping, exponential function, trigonometric functions, hyperbolic functions, logarthims, general power, linear fractional transformation. (Sections: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8,12.9)

Unit 2

Complex line integral, Cauchy integral theorem, Cauchy integral formula, derivatives of analytic functions. (Sections: 13.1, 13.2, 13.3, 13.4,)

Power series, Taylor series and Maclaurin series. Laurent series, zeros and singularities, residues, Cauchy residue theorem, evaluation of real integrals using residue theorem. (Sections: 14.4, 15.1, 15.2, 15.3, 15.4)

Unit 3

Laplace transforms, inverse transforms, linearity, shifting, transforms of derivatives and Integrals, differential equations, unit step function, second shifting theorem, Dirac's delta function. Differentiation and integration of transforms. Convolution, integral equations, partial fractions, differential equations, systems of differential equations. (Sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7)

Fourier integrals (Fourier integral theorem statement only), Fourier cosine and sine transforms, Fourier transforms. (Sections: 10.8 to 10.10)

TEXTBOOK:

'Advanced Engineering Mathematics', E Kreyszig, John Wiley and Sons, 2002, Eighth Edition.

MAT212 MATHEMATICAL STATISTICS AND NUMERICAL METHODS 3 1 0 4

Unit 1

Probability, random variables, probability distributions (continuous and discrete), mean and variance of a distribution, expectation and moment generating functions, binomial, poisson and normal distributions, random sampling, estimation of parameters. (Sections: 22.3, 22.5, 22.6, 22.7, 22.8, 23.1, 23.2)

Unit 2

Confidence interval and central limit theorem, testing of hypothesis. (Sections: 23.3, 23.4)

Solution of equations by iterative methods, interpolation. (Sections: 17.2, 17.3)

Unit 3

Numerical integration and differentiation, solution of linear systems by iterative methods, Eigen values of matrices by iterative methods. Numerical solutions for ordinary differential equations and partial differential equations. (Sections: 17.5, 18.3, 18.8, 19.1, 19.4)

TEXTBOOK:

'Advanced Engineering Mathematics', E Kreyszig, John Wiley and Sons, 2002, Eighth Edition.

MEC100 ENGINEERING MECHANICS 3 1 0 4

Unit 1

Principles of statics: Introduction to vector approach – free body diagrams - forces in plane – forces in space - concurrent forces – resolution of forces - equilibrium of particle.

Statics of rigid bodies in two dimensions and three dimensions: Moment of a force about a point - moment of a force about an axis - moment of a couple – equivalent force - couple system - rigid body equilibrium – support reactions.

Unit 2

Applications of statics: Friction – ladder friction – wedge friction - analysis of trusses – method of joints – method of sections.

Centroid and centre of gravity: Centroids of lines, areas and volumes – composite bodies.

Second moment of area – polar moment of inertia - mass moment of inertia - radius of gyration.

Unit 3

Dynamics of particles: Kinematics of particles – rectilinear motion – relative motion - position, velocity and acceleration calculations in cylindrical coordinates.

Dynamics of rigid bodies: General plane motion - translation and rotation of rigid bodies – Chasle's theorem – velocity and acceleration calculations in moving frames of references – Coriolis acceleration.

TEXTBOOKS:

1. *Shames, I. H, "Engineering Mechanics - Statics and Dynamics", 4/e, Prentice-Hall of India Pvt. Ltd., 2003.*
2. *Beer, F.P. & Johnston, E.R., "Vector Mechanics for Engineers - Statics and Dynamics", 8/e, McGraw Hill International Book Co., 2008.*

REFERENCES:

1. *Hibbeler, R.C., "Engineering Mechanics", 12/e, Pearson Education Pvt. Ltd., 2007.*
2. *Meriam, J.L., "Dynamics", 5/e, John Wiley & sons, 2003.*
3. *K. L. Kumar, "Engineering Mechanics", 3/e, Tata McGraw Hill, 2003.*

MEC180 WORKSHOP A 1 0 2 2

Product detailing workshop: (Study of simple mechanical and electromechanical system)

Disassemble the product or sub assembly – measure various dimensions using measuring instruments – free hand rough sketch of the assembly and components – name the components and indicate the various materials used – study the functioning of the assembly and parts – study the assembly and components design for compactness, processing, ease of assembly and disassembly – assemble the product or subassembly.

Pneumatics and PLC workshop:

Study of pneumatic elements – design and assembly of simple circuits using basic pneumatic elements – design and assembly of simple circuits using electro-pneumatics. Study of PLC and its applications – simple programming using ladder diagrams.

Sheet metal workshop:

Study of tools and equipment – draw development drawing of simple objects on sheet metal (cone, cylinder, pyramid, prism, tray, etc.) – fabrication of components using small shearing and bending machines – riveting and painting practice.

Welding workshop:

Study of tools and equipment – study of various welding methods – arc welding practice and demonstration of gas welding and cutting.

Demo and practice workshop:

Fitting: Study of tools, practice in chipping, filing and making joints.

Carpentry: Study of tools, planning practice and making joints.

REFERENCES:

Concerned Workshop Manual

MEC181 ENGINEERING DRAWING 1 0 3 2

Use of drawing instruments – drawing practice – lettering – dimensioning – sketching.
Orthographic projections – projection of points; projection of lines; projection of planes; projection of solids.
Section of solids; Intersection of solids; development of surfaces.
Orthographic views of three-dimensional solids.
Isometric projection.

TEXTBOOK:

John, K. C., Engineering Graphics for Degree, PHI Learning, 2010.

REFERENCES:

1. *Bhat N.D. and Panchal V.M. – Engineering Drawing – Plane and solid Geometry, 42e, Charoatar Publishing House, 2000*
2. *James D. Bethune, Engineering Graphics with AutoCAD, 2002, Pearson Education, First reprint, 2003*
3. *Narayana K.L. & Kannaiah P, Engineering Graphics, SciTech publications, Chennai, 2003*
4. *Waran J Luzadder and John M Duff, Fundamentals of Engineering Drawing, 11e, Prentice Hall of India, New Delhi, 1995*
5. *K. R. Gopalakrishna, Engineering Drawing, 2003, Subhas Publications*

MEC182 COMPUTER AIDED DRAWING 1 0 3 2

Introduction to CAD
Preparation of drawings using CAD Tools
Introduction to VBA / LISP
Introduction to 3D modeling and Surface Modeling

TEXTBOOKS:

1. *Sham Tickoo, AutoCAD 2011 – a Problem solving approach, Autodesk Press, 2011.*
2. *John, K. C., Engineering Graphics for Degree, PHI Learning, 2010.*

REFERENCES:

CADian Manual

MEC220 ENGINEERING THERMODYNAMICS 3 1 0 4

Unit 1

Introduction and importance of thermodynamics, different approaches in the study of thermodynamics, SI units, basic concepts and definitions - system, surroundings, types of systems, properties. Pressure measurement, thermodynamic equilibrium,

quasi-static process, cyclic process, thermodynamic energy interactions - evaluation of work type energy interaction, heat interaction, energy and forms of energy. History of laws of thermodynamics. First law for closed system, analysis of closed systems. Concept of zeroth law, thermometry, temperature scales. Perfect gas, equation of state, specific heats, characterisation of various thermodynamic processes. Real gas models - Van der Waals equation, Virial equation of state, compressibility chart.
Thermodynamic properties of fluids, pure substance, phase-change process of pure substance, p-v-T surface, T-v, p-v and other diagrams, specific internal energy and enthalpy and other properties, steam tables.
Open system - conservation of mass applied to a control volume, conservation of energy applied to a control volume, application of steady-state flow process for typical work transfer and heat transfer devices. Throttling process, application of throttling process.

Unit 2

Second law of thermodynamics, statement of Kelvin-Planck and Clausius, heat engine, heat pump, refrigerator, irreversible processes, reversible processes, Carnot cycle, Carnot engine, Carnot theorems.
Clausius inequality and thermodynamic temperature scale, concept of entropy, entropy change in different processes, principle of Increase in entropy for closed systems.

Unit 3

Thermodynamic property relations: Introduction, important mathematical relations, cyclic rule, Maxwell relations, enthalpy, entropy, internal energy, and specific heat relations; Clausius-Clapeyron equation, Joule-Thomson coefficient and Inversion line.
Introductory treatment of power and refrigeration cycles - air standard Otto and diesel cycles, Rankine cycle, reversed Carnot cycle as a refrigeration cycle, vapour compression cycle.

TEXTBOOK:

Cengel, Y.A. and Boles, M.A., 'Thermodynamics: An Engineering Approach', Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.

REFERENCES:

1. *Borganakke, S. and Wylen V., 'Fundamentals of Thermodynamics', Wiley Publications, New York, 2003.*
2. *Saad, M.A., 'Thermodynamics: Principles and Practice', Prentice Hall, New Jersey, 1998.*
3. *John R. Howell and Richard D. Buckius., 'Fundamentals of Engineering Thermodynamics", McGraw –Hill,1987.*

MEC290 MACHINE DRAWING 1 1 3 3

Unit 1

BIS codes for practice of machine drawing - dimensioning, sectional views, abbreviations and conventions, welding symbols, surface finish symbols, screws, bolts, nuts and rivets.

Introduction to sketch mode and 2D draft mode in a 3D software package – 2D sketching, relationship/constraints, dimensioning.

Fits and tolerances - geometric tolerances. Machine elements - keys, pin joints, fasteners, hexagonal and square head bolts and nuts, conventional representation of threads.

Introduction to solid modelling using 3D software package - reference planes. Protrusion, revolved protrusion, swept protrusion, round, cutout, revolved cutout, hole, pattern, mirror, thread, chamfer.

Unit 2

Joints - cotter joints - sleeve, spigot and socket, jib and cotter, knuckle joints, couplings - flange coupling, universal coupling, riveted joints - single and multiple rivets - chain, zigzag and structural riveted joints, welded joints.

Advanced feature creations using solid modelling package - rib, thin wall, lip, mounting boss, web etc - editing features, creation of views from 3D model and section views.

Bearings - footstep bearing, plummer block, swivel bearing, machine parts - tailstock, tool head of a shaper, valves - stop valve, safety valve - Ramsbottom safety valve. Preparation of assembled views from the given part drawings.

Unit 3

Assembly modeling using relations/constraints and conversion of parts and assembly to drafting – creation of bill of material – calculation of mass properties – interference checks between solids.

Automated preparation of part drawings and assembly drawings from 3D of screw jack, connecting rod assembly, crossheads of steam engine.

TEXTBOOKS:

1. *Gopalakrishna, K. R., 'Machine Drawing', 16e, Subhas publishing House, 2002*
2. *Sidheswar, N., Kannaiah, P., and Sastri, V.V.S., 'Machine Drawing', TMH, 2006, New Delhi*

REFERENCES:

1. *John, K.C. and Verhese, P.I, 'Machine Drawing', Jovast Publishers, 2005.*
2. *'PSG Design Data Book', Kalaikathir Achchagam, 2009.*
3. *Bhatt, N.D., 'Machine Drawing', Charotar Publishing House, 1991.*

MEC461 QUALITY CONTROL AND RELIABILITY ENGINEERING 3 0 0 3

Unit 1

Introduction: Review of statistics and probability. Quality related costs, contemporary quality engineering philosophy, quality systems and international standards and 6 sigma. Control charts for variables: X-bar and R charts, X-bar and S charts; control charts for individual measurements; exponentially Weighted Moving Average (EWMA) and Deviation (EWMD) charts.

Unit 2

Control charts for attributes: p, np, c, and u charts Interpretation of control charts. Average Run Length (ARL) study. Multivariate quality control. Control charts for short production runs, modified acceptance control charts. Sensitivity analysis - process capability analysis.

Introduction to reliability: concepts and definition of reliability – reliability mathematics – failure distributions.

Unit 3

Hazard models – hazard rate function – failure density function – conditional reliability – exponential, Rayleigh, Weibull, Normal and Lognormal distributions – two-parameter exponential and three-parameter Weibull distributions – MTTF, MTBF – design life.

Reliability of simple Systems – series and parallel configurations – reliability improvement – redundancy – combined series and parallel systems – high level and low level redundancy – k-out of n system – standby redundancy.

Maintainability – factors affecting maintainability of systems – design for maintainability - MTTR – maintenance – spare provisioning.

TEXTBOOKS:

1. *Montgomery, D.C., 'Introduction to Statistical Quality Control', John Wiley, 2004.*
2. *Ebeling, C., 'An introduction to reliability and maintainability Engineering', Tata McGraw Hill publishing Company Ltd., 2004.*

REFERENCES:

1. *Eugene, G.L., 'Statistical Quality Control', McGraw-Hill, 1996.*
2. *Srinath, L. S., 'Concept in reliability with an introduction to maintainability and availability', Associated East-West, 1998.*
3. *Lewis, E.E., 'Introduction to reliability Engineering', John Wiley & sons, 1987.*
4. *Rao, S. S., 'Reliability based Design', McGraw Hill, 1992.*
5. *Barlow, R.E., Proselan, R.E., and Hunter, L. C., 'Mathematical Theory of Reliability', John Wiley, New York, 1965.*
6. *Halpern, S., 'The Assurance services, an Introduction to Reality control and Reliability' Prentice Hall, New Jersey, 1977.*
7. *O'cconer, P.D.T., 'Practical Reliability Engineering', John Wiley & Sons Ltd., 2003*

MEC462 SIMULATION MODELING OF MANUFACTURING SYSTEMS 3 0 0 3

Unit 1

Introduction: Introduction to manufacturing systems – introduction to simulation – applications – system and system environment – types of simulation - simulation procedure – examples of simulation – introduction to simulation softwares.

Probability distributions: review of basic probability and statistics – probability distributions – random number generators – testing of random numbers.

Unit 2

Analysis of simulation input data: data collection – statistical analysis of numerical data – tests for Independence and Identically distributed data - distribution fitting – selecting a distribution in the absence of data – modelling discrete probabilities – demonstration of input modelling using arena simulation package.

Model building of discrete systems: Modelling paradigms - modelling of structural elements and operational elements – modelling issues – model verification and validation.

Unit 3

Applications of simulation in manufacturing – manufacturing modelling techniques – modelling material handling system – model building exercises using arena - case study.

Simulation output analysis: design of simulation experiments: determination of warm up period, run length, number of replications - statistical analysis of simulation output – terminating and non-terminating simulations – comparing alternative system designs – variance reduction techniques – simulation optimization.

TEXTBOOKS:

1. *Law, A. W., and Kelton, D. W., 'Simulation Modeling and Analysis', 3e, McGraw Hill, 2000.*
2. *Kelton, D. W., Sadowski, R. P., and Sasowski, D.A., 'Simulation with ARENA', McGraw Hill, 2009.*

REFERENCE BOOKS:

1. *Banks, J., Carson, J. S., Nelson, B.L., and Nicol, D.M., 'Discrete Event System simulation', 3e, Pearson Education, 2001.*
2. *Viswanathan, N. and Narahari, Y., 'Performance Modeling of Automated Manufacturing Systems', Prentice Hall, 1998.*

MEC484 PROJECT MANAGEMENT 3 0 0 3

Unit 1

Foundations of project management: Project life cycle - project environment - project selection - project proposal - project scope - work breakdown structure.

Network scheduling: Critical path method, program evaluation & review technique - planning and scheduling of activity networks - assumptions in PERT modelling - time-cost trade-offs - linear programming and network flow formulations - PERT/CPM.

Unit 2

Scheduling with limited resources: resource planning - resource allocation - project schedule compression - project scheduling software. Precedence diagrams - decision CPM - generalized activity networks - GERT.

Unit 3

Estimation of project costs: **e**arned value analysis. Monitoring project progress. Project appraisal and selection - recent trends in project management.

TEXTBOOK:

Meredith, Jack, R., and Samuel, J., Mantel Jr., 'Project Management - A Managerial Approach', John Wiley, 1995.

REFERENCES:

1. *Ted, K., 'Project Management, Tools, and Trade-offs', John Wiley, 2004.*
2. *Samuel, J. M. and Meredith, J. R., 'Core Concepts of Project Management', John Wiley, 2001.*

MNG400 PRINCIPLES OF MANAGEMENT 3 0 0 3

Unit 1

HISTORICAL DEVELOPMENT: definition of management – science or art – management and administration – development of management thought – contribution of Taylor and Fayol – functions of management – types of business organisations.

PLANNING: nature & purpose – steps involved in planning – objectives – setting objectives – process of managing by objectives – strategies, policies & planning premises - forecasting – decision-making.

Unit 2

ORGANISING: nature and purpose – formal and informal organization – organization chart – structure and process – departmentation by difference strategies – line and staff authority – benefits and limitations – de-centralization and delegation of authority – staffing – selection process - techniques – HRD – managerial effectiveness.

DIRECTING: scope – human factors – creativity and innovation – harmonizing objectives – leadership – types of leadership motivation – hierarchy of needs – motivation theories – motivational techniques – job enrichment.

Unit 3

Communication: process of communication – barriers and breakdown – effective communication – electronic media in communication.

CONTROLLING: system and process of controlling – requirements for effective control – the budget as control technique – information technology in controlling – use of computers in handling the information – productivity – problems and

management – control of overall performance – direct and preventive control – reporting – the global environment – globalization and liberalization – international management and global theory of management.

TEXTBOOKS:

1. *Harold Kooritz & Heinz Weihrich "Essentials of Management", Tata McGraw-Hill, 1998*
2. *Joseph L Massie "Essentials of Management", Prentice Hall of India, (Pearson) Fourth Edition, 2003.*

REFERENCES BOOKS:

1. *Tripathy P C and Reddy P N, "Principles of Management", Tata McGraw-Hill, 1999.*
2. *Decenzo David, Robbin Stephen A, "Personnel and Human Reasons Management", Prentice Hall of India, 1996*
3. *JAF Stomer, Freeman R. E and Daniel R Gilbert, "Management", Pearson Education, Sixth Edition, 2004.*
4. *Fraidoon Mazda, "Engineering Management", Addison Wesley, 2000.*

PHY100 PHYSICS 3 0 0 3

Unit 1

Special theory of relativity: Frames of reference, postulates of special theory of relativity, time dilation, length contraction, relativistic mass, relativistic momentum, mass and energy, Lorentz transformation, velocity addition, Doppler effect.

Physical background for quantum mechanics: Black body radiation, photoelectric effect, Compton effect, X-ray diffraction, pair production, de-Broglie waves, uncertainty principle.

Unit 2

Quantum mechanics: Wave function, wave equation, Schrodinger equation (time dependent), expectation values-operators, eigen functions and eigen values, Schrodinger equation(steady state), particle in a box-finite potential, tunneling effect, quantum theory of hydrogen atom.

Unit 3

Classical and quantum statistics: Statistical distribution, Maxwell Boltzmann's statistics, molecular energies in an ideal gas, quantum statistics, Rayleigh Jean's formula, Planck's radiation law, free electron in a metal, electron energy distribution, specific heat of solids, evolution of stars.

Solid state physics: Crystalline and amorphous solids - ionic crystals - covalent crystals - Van der Walls bond - metallic bond - Band theory of solids - semiconductor devices.

TEXTBOOK:

Arthur Beiser, "Concepts of Modern Physics", Tata Mcgraw Hill, 2003 (6 th edition).

REFERENCES:

1. *T.Thornton and A.Rex, "Modern Physics for Scientists and Engineers", Fort Worth: Saunders, 2000 (2 nd edition).*
2. *P.A.Tipler and R. A. Llewellen, "Modern Physics", New York: Freeman, 1999 (3 rd edition).*
3. *S.H.Patil, "Elements of Modern Physics", Tata Mc Graw Hill, 1989.*
4. *F.K.Richtmyer, H.Kennard, John N.Copper, "Modern Physics", Tata Mc Graw Hill, 1995.*

PHY181 PHYSICS LAB. 0 0 3 1

Experiments on mechanics

1. Torsional pendulum.
2. Co-efficient of viscosity of liquid.
3. Young's modulus - non-uniform bending.

Experiments on optics

1. Determination of lycopodium powder particle size using laser.
2. Dispersive power of prism.
3. Newton's ring.

Experiments on electricity

1. Meter bridge / energy gap.
2. Frequency of AC current.
3. Temperature co-efficient of resistance.

TEXTBOOK:

The manual for experiments prepared by the Department of Physics, AVVP. Experiments will be renewed as an when feasible.

REFERENCE:

D.P.Khandelwal, "A Laboratory Manual of Physics", Vikas Publishing House Pvt LTd., New Delhi,1985.

PHY250 ELECTRICAL ENGINEERING MATERIALS 3 0 0 3

Unit 1

Conducting materials: The nature of chemical bond, crystal structure Ohm's law and the relaxation time, collision time, electron scattering and resistivity of metals, heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and it's consequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2

Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and it's applications.

Unit 3

Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity.

PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of the p-n junction rectifier, the n-p-n transistor.

TEXTBOOK:

A J Decker, "Electrical Engineering materials", PHI, New Delhi, 1957.

REFERENCES:

1. *A J Decker, "Solid State Physics", Prentice Hall, Englewood Cliffs, N J 1957.*
2. *C Kittel, "Introduction to solid state Physics", Wieley, New York, 1956 (2 nd edition).*
3. *Allison, Electronic Engineering materials and Devices, Tata Mc Graw Hill*
4. *F K Richtmyer E H Kennard, John N Copper, "Modern Physics", Tata Mc Graw Hill, 1995 (5 th edition).*

PHY251 OPTOELECTRONIC DEVICES 3 0 0 3

Unit 1

Properties of semiconductors: Electron and photon distribution: density of states, effective mass and band structure, effect of temperature and pressure on band gap, recombination processes.

Basics of semiconductor optics: Dual nature of light, band structure of various semiconductors, light absorption and emission, photoluminescence. electro luminescence, radioactive and non-radiative recombination, wave trains.

Unit 2

Semiconductor light-emitting diodes: Structure and types of LEDs and their characteristics, guided waves and optical modes, optical gain, confinement factor, internal and external efficiency, semiconductor heterojunctions, double-heterostructure LEDs.

Semiconductor lasers: Spontaneous and stimulated emission, principles of a laser diode, threshold current, effect of temperature, design of an edge-emitting diode, emission spectrum of a laser diode, quantum wells, quantum-well laser diodes**.**

Unit 3

Semiconductor light modulators: Modulating light (direct modulation of laser diodes, electro-optic modulation, acousto-optic modulation), isolating light (magneto-optic isolators), inducing optical nonlinearity (frequency conversion, switching)

Semiconductor light detectors: I-V characteristics of a p-n diode under illumination, photovoltaic and photoconductive modes, load line, photocells and photodiodes, *p-i-n* photodiodes, responsivity, noise and sensitivity, photodiode materials, electric circuits with photodiodes, solar cells.

REFERENCES:

1. *Semiconductor Optoelectronics: Physics and Technology, Jasprit Singh, McGraw-Hill Companies, ISBN 0070576378*
2. *Optoelectronics, E. Rosencher and B. Vinter, Cambridge Univ. Press, ISBN 052177813.*
3. *Photonic Devices, J. Liu, Cambridge Univ. Press, ISBN 0521551951.*
4. *Semiconductor Optoelectronic Devices 2nd Edition", P. Bhattacharya, Prentice Hall, ISBN 0134956567.*
5. *Physics of Semiconductor Devices, by S.M. Size (2nd Edition, Wiley, New York, 1981).*

PHY252 PHYSICS OF SEMICONDUCTOR DEVICES 3 0 0 3

Unit 1

Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects.

Electrical conductivity: Classical free electron theory – assumptions, drift velocity, mobility and conductivity, drawbacks. quantum free electron theory – Fermi energy, Fermi factor, carrier concentration. Band theory of solids – origin of energy bands, effective mass, distinction between metals, insulators and semiconductors**.**

Unit 2

Theory of semiconductors: Intrinsic and extrinsic semiconductors, band structure of semiconductors, carrier concentration in intrinsic and extrinsic semiconductors, electrical conductivity and conduction mechanism in semiconductors, Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. Carrier generation-recombination, mobility, drift-diffusion current. Hall effect.

Theory of p-n junctions – *diode and transistor*: p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential. V-I characteristics, junction capacitance and voltage breakdown**.**

Unit 3

Bipolar junction transistor, p-n-p and n-p-n transistors: principle and modes of operation, current relations. V-I characteristics. Fundamentals of MOSFET, JFET.

Heterojunctions – quantum wells.

Semiconducting devices: *Optical devices:* optical absorption in a semiconductor, e^--hole generation. Solar cells – p-n junction, conversion efficiency, heterojunction solar cells. Photo detectors – photo conductors, photodiode, p-i-n diode. Light emitting diode (LED) – generation of light, internal and external quantum efficiency. *Modern semiconducting devices*: CCD - introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOKS:

1. *C Kittel, "Introduction to Solid State Physics", Wiley, 7th Edn., 1995.*
2. *DA Neamen, "Semiconductor Physics and Devices", TMH, 3rd Edn., 2007.*

REFERENCES:

1. *SM Sze, "Physics of Semiconductor Devices", Wiley, 1996.*
2. *P Bhattacharya, "Semiconductor Opto- Electronic Devices", Prentice Hall, 1996.*
3. *MK achuthan & KN Bhat, "Fundamentals of Semiconductor Devices", TMH, 2007.*
4. *J Allison, "Electronic Engineering Materials and Devices", TMH, 1990.*

PHY253 ELECTROMAGNETIC FIELDS AND WAVES 3 0 0 3

Unit 1

Electrostatics: Coulombs law and electric field intensity, field due to a continuous volume charge distribution, field of a line charge, field of sheet of charge, electric flux density, Gauss's law, application of Gauss's law, Maxwell's first equation.

Poisson's and Laplace's equations: The potential field of a point charge, potential field of a system of charges :conservative property, potential gradient, the dipole.

Unit 2

Poisson's and Laplace's equations, uniqueness theorem, examples of the solution of Laplace's equation, solution of Poisson's equation.

Electromagnetics: Biot Savart law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, derivation of steady magnetic field laws, Faraday's laws, displacement current, Maxwells equations in point and integral form, retarded potentials

Unit 3

Electromagnetic waves: EM wave motion in free space, wave motion in perfect dielectrics, plane wave in lossy dielectrics, Poynting vector and power consideration, skin effect, reflection of uniform plane waves, standing wave ratio. Transmission line equations, line parameters-examples, dipole radiation, retarded potentials, electric dipole radiation.

TEXTBOOK:

William H Hayt , "Engineering Electromagnetics", Tata Mc Graw Hill , New Delhi, 2002 (5th edition).

REFRENCES:

1. *David J Griffiths, "Introduction to Electrodyanamics", Prentice-Hall of India, New Delhi, 1999 (2nd edition).*
2. *J D Jackson, "Classical Electrodynamics", Weiley Eastern, 2004 (2nd edition).*
3. *B.Chakraborty, "Principles of Electrodynamics", Books and Allied Publishers, 2002*

PHY254 MICROELECTRONIC FABRICATION 3 0 0 3

Unit 1

Introduction to semiconductor fabrication – scaling trends of semiconductor devices; crystal structure of semiconductor materials, crystal defects, phase diagrams and solid solubility; physics of Czochralski growth of single crystal silicon, Bridgeman method for GaAs, float zone process; diffusion science: Ficks laws of diffusion, atomistic models of diffusion, dopant diffusion mechanisms; kinetics of thermal oxidation, Deal-Grove Model, nitridation of silicon, structure and characteristics of oxides, effect of dopants on oxidation kinetics, dopant redistribution;

Unit 2

Physics of ion implantation: Coulombic scattering and projected range, nuclear and electronic stopping, channeling, implantation damage removal, dopant activation by rapid thermal annealing; principles of optical lithography – optics and diffraction, light sources and spatial coherence, physics of pattern transfer, nodulation transfer function; chemistry of lithographic processes: organic and polymeric photoresists, developing and exposure, contrast; principles of non-optical lithography: electron beam, X-ray lithography, resists, sources; etching: Chemistry of wet etching, plasma physics, chemistry of plasma etching and reactive ion etching; chemical mechanical polishing.

Unit 3

Vacuum science: Kinetic theory of gases, gas flow and conductance, vacuum pumps and seals; deposition of thin films: physics of sputtering and evaporation, step coverage and morphology of deposited films, chemical vapor deposition: chemical equilibrium and law of mass action, gas flow and boundary layers, types of CVD, plasma assisted CVD; thermodynamics of epitaxial growth, types molecular beam epitaxy, isolation and contact formation – LOCOS and trench, silicides, metallization with Al and Cu; process Integration: CMOS, bipolar process flow.

TEXTBOOK:

Stephen Campbell, Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2001

REFERENCE:

1. *S K Gandhi, VLSI Fabrication Principles, John Wiley & Sons, 1994*
2. *Gary S May and Simon M Sze, Fundamentals of Semiconductor Fabrication, John Wiley, 2003.*
3. *S Wolfe, Silicon Processing for the VLSI Era, Lattice Press, 1998.*

PHY255 ELECTRONIC MATERIALS SCIENCE 3 0 0 3

Unit 1

Types of bonding in solids, Crystallography and crystalline defects: Crystallography, Directions and planes, Crystalline defects, line defects, Planar defects, Volume defects; Binary and Ternary Phase Diagrams: Lever rule and phase rule, Eutectic, peretectic and Eutectoid systems, Applications of Phase diagrams; Basic Quantum Physics - atomic structure, Use of band theory and occupation statistics to explain existence and basic properties of metals and nonmetals. Working of Semiconductor Devices using band diagrams and their electrical characteristics: pn junctions, BJT, MOSFET.

Unit 2

Use of band theory to explain optoelectronic properties of materials and optoelectronic devices: LEDs, Solar Cells, Lasers, pin diodes, photodiodes; Magnetic properties and Superconductivity: Magnetic moments and Magnetic Permeability, types of magnetism, saturation magnetization, magnetic domains, soft and hard magnetic materials, superconductivty and its origin, Giant Magneto Resistance, Josephson effect, Energy band diagrams and Magnetism, Applications of magnetic materials- Magnetic recording materials, etc.

Unit 3

Optical Properties of Materials: Reflection, Refraction, Dispersion, Refractive Index, Snells Law, Light Absorption and Emission, Light Scattering, Luminescence, Polarization, Anisotropy, Birefringerence; Dielectric Properties of Materials: Polarization and Permittivity, Mechanisms of polarization, dielectric properties-dielectric constant, dielectric loss, dielectric strength and breakdown, Piezoelectricity, Ferreoelectricity, and Pyroelectricity, Dielectric Materials

TEXTBOOK:

S.O. Kasap, Principles of Electronic Materials and Devices, 2006, 3rd edition, Tata McGraw Hill.

REFERENCE:

D. Jiles: Introduction to the Electronic Properties of Materials, Chapman & Hall. 1994.

PHY260 PHYSICS OF LASERS AND APPLICATIONS 3 0 0 3

Unit 1

Review of some basic concepts and principle of laser.

Introduction to light and its properties: Reflection, refraction, interference, diffraction and polarization. Photometry – calculation of solid angle. Brewster's law. Snell's law and, its analysis.

ntroduction to LASERS: Interaction of radiation with matter - induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Active material. Population inversion – concept and discussion about different techniques. Resonant cavity.

Unit 2

Properties of LASERS

Gain mechanism, threshold condition for PI (derivation), emission broadening - line width, derivation of Dw FWHM · natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS

Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS. gas LASER: (i) He-Ne LASER - principle, construction, working and application. (i) CO_2 LASER - principle, construction, working and application.

Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi conductor diode LASERS.

Applications in Communication field:

LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.

Applications of LASERS in other fields:

Holography: Principle, types, intensity distribution, applications. laser induced fusion. Harmonic generation. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

REFERENCES:

1. *William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).*
2. *BB Laud, "Lasers and Non linear Optics", New Age International (P) Ltd., New Delhi.*
3. *Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).*
4. *KR Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.*
5. *T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).*

PHY261 LASERS IN MATERIAL PROCESSING 3 0 0 3

Unit 1

Basic optical theory: Nature of electromagnetic radiation, interaction of radiation with matter, reflection, refraction, polarization, laser fundamentals, laser beam characteristics, beam quality (laser cavity modes),Q-switching, mode locking, continuous wave, types of lasers, energy and power.

Laser interaction with materials: Optical properties of materials, laser interaction with metals, insulators, semiconductors, polymers and biological materials.

Laser surface treatment: Introduction to laser surface hardening, laser surface melting, laser surface alloying, laser surface cladding, laser cleaning. Laser ablation: mechanisms (photothermal, photophysical and photochemical), mask projection techniques, laser micro and nano structuring.

Unit 2

Laser cutting and drilling: Mechanism for inert gas and oxygen-assisted cutting, factors controlling cut quality and kerf width. Laser assisted drilling.

Laser welding: Introduction to laser keyhole welding and contrast with conduction limited welding, applications,

Direct laser fabrication (DLF): Laser sintering & laser rapid manufacturing, comparison with rapid prototyping. Main potential and limitations of DLF for direct fabrication and for the production of novel engineering materials and structures.

Unit 3

Laser forming: Mechanisms involved, including thermal temperature gradient, buckling, upsetting. Applications in alignment and straightening and in rapid production processes.

Scope of application of laser materials processing: focused on industrial application of laser in materials processing including laser welded tailored blanks.

Laser safety: Introduction to safety procedures in the use of lasers, including wavelength effects and laser safety standards.

REFERENCES:

1. *Steen, WM, Laser Material Processing (3rd Edition), Springer Verlag, 2003, ISBN 1852336986.*
2. *Silvast, WT, Laser Fundamentals, Cambridge University Press, 1998, ISBN 0521556171.*

3. *J. F. Ready, D.F. Farson. LIA Handbook of Laser Materials Processing Laser Institute of America, 2001.*
4. *M. von Allmen. Laser-Beam Interactions with Materials, Springer, 1987*
5. *D. Bauerle. Laser Processing and Chemistry, Springer, 2000*
6. *W.W. Duley, UV lasers : effects and applications in materials science, Cambridge University, Press, Cambridge ; New York, 1996.*
7. *J. Dutta Majumdar, and I. Manna, Laser Material Processing, Sadhana, Vol. 28, Year: 2003, 495-562.*

PHY262 NON-LINEAR DYNAMICS 3 0 0 3

Unit 1

Introduction: examples of dynamical systems, driven damped pendulum, ball on oscillating floor, dripping faucet, chaotic electrical circuits.

One-dimensional maps: the logistic map, bifurcations in the logistic map, fixed points and their stability, other one-dimensional maps.

Non-chaotic multidimensional flows: the logistic differential equation, driven damped harmonic oscillator, Van der Pol equation, numerical solution of differential equations.

Dynamical systems theory: two-dimensional equilibrium and their stability, saddle points, are contraction and expansion, non-chaotic three-dimensional attractors, stability of two-dimensional maps, chaotic dissipative flows.

Unit 2

Lyapunov exponents: for one- and two-dimensional maps and flows, for three-dimensional flows, numerical calculation of largest Lyapunov exponent, Lyapunov exponent spectrum and general characteristics, Kaplan-Yorke dimension, numerical precautions.

Strange attractors: general properties, examples, search methods, probability of chaos and statistical properties of chaos, visualization methods, basins of attraction, structural stability.

Bifurcations: in one-dimensional maps and flows, Hopf bifurcations, homoclinic and heteroclinic bifurcations, crises.

Hamiltonian chaos: Hamilton's equations and properties of Hamiltonian systems, examples, three-dimensional conservative flows, symplectic maps.

Unit 3

Time-series properties: examples, conventional linear methods, a case study, time-delay embeddings.

Nonlinear prediction and noise-reduction: linear predictors, state-space prediction, noise reduction, Lyapunov exponents from experimental data, false nearest neighbors.

Fractals: Cantor sets, curves, trees, gaskets, sponges, landscapes.
Calculations of fractal dimension: similarity, capacity and correlation dimensions, entropy, BDS statistic, minimum mutual information, practical considerations.
Fractal measure and multifractals: convergence of the correlation dimension, multifractals, examples and numerical calculation of generalized dimensions.
Non-chaotic fractal sets: affine transformations, iterated functions systems, Mandelbrot and Julia sets.
Spatiotemporal chaos and complexity: examples, cellular automata, coupled map lattices, self-organized criticality**.**

TEXTBOOK:

Hilborn, R. C., Chaos and Nonlinear Dynamics, Second Edition, Oxford University Press, 2000

REFERENCES:

1. *Sprott, J. C., Chaos and Time Series Analysis, Oxford University Press, 2003*
2. *Strogatz, S. H., Nonlinear Dynamics and Chaos, Westview Press, 2001*
3. *Solari, H. G., Natiello, M. A., and Mindlin, G. B., Nonlinear Dynamics, Overseas Press (India) Private Limited, 2005*

PHY263 CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY 3 0 0 3

Unit 1

Introduction

Introduction to nanotechnology, comparison of bulk and nanomaterials – change in band gap and large surface to volume ratio, classification of nanostructured materials. Synthesis of nanomaterials - classification of fabrication methods – top down and bottom up methods.

Concept of quantum confinement and phonon confinement

Basic concepts – excitons, effective mass, free electron theory and its features, band structure of solids. Bulk to nano transition – density of states, potential well - quantum confinement effect – weak and strong confinement regime. Electron confinement in infinitely deep square well, confinement in two and three dimension. Blue shift of band gap - effective mass approximation. Vibrational properties of solids - phonon confinement effect and presence of surface modes**.**

Unit 2

Tools for characterization:

Structural – X-ray diffraction, transmission electron microscope, scanning tunneling microscope, atomic force microscope. Optical - UV – visible absorption and photoluminescence techniques, Raman spectroscopy.

Nanoscale materials – properties and applications:

Carbon nanostructures – structure, electrical, vibration and mechanical properties. Applications of carbon nanotubes

Unit 3

Field emission and shielding – computers – fuel cells – chemical sensors – catalysis – mechanical reinforcement. Quantum dots and Magnetic nanomaterials – applications.

Nanoelectronics and nanodevices:

Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMSs) – fabrication (lithography) and applications. Nanodevices - resonant tunneling diode, quantum cascade lasers, single electron transistors – operating principles and applications**.**

TEXTBOOKS:

1. *, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan ,Nanoscale Science and Technology, John Wiley and Sons Ltd 2004.*
2. *W. R. Fahrner (Ed.), Nanotechnology and Nanoelectronics, Springer 2006.*

PHY264 THIN FILM PHYSICS 3 0 0 3

Unit 1

Introduction and preparation of thin film: Difference between thin and thick film. Appreciation of thin film technology in modern era. Deposition technology: Physical methods, chemical methods, other new techniques, vacuum technology: Vacuum pumps & pressure gauges.

Defects in thin film: General concepts, nature of defect, microscopic defect and dislocation. Boundary defects. Defect and energy states - donar acceptor levels, trap and recombination centers, excitons, phonons**.**

Unit 2

Thin film analysis: Structural studies: XRD and electron diffraction. Surface studies: electron microscopy studies on film (SEM, TEM, AFM.) Film composition*:* X-ray photoelectron spectroscopy (XPS), Rutherford Back Scattering spectroscopy (RBS) and Secondary Ion Mass Spectroscopy (SIMS).

Properties of thin film: Optical behaviors*:* transmission, reflection, refractive index, photoconductivity, and photoluminescence.

Unit 3

Electrical behaviors: sheet resistivity, electron mobility and concentration, Hall effect, conduction in MIS structure.

Mechanical behaviors: stress, adhesion, hardness, stiffness.

Applications of thin films in various fields: Antireflection coating, FET, TFT, resistor, thermistor, capacitor, solar cell, and MEMs fabrication of silicon wafer: Introduction. preparation of the silicon wafer media, silicon wafer processing steps**.**

TEXTBOOK:

K.L. Chopra, "Thin Film Phenomena", McGraw-Hill, New York, 1969

REFERENCES:

1. *L.T. Meissel and R.Glang, "Hand book of thin film technology", McGraw Hill, 1978.*
1. *A.Goswami, "Thin Film Fundamentals ", New Age International, Pvt Ltd, New Delhi, 1996.*
2. *O.S.Heavens "optical Properties of Thin Films" by, Dover Publications, newyork 1991.*
3. *Milton Ohring "Materials science of thin films deposition and structures", Academic press, 2006.*
4. *Donald L.Smith "Thin Film deposition principle and Practice", McGraw –Hill international Edition, 1995.*

PHY270 MEDICAL PHYSICS 3 0 0 3

Unit 1

Ultrasonics - production methods and properties - acoustic impedance - Doppler velocimetry - echo cardiography – resolution – speckle - ultrasound imaging - therapeutic use of ultrasound - use in diagnostics of cardiac problems.

X-rays – production – intensity - hard and soft X-rays - characteristic and continuous X-ray spectrum - attenuation of x-rays by hard and soft tissues – resolution – contrast X-ray imaging - fluoroscopy modes of operation - image quality - fluoroscopy suites - radiation dose – computed-aided tomography (CAT)

Unit 2

Nuclear medicine - principles of nuclear physics – natural radioactivity, decay series, type of radiation and their applications, artificially produced isotopes and its application, accelerator principles; Nuclear Isomerism, internal conversion - ideal energy for radiotherapy based on interactions. Radionuclide used in medicine - radioisotope production – dosimetry – safety - radiation hazards – PET.

Nuclear magnetic resonance physics - magnetic moment – magnetization – relaxation - nuclear magnetic resonance spectroscopy.

Unit 3

Nuclear magnetic resonance imaging (MRI) – principle - chemical shift - magnetic resonance signal induction and relaxation - pulse sequencing and spatial encoding.

Laser physics – characteristics of laser radiation, mode locking - power of laser radiation - lasers as diagnostic tool - lasers in surgery - laser speckle, biological effects, laser safety management.

TEXTBOOK:

Hendee W R and Rittenour E E, "Medical Imaging Physics", John Wiley & Sons, Chicago, 2001.

REFERENCE BOOKS

1. *Glasser.O.Medical Physics Vol.1, 2, 3 Book Publisher Inc Chicago, 1980*
2. *Jerraold T Bush Berg etal, The essentials physics of medical imaging, Lippincott Williams and wilkins(2002)*

PHY271 ADVANCED CLASSICAL DYNAMICS 3 0 0 3

Unit 1

Introduction to Lagrangian dynamics

Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties**.**

Unit 2

Central field problem

Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics

Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body**.**

Unit 3

Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.

Practical rigid body problems

Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite maneuvering and attitude control - coning maneuver - Yo-yo despin mechanism - gyroscopic attitude control, gravity-gradient stabilization.

TEXTBOOKS:

1. *H. Goldstein, Classical Mechanics, Narosa Publishing House, New Delhi, 1980, (Second Edition)*
2. *H. Goldstein,Charles Poole, John Safko, Classical Mechanics, Pearson education, 2002 (Third Edition)*
3. *Howard D. Curtis, Orbital Mechanics for Engineering Students, Elsevier, pp.475 — 543*
4. *Anderson.John.D, Modern Compressible flow, Mc Graw Hill.*

REFERENCE BOOKS:

1. *D. A. Walls, Lagrangian mechanics, Schaum Series, McGrawHill, 1967.*
2. *J. B. Marion and S. T. Thornton, Classical dynamics of particles and systems, Ft. Worth, TX: Saunders, 1995.*

PHY272 QUANTUM PHYSICS AND ITS APPLICATIONS 3 0 0 3

Unit 1

Review of Planck's relation, De-Broglie relation and uncertainty principle basic concepts - Schrodinger equation: probabilistic interpretation of wave function, one dimension problems – particle in a box, harmonic oscillator, potential barrier and tunneling. Hydrogen atom, electrons in a magnetic field - X-ray spectra - periodic table.

Unit 2

Bosons and Fermions - symmetric and antisymmetric wavefunctions - elements of statistical physics: density of states, fermi energy, Bose condensation - solid state physics: Free electron model of metals, elementary discussion of band theory and applications to semiconductor devices.

Einstein coefficients and light amplification - stimulated emission - optical pumping and laser action.

Unit 3

Operation of He-Ne laser and Ruby laser - laser in science and Industry - Raman effect and applications.

Nuclear physics: nuclear properties - binding energy and mass formula - nuclear decay with applications - theory of alpha decay - nuclear forces – fission - principle of nuclear reactor - elementary particles - leptons, hadrons, quarks, field bosons - the standard model of elementary particles.

TEXTBOOK:

A Beiser, Perspectives in Modern Physics,Mc Graw Hill

REFERENCES;

1. *Arthur Beiser, Concepts of Modern Physics, 6th Edition Tata McGraw Hill*
2 *S H Patil,Elements of Modern Physics, Tata Mc Graw Hill, 1989*
3 *K Krane, Modern Physics, John Weiley, 1998.*
4 *K Thyagarajan, A K Ghatak, Lasers-Theory and Applications, Macmillan, 1991*

PHY273 COMPUTATIONAL PHYSICS 3 0 0 3

Unit 1

Differentiation: Numerical methods, forward difference and central difference methods, Lagrange's interpolation method.

Integration: Newton - cotes expression for integral, trapezoidal rule, Simpsons's rule, Gauss quadrature method.

Unit 2

Solution of differential equations: Taylor series method, Euler method, Runge Kutta method, predictor-corrector method.

Roots of equations: Polynomial equations, graphical methods, bisectional method, Newton-Raphson method, false position method.

Unit 3

Solution of simultaneous equations: Elimination method for solving simultaneous linear equations, Gauss elimination method, pivotal condensation method, Gauss-seidal iteration method, Gauss Jordan method, matrix inversion method.

Eigen values and Eigen vectors of matrix: Determinant of a matrix, characteristic equation of a matrix, eigen values and eigen vectors of a matrix, power method.

TEXTBOOK:

Rubin H Landau & Manuel Jose Paez Mejia, "Computational Physics", John Wiley & Sons

REFERENCES:

1. *Suresh Chandra, "Computer Applications in Physics", Narosa Publishing House, New Delhi*
1. *M Hijroth Jensen, Department of Physics, University of Oslo, 2003 (Available in the Web)*

PHY274 ASTROPHYSICS 3 0 0 3

Unit 1

Historical introduction: Old Indian and western – astronomy - Aryabhatta, Tycho Brahe, Copernicus, Galileo - Olbers paradox - solar system – satellites, planets, comets, meteorites, asteroids.

Practical astronomy - telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.

Celestial mechanics - Kepler's laws - and derivations from Newton's laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2

Stellar astronomy: H-R diagram, color-magnitude diagram - main sequence - stellar evolution – red giants, white dwarfs, neutron stars, black holes - accretion disc - Schwartzchild radius - stellar masses Saha–Boltzman equation - derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables - Novae and Super novae. Binary and multiple star system - measurement of relative masses and velocities. Interstellar clouds-Nebulae.

Unit 3

Galactic astronomy: Distance measurement - red shifts and Hubble's law – age of the universe, galaxies – morphology - Hubble's classification - gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.

Relativity: Special theory of relativity - super-luminal velocity - Minkowski space -

introduction to general theory of relativity – space - time metric, geodesics, space-time curvature. Advance of perihelion of Mercury, gravitational lens.

Cosmology: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo-synthesis - plank length and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle**.**

REFERENCES:

1. *"Textbook of Astronomy and Astrophysics with elements of Cosmology", V.B.Bhatia, Narosa publishing 2001.*
2. *William Marshall Smart, Robin Michael Green "On Spherical Astronomy ",(Editor) Carroll, Bradley W Cambridge University Press ,1977*
3. *Bradley W.Carroll and Dale A. Ostlie.- "Introduction to modern Astrophysics" Addison- wesley, 1996.*
4. *BradleyW.Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison-Wesley Publishing Company, 1996'*
5. *'Stellar Astronomy' by K.D Abhayankar.*
6. *'Solar Physics' by K.D Abhayankar.*

SSK111 SOFT SKILLS I 0 0 3 1

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self motivation and continuous knowledge upgradation.

Self-confidence: Characteristics of the person perceived, characteristics of the situation, characteristics of the perceiver. Attitude, values, motivation, emotion management, steps to like yourself, positive mental attitude, assertiveness.

Presentations: Preparations, outlining, hints for efficient practice, last minute tasks, means of effective presentation, language, gestures, posture, facial expressions, professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy, etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words. Listening skills: The importance of listening in communication and how to listen actively.

Prepositions, articles and puncuation: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving level – I**:** Number system; LCM &HCF; Divisibility test; Surds and indices; Logarithms; Ratio, proportions and variations; Partnership;

Problem solving level – II: Time speed and distance; work time problems;

Data interpretation: Numerical data tables; Line graphs; Bar charts and Pie charts; Caselet forms; Mix diagrams; Geometrical diagrams and other forms of data representation.

Logical reasoning: Family tree; Deductions; Logical connectives; Binary logic; Linear arrangements; Circular and complex arrangement; Conditionalities and grouping; Sequencing and scheduling; Selections; Networks; Codes; Cubes; Venn diagram in logical reasoning; Quant based reasoning; Flaw detection; Puzzles; Cryptogrithms.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quantitative Aptitude by R.S. Aggarwal ,S. Chand*
6. *Quantitative Aptitude – Abijith Guha ,TMH.*
7. *Quantitative Aptitude for Cat- Arun Sharma. TMH.*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.*
2. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*

www.the grammarbook.com online teaching resources

www.englishpage.com online teaching resources and other useful websites.

SSK112 SOFT SKILLS II 0 0 3 1

Professional grooming and practices: Basics of corporate culture, key pillars of business etiquette. Basics of etiquette: Etiquette – socially acceptable ways of behaviour, personal hygiene, professional attire, cultural adaptability. Introductions and greetings: Rules of the handshake, earning respect, business manners. Telephone etiquette: activities during the conversation, conclude the call, to take a message. Body Language: Components, undesirable body language, desirable body language. Adapting to corporate life: Dealing with people.

Group discussions: Advantages of group discussions, structured GD – roles, negative roles to be avoided, personality traits to do well in a GD, initiation techniques, how to perform in a group discussion, summarization techniques.

Listening comprehension advanced: Exercise on improving listening skills, grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading comprehension advanced: A course on how to approach middle level reading comprehension passages.
Problem solving level – III: Money related problems; Mixtures; Symbol based problems; Clocks and calendars; Simple, linear, quadratic and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics.

Data sufficiency: Concepts and problem solving.

Non-verbal reasoning and simple engineering aptitude: Mirror image; Water image; Paper folding; Paper cutting; Grouping of figures; Figure formation and analysis; Completion of incomplete pattern; Figure matrix; Miscellaneous.

Spacial aptitude: Cloth, leather, 2D and 3D objects, coin, match sticks, stubs, chalk, chess board, land and geodesic problems etc., related problems.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quick Maths – Tyra.*
6. *Quicker Arithmetic – Ashish Aggarwal*
7. *Test of reasoning for competitative examinations by Thorpe.E. TMH*
8. *Non-verbal reasoning by R.S. Aggarwal ,S. Chand*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova*
2. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*

www.the grammarbook.com online teaching resources
www.englishpage.com online teaching resources and other useful websites.

SSK113 SOFT SKILLS III 0 0 3 1

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation/knowledge about the company, professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level – IV: Geometry; Trigonometry; Heights and distances; Co-ordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics). Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Data Interpretation by R.S. Aggarwal ,S. Chand*
6. *Logical Reasoning and Data Interpretation – Niskit K Sinkha*
7. *Puzzles –Shakuntala Devi*
8. *Puzzles – George J. Summers.*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.*
2. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*

www.the grammarbook.com online teaching resources
www.englishpage.com online teaching resources and other useful websites.