

15AES111 INTRODUCTION TO AEROSPACE TECHNOLOGY 3 0 0 3**Unit 1**

Visual Content (video) about Atmospheric Dynamics and its Influence on Flying Machines – History of Aviation (visual content) – Types of Flying Machines, Major Components of an Aircraft, and their Functions (visual content) – Aircraft vs Rotorcraft (visual content) – Basic Instruments for Flying (visual content) – Physical Properties and Structure of the Atmosphere: Temperature, Pressure and Altitude Relationships.

Unit 2

Newton's Law of Motions Applied to Aeronautics: Evolution of Lift, Drag and Moment – Aerofoils – General Types of Construction: Monocoque and Semi-monocoque – Typical Wing and Fuselage Structure (visual content) – Basic Ideas about Piston, Turboprop and Jet Engines - Use of Propeller and Jets for Thrust Production (visual content) – Stealth Technology: History and Principles.

Unit 3

History of Space flight (visual content) – Major Components of Rocket, Spacecraft and their Functions (visual content) – Principles of Rocket Engines – The Solar System and the Copernican Model - Kepler's Laws – Orbital Motion – Satellite Orbits - Earth's Outer Atmosphere (visual content).

TEXTBOOK:

Anderson J. D, "Introduction to Flight," 7th edition, McGraw Hill, 2011.

REFERENCES:

1. Anderson, D. F and Eberhatdt S, "Understanding Flight," 2nd edition, McGraw, 2009.
2. Turner M. J, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.
3. Curtis H. D, "Orbital Mechanics for Engineering Students," 3rd edition, Butterworth-Heinemann, 2013.
4. Paul A Suhler, "From Rainbow to Gusto: Stealth and the Design of the Lockheed Blackbird," AIAA, 2009.

15AES201 MECHANICS OF FLUIDS 3 1 0 4**Unit 1**

Concept of a Fluid: Continuum, Primary Properties, Compressibility of Fluids, Bulk Modulus, Isothermal & Isentropic Processes, Speed of Sound – Secondary Properties: Viscosity, Newton's Law of Viscosity, Sutherland Equation, Andrade Equation, Surface Tension, Capillarity, Vapor Pressure, Boiling, Cavitation – Hydrostatics: Pascal's Law, Hydrostatic Force on Planar and Non-planar Surfaces, Area Moment of Inertia, Archimedes' Principle, Buoyancy, Stability of Floating Bodies.

Unit 2

Fluid Dynamics: Lagrangian & Eulerian Concepts, Reynolds Transport Theorem, Extensive Property, Intensive Property, Continuity Equation (Differential & Integral Forms) – Conservation of Momentum and Energy: Euler Equation of Motion, Stream Function, Velocity Potential, Bernoulli Equation (Inviscid Steady Flow & Potential Steady Flow) – Laminar Flow: Hagen-Poiseuille Flow, Couette Flow, Plane Poiseuille Flow.

Unit 3

Boundary Layer Development: Boundary Layer Thickness, Displacement Thickness, Momentum Thickness – Momentum Equations: von Karman Momentum Integral Equations (zero pressure gradient), Skin-friction Drag on a Surface – Boundary Layer Equations: Prandtl Boundary Layer Equation and Blasius Solution – Dimensional Analysis: Buckingham Pi-theorem, Method of Repeating Variables – Similitude and Modeling: Modeling Laws, Geometric Similarity, Dynamic Similarity, Kinematic Similarity, Applications.

TEXTBOOK:

Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, "Fundamentals of Fluid Mechanics," 4th edition, John Wiley, 2002.

15AES202 INTRODUCTION TO THERMODYNAMICS 2 1 0 3**Unit 1**

Review of the Laws of Thermodynamics – Introduction to Engineering Applications of Thermodynamic Equilibrium – Quasi-static Process – Cyclic Process – Work and Heat – Application of First Law for Open and Closed Systems: Typical Work Transfer and Heat Transfer Devices – Perfect Gas – Equation of State - Specific Heats – Real Gas Models – Compressibility Chart – Thermodynamic Properties of Fluids – Pure Substance – Phase-change Process of Pure Substance – P-V-T Surface – SteamTables.

Unit 2

Introduction to the Application of Second Law of Thermodynamics – Heat Engine – Heat Pump – Refrigerator – Irreversible Processes – Reversible Processes – Carnot Cycle – Carnot Engine – Carnot Theorems – Clausius Inequality – Concept of Entropy and Entropy Change – Introduction to Compressibility and Compressible Flow – Propagation of Sound – Mach number.

Unit 3

Thermodynamic Property Relations: Cyclic Rule, Maxwell Relations, T-D-S Equations – Clausius-Clapeyron Equation – Joule-Thomson coefficient and Inversion Line -

Fundamentals of Power cycles: Air Standard Otto and Diesel Cycles, Rankine Cycle, Reversed Carnot Cycle, Brayton Cycle and its Application in Propulsion Systems.

TEXTBOOKS:

1. Cengel, Y.A. and Boles, M. A., "Thermodynamics: An Engineering Approach," Tata McGraw, 2002.
2. Saad, M. A., "Thermodynamics: Principles and Practice," Prentice Hall, New Jersey, 1998.

REFERENCE:

Borganakke, S. and Wyley V. "Fundamentals of Thermodynamics," Wiley, New York, 2003.

15AES203 MECHANICS OF MATERIALS 2 1 0 3

Unit 1

Stresses in axial members: Normal stress – St. Venant's principle – normal strain – tension and compression test – stress and strain diagrams – factor of safety – Hooke's law. Axial deformation – principle of superposition – lateral strain – Poisson's ratio – shear stress and strain – shear modulus – volumetric strain – bulk modulus – relation between elastic constants. Stresses in joints – shear and bearing stresses – temperature stress and strain – stress concentration.

Unit 2

Stresses in transverse members: Isolation of beam element – intensity of load, shear force and bending moment relation – shear force and bending moment diagrams – bending stresses in transverse members – Euler – Bernoulli' s simple beam theory – bending stress distribution – shear stresses in transverse members – shear stress distribution.

Unit 3

Deflection in transverse members: Moment-curvature relation – double-integration, Macaulay's – conjugate beam – propped cantilever – fixed beams. Stresses in torsional members: Torsional shear stress – torsion equation for circular section – polar moment of inertia – torsional deformation – stresses due to combined loading.

TEXTBOOK:

James M Gere, Barry J. Goodno "Mechanics of Materials", 8th Edition, Cengage Learning, USA, 2013.

REFERENCES:

1. Irving H. Shames and James M. Pitarresi, "Introduction to Solid Mechanics" third edition, Prentice-Hall of India Pvt. Ltd. 2006
2. Egor P. Popov, "Engineering Mechanics of Solids", Second edition, Prentice-Hall of India Pvt. Ltd., 2004
3. S. H. Crandall and N. C. Dahl, "Introduction to Mechanics of Solids", 3rd Edition, Tata McGraw Hill, India, 2013.

4. R.C. Hibbeler "Mechanics of Materials", 8th Edition, Pearson Prentice Hall, New Jersey, USA, 2011.

15AES204 MATERIALS FOR AVIATION AND SPACE 3 0 0 3

Unit 1

Atomic structure, bonding and crystal structure in materials. Imperfections in crystalline solids and their role in influencing materials properties. Mechanical properties: Stress and strain curves for brittle and ductile alloys, elastic, plastic, anelastic, visco-elastic behavior, ductility, resilience, toughness of metals, strengthening mechanisms, grain boundary hardening, solution hardening and work hardening.

Unit 2

Metals and Alloys: Microstructure, properties and applications of ferrous and non-ferrous materials in aviation and space. Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, intermetallic compounds, recrystallization and grain growth.

Ceramics: Structure, properties and applications of traditional and advanced ceramics for re-entry of space vehicles.

Unit 3

Polymers: Classification of engineering and high performance polymers, additives for engineering and high performance polymers, elastomers. Smart materials and superconductivity, nanomaterials, superalloys. Materials characterization techniques such as, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, differential scanning calorimetry and X-Ray photo electron spectroscopy.

TEXTBOOK:

Cantor B, Assender H, and Grant P (2001), *Aerospace Materials*, ISBN 07503 0742 0, IOP Publishing Ltd.

REFERENCES:

1. Gauthier M. M. (1995). *Engineered Materials Handbook Materials Park, OH: ASM International. [Comprehensive overview on engineering plastics, elastomers, composites, ceramics and ceramic matrix composites.]*
2. Boyer R., Welsch G., and Collings E. W. (1994). *Materials Properties Handbook: Titanium alloys. Materials Park, OH: ASM International. [Extensive coverage of Ti alloy data.]*
3. Davis J. R. (1997). *ASM Speciality Handbook Heat Resistant Materials. Materials Park, OH: ASM International. [Comprehensive overview on superalloys, ferrous and non-ferrous heat-resistant materials.]*

15AES211 AERODYNAMICS I 3 0 0 3

Unit 1

Importance of Aerodynamics – Classification and Practical Objectives – Aerodynamic Forces – Moments and their Non-dimensionalization – Airfoil Nomenclature – Airfoil Characteristics.

Unit 2

Complex Functions: Analytic Functions and Cauchy-Riemann Criteria, Conformal Mapping, Joukowski Transformation.

Unit 3

Concept of Circulation – Plane Potential Flow – Laplace Equation – Elementary Flows and its Superposition – Kutta Condition – Kutta-Joukowski Theorem – Kelvin's Circulation Theorem – Starting Vortex.

TEXTBOOK:

John D Anderson, "Fundamentals of Aerodynamics," 5th edition, McGraw Hill, 2010.

REFERENCES:

1. *E. L. Houghton and P. W. Carpenter, "Aerodynamics for Engineering Students," 5th edition, Butterworth-Heinemann, 2003.*
2. *Milne-Thomson, "Theoretical Aerodynamics," Dover, 1974.*
3. *Krishnamurthy Karamcheti, "Principles of Ideal-Fluid Aerodynamics," 2nd edition, Krieger Pub Co, 1980.*

15AES212 COMPRESSIBLE FLUID FLOW 2 1 0 3

Unit 1

Review of Thermodynamics: Energy Equation - Compressible Flows: Isentropic Flow, Stagnation Properties. Propagation of Sound, Mach number, Distinction between Subsonic and Supersonic flows, the Acoustic Equation, Finite Waves, Formation of Shock waves.

Unit 2

Flow Through Varying-area Ducts – Normal Shock Wave – Oblique Shock Wave – Shock Polar – Shock Wave Interactions – Prandtl-Meyer Expansion – Effect of Back Pressure on Nozzle Flows – Supersonic Wind Tunnels.

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:

John D Anderson, "Modern Compressible Flow," 3rd edition, McGraw Hill, 2002.

REFERENCES:

1. *Shapiro A. H, "The Dynamics and Thermodynamics of Compressible Fluid Flow," Vol.1, Ronald Press Company, 1977.*
2. *Zucker R. D and Biblarz. O, "Fundamentals of Gas Dynamics," 2nd edition, John Wiley, 2002.*

15AES213 AEROSPACE STRUCTURES I 3 0 0 3

Unit 1

Stress at a point, stress transformations, principal stresses, normal and shear strains, strain transformations, principal strains, Mohr's circle, bi-axial and tri-axial stresses, generalized Hooke's law, plane stress and plane strain, analysis of thin and thick walled pressure vessels.

Unit 2

Types of riveted, bolted, and welded joints, merits and demerits of various joints, study of failure behavior and simple design of joints, strain and potential energies, strain energy density, gradually applied loads and suddenly applied loads, Castigliano's theorem I and Castigliano's theorem II, Maxwell-Betti's theorem, unit load method and its applications, principle of virtual work, principle of virtual displacement and principle of virtual force.

Unit 3

Buckling of columns, Euler's formula, effective length, load versus deflection plot, load eccentricity, imperfections, South-well plot, beam columns, maximum principle stress theory, maximum principle strain theory, maximum strain energy theory, maximum shear stress (Tresca) theory, and maximum distortion (von-Mises) theory, loads on an aircraft, characteristics of aircraft structures, basic structural members in aircraft structures and their functions.

TEXTBOOKS:

1. *James M Gere, Barry J. Goodno "Mechanics of Materials", 8th Edition, Cengage Learning, USA, 2013.*
2. *R. C. Hibbeler "Mechanics of Materials", 8th Edition, P P Hall, New Jersey, USA, 2011.*

REFERENCES:

1. *James M Gere, Stephen P. Timoshenko "Mechanics of Materials", 2nd Edition, CBS Publishers, New Delhi, 1986.*
2. *Srivastava, Gope " Strength of Materials", Prentice-Hall of India, 2007*
3. *C.T. Sun, "Mechanics of Aircraft Structures", Second Edition, John Wiley & Sons, New York, 2006.*
4. *Megson, T. H. G., "Aircraft Structures for Engineering Students", Butterworth-Heinemann, USA, 2007.*

15AES214 INTRODUCTION TO CONTROL THEORY 2 1 0 3

Unit 1

Mathematical Modeling: Linear Systems, Block Diagrams, Feedback, Input Test Signals, Laplace Transforms. Transfer Functions, State Space Representation.

Unit 2

Definition of Stability – Response vs Pole Locations – Time Domain Specifications – System Type and Steady-State Errors – Routh's Stability Criterion – Root Locus – Guidelines for Sketching – Bode Plot Techniques – Nyquist Criterion – Stability Margins (Gain and Phase).

Unit 3

Root Locus Design Method: Dynamic Compensation (Lead/Lag), PID Controllers – Frequency Response Design Method – Robust Stability and Robust Performance – Introduction to State Space Design, 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. Norman S. Nise, "Control Systems Engineering," 6th edition, Wiley India, 2012.

REFERENCE:

Ogata, K. "Modern Control Engineering," 5th edition, Prentice Hall, 2010.

15AES281 MEASUREMENT AND INSTRUMENTATION LAB. 0 0 2 1

Calibration exercises on general purpose test (GPT) equipment such as Oscilloscope, signal generator, and pressure gauges.

Measurement experiments: Displacement using LVDT, velocity using Pitot tube and anemometer, force using Proving ring and load cell, torque using strain gauges, speed using stroboscope and magnetic pickup, and temperature using thermocouple.

Mini Projects: Interdisciplinary in content based on application of course work completed by the student.

15AES285 MECHANICS OF FLUIDS LAB. 0 0 2 1

Flow Experiments: Calibration of Orificemeter and Venturimeter, V and Rectangular Notches, Pipe Friction, Verification of Bernoulli's Theorem, Reynold's Apparatus, Metacentric Height, Jet Impact Studies.

15AES286 MATERIALS TESTING LAB. 0 0 2 1

Tension test on metals, hardness test on metals using the Rockwell and Brinell tests, impact tests on metals using the Charpy and Izod equipments, double shear tests, helical spring tests, static bending and compression tests on wood and deflection test to verify the Maxwell reciprocal theorem.

In addition to the conventional tests, students are assigned to open lab projects that involve experimental studies including fabrication and setting up unconventional testing methods to understand the basic concepts of strength of materials.

15AES301 AERODYNAMICS II 2 1 0 3

Unit 1

Classical Thin Airfoil Theory for Symmetric and Cambered Airfoils: Lift and Moment Coefficients, Center of Pressure, Predicting Zero Lift Angle of Attack, Flapped Airfoils, Effects of Thickness.

Unit 2

Finite Wing Theory: The Concept of Downwash and Induced Drag – Classical Theorems: Curved Vortex Filament, Biot-Savart Law, Helmholtz's Vortex Theorems – Method of Analysis: Prandtl's Classical Lifting Line Theory, Modern Numerical Lifting Line Method, Lifting Surface Theory, Modern Vortex Lattice Numerical Method.

Unit 3

Flow Physics Associated with Delta Wings: Subsonic Flow Pattern, Pressure Envelope, Leading Edge Vortex Flap (LEV) Technology and Performance Comparison, Buffeting Phenomena and Types of Vortex Breakdown.

TEXTBOOK:

John D Anderson, "Fundamentals of Aerodynamics," 5th edition, McGraw Hill, 2010.

REFERENCE:

E. L. Houghton and P. W. Carpenter, "Aerodynamics for Engineering Students," 5th edition, Butterworth-Heinemann, 2003.

15AES302 AEROSPACE PROPULSION 2 1 0 3

Unit 1

Momentum Analysis of Thrust Generation – Types of Propulsion Systems and their Components – Performance Measures – Propellers: Performance Coefficients – Review of Thermodynamic Cycles - Ideal Cycle Analysis: Ramjets, Turbojets and Turbofan Engines.

Unit 2

Component Performance – Analysis of Real Engines – Chemistry of Combustion – Heat of Combustion – Reaction Rate – Flames – Stability Considerations – Application to Gas Turbine Combustion – Fuels: Properties, Conventional and Modern Aviation Fuels.

Unit 3

Rocket Vehicle Mechanics – Multistaging – Thermodynamics of Rocket Engine – Rocket Engine Performance – Types of Rocket Engines – Fuels for Solid and Liquid Propellant Rockets – Rocket Cooling.

TEXTBOOK:

Mattingly, Jack. D, "Elements of Propulsion: Gas Turbines and Rockets," AIAA Education Series, 2006.

REFERENCES:

1. Turner Martin, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.
2. Mukunda. H. S, "Understanding Combustion," 2nd edition, Macmillan India Limited, 2007.

15AES303 AEROSPACE STRUCTURES II 3 0 0 3

Unit 1

Introduction to theory of elasticity: equilibrium equations, boundary conditions, constitutive relations, plane stress and plane strain conditions, stress and displacement formulations, strain compatibility relation, governing equations, inverse and semi-inverse methods, Airy's stress function, Torsion in non-circular bars, Prandtl stress function, St. Venant warping function, membrane analogy, torsion in narrow rectangular section.

Unit 2

Euler–Bernoulli and Timoshenko beam theories, bi-directional bending, bending and transverse shear stresses, bending stresses in narrow rectangular section, general symmetric sections, and thin-walled sections, flexural shear flows (FSF), FSF in thin-walled open sections, shear center in open sections.

Unit 3

Torsional shear flows (TSF) in thin-walled open sections, TSF in thin-walled closed sections (single and multiple cells) and warping in open and closed thin-walled sections, FSF in thin-walled closed sections (single and multi-cells) and shear center in closed sections, buckling of non-symmetrical sections and buckling of thin-walled sections.

TEXTBOOK:

C. T. Sun, "Mechanics of Aircraft structures", John Wiley & sons, New York, 2006.

REFERENCES:

1. Megson, T. H. G., "Aircraft Structures for Engineering Students", Butterworth-Heinemann, USA, 2007
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, New York, 1969.

15AES304 AVIONICS 3 0 0 3

Unit 1

Introduction: Importance and Role of Avionics, the Avionic Environment – Air Data Systems: Air Data Information and its Use, Air Data Laws and Relationships, Air Data Sensors and Computations.

Unit 2

Embedded Systems: Basic Hardware Building Blocks of a Typical Embedded System – Software Concepts Relevant to Avionics: Interrupts and Real Time Operating Systems – Case Studies Illustrating Importance of Embedded Systems in Avionics – Introduction to Electronic Communication Systems – Utility of Radio Navigation Aids.

Unit 3

Inertial Sensors and Systems: Laser and MEMS Gyros, Accelerometers, Attitude Heading Reference System – Navigation Systems: Basic Principles, Inertial Navigation, Strapped-Down Inertial Systems – Introduction to Autopilot and UAV Avionics.

TEXTBOOK:

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

REFERENCES:

1. Kaytonand Fried, "Avionics Navigation Systems", Wiley, 1997.
2. Frank Vahid, Tony Givargis, "Embedded System Design", Wiley, 2006.

15AES311 FINITE ELEMENT METHODS FOR AEROSPACE 2 1 0 3

Unit 1

Introduction to FEM - equilibrium condition, strain-displacement relation, linear constitutive relations - domain discretization, types of elements, assembly procedures, boundary conditions - Formulations: Potential energy method, Variational formulation, Weighted residual, Galerkin and Rayleigh-Ritz methods.

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 - Introduction to FE formulation of Plate bending and shell elements - Numerical integration - Solution techniques of the numerical equations - Introduction to FE software - FE modeling of aircraft and spacecraft components - Application of boundary conditions and loadings on FE models - Analysis of subcomponents like wings, fuselage, motor casing, etc.

TEXTBOOK:

Daryl L. Logan, "A First Course in the Finite Element Method", CL, New Delhi, 2007.

REFERENCES:

1. C. S. Krishnamoorthy, "Finite Element Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1999.
2. David V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Megson, T. H. G., "An introduction to aircraft structural analysis", Butterworth-Heinemann, USA, 2010.
4. Tirupathi R. Chandrapatla and Ashok D. Belegundu, "Introduction to Finite Element in Engineering", Prentice Hall of India, New Delhi.

15AES312 FLIGHT MECHANICS 2 1 0 3

Unit 1

Equations of Motion – Forces Acting on the Aircraft – Review of Aerodynamic characteristics of the Wing and Compressibility Effects – Review of Propulsion Systems and their Performance Characteristics – Drag Contribution from Aircraft Components – Airplane Performance of Turbojets: Steady Flight, Range, Endurance, Conditions for Maximum Range and Endurance, Climb Performance, Turn Performance, Maximum Load Factor During Turn.

Unit 2

Glide Performance - Take-Off and Landing Performance – Performance of Piston-Props: Steady Flight Climb and Turn Performance, Climb Performance, Turn Performance, Comparison with Turbojets - Turbofan and Turboprop Performance Evaluation Guidelines.

Unit 3

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 – Lateral Stability and Control – Introduction to Dynamic Stability – Stability Derivatives.

TEXTBOOKS:

1. Hale, Francis J, "Introduction to Aircraft Performance, Selection, and Design". Wiley, 1984.
2. Nelson. R. C, "Flight Stability and Automatic Control", 2nd edition, McGraw-Hill, 1998.

REFERENCES:

1. Perkins. C. D and Hage. R. E, "Aircraft Performance, Stability and Control", 11th edition, Wiley, 1967.
2. Anderson. J. D, "Aircraft Performance and Design", McGraw-Hill, 2010.
3. Russel. J. B, "Performance and stability of aircraft", Butterworth-Heinemann, 1996.

15AES332 FUNDAMENTALS OF HEAT TRANSFER 3 0 0 3

Unit 1

Basic Modes of Heat Transfer: Steady State Calculations with Multiple 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, Reynolds Analogy - 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 Flat Plate and in Circular Pipe – Applications of Numerical Techniques in Problem Solving.

Unit 3

Boiling and Condensation – Radiative Heat Transfer: Introduction to Physical Mechanism, Radiation Properties, Radiation Shape Factors, Heat Exchange between Non-Black Bodies, Radiation Shields. Classification of Heat Exchangers – Temperature Distribution – Overall Heat Transfer Coefficient – Heat Transfer in Gas Turbine Combustion Chambers, Rocket Thrust Chambers and Cryogenic Systems.

TEXTBOOK:

Incropera. F. P. and Dewitt. D. P., "Fundamentals of Heat and Mass Transfer," 5th edition, John Wiley and Sons, New York, 2002.

REFERENCES:

1. Yunus A. Cengel., "Heat Transfer – A practical approach," 2nd edition, Tata McGraw-Hill, 2002
2. Holman. J. P., "Heat Transfer," 6th edition, McGraw-Hill, New York, 1991.
3. Sutton. G. P., "Rocket Propulsion Elements," 5th edition, John Wiley and Sons, New York, 1986.

15AES342 EXPERIMENTAL AERODYNAMICS 3 0 0 3

Unit 1

Examples of Fluid Mechanics Measurements: Wind-Tunnel Studies, Turbulent Mixing Layer, Spatial and Temporal Resolution in Measurements, Classification of Deterministic Data, Random Data, Signal Analysis and Uncertainty Analysis.

Unit 2

Qualitative Characterization: Flow Visualization in Liquid and Gaseous Medium, Colored Filament, Smoke, Vapor and Tufts Visualization, Image Processing Techniques, Identifying Structures - Optical Systems for Flow Measurement: Shadowgraph, Schlieren and Interferometric Techniques.

Unit 3

Quantitative Characterization: Drag Measurements, Static Probes, Pressure Sensitive Paints (PSP), Velocity Measurements, Pitot-Static Probe, Thermocouple, Thermal Anemometers (Hot Wire and Film Sensors), Laser Velocimetry (LDA), Particle Image Velocimetry (PIV).

TEXTBOOK:

Cameron Tropea, Alexander L Yarin, John F Foss, "Springer Handbook of Experimental Fluid Mechanics," Springer, 2007.

REFERENCES:

1. Richard J Goldstein, "Fluid Mechanics Measurements," 2nd edition, Taylor & Francis, 1996.
2. Wolfgang Merzkirch, "Flow Visualization," Academic Press, 1974.

15AES352 VIBRATION ANALYSIS 3 0 0 3

Unit 1

Introduction to vibration, undamped vibration, natural frequency, damped vibration, viscous damped system, under, over and critically damped system, logarithmic decrement, Coulomb damping, response to initial condition, response to simple harmonic motion, rotating unbalance, base excitation, whirling of shafts, vibration measuring instruments, response to periodic motion.

Unit 2

Response to non-periodic motions, impulse response, step response, convolution and Du Hamel integrals, Numerical methods: Runge-Kutta method, Normal mode

analysis, response to initial conditions, beat phenomenon, response to simple harmonic motion, damped vibration, static and dynamic coupling, principle coordinate, decoupling, Rayleigh's proportionality damping, vibration absorber.

Unit 3

Modeling of multi-degree freedom system, stiffness and flexibility influence coefficients, modeling of beam and portal members, response to periodic and non-periodic motions, modal analysis (mode – synthesis method), Vibration of continuous: Free vibration of string, bar, shaft and beam.

TEXTBOOK:

W. T. Thomson, "Theory of vibrations with applications," Pearson, 1997.

REFERENCES:

1. Leonard Meirovitch, "Elements of vibration Analysis," Tata McGraw Hill, 1986.
2. Leonard Meirovitch, "Fundamentals of vibration," McGraw Hill, 2001.
3. S. S. Rao, "Mechanical vibrations," Pearson, 2010.

15AES353 COMPOSITE MATERIALS AND MECHANICS 3 0 0 3

Unit 1

Introduction to Composites: Concept of Composite materials, Classification of Composites, Various types of composites, Classification-based on Matrix Material: Organic Matrix Composites (Polymer matrix composites (PMC) / Carbon Matrix Composites or Carbon-Carbon Composites, Advantages of Composites materials. Reinforcements and Matrices for various types of composites Fibers / Reinforcement Materials, Role and Selection of reinforcement materials, Types of fibers, Mechanical properties of fibers,

Unit 2

Functions of Matrix, Desired Properties of Thermosets and Thermoplastics, Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Laminated composites, Lamina and Laminate Lay-up, Ply-orientation definition, Manufacturing processes. Testing of Composites: Mechanical testing of composites, Tensile testing, Compressive testing.

Unit 3

Determination of longitudinal and transverse strengths of lamina, mechanics of short fiber composites, stress-strain relationships of anisotropic lamina with arbitrary orientations, analysis of laminated composites, types of laminates, stress-strain variation in laminates using classical lamination theory, thermal stresses in laminates, different types of failure criteria, introduction to inter-laminar stresses in composites.

TEXTBOOK:

Jones R. M., "Mechanics of Composite Materials", Hemisphere Publishing Corporation, New York

REFERENCES:

1. Agarwal B. D. and Broutmen L. J. "Analysis and performance of Fiber Composites", John Wiley and Sons, New York 1990.
2. Chawla, Krishan K (2012), Composite Materials, Science and Engineering, ISBN: 978-0-387-74365, Springer.
3. Sam Zhang, Dongliang Zhao (2013), Aerospace Materials Handbook, ISBN: 978-1-4398-7329-8, Taylor and Francis.
4. Leonard Hollaway (1994), Handbook of Polymer Composite for Engineers, ISBN: 1-85573-1290, Woodhead Publishing Ltd.

15AES372 MANUFACTURING PROCESSES 3 0 0 3

Unit 1

Introduction to casting, rolling, forging, extrusion, drawing and sheet metal working-types of defects and remedies.

Unit 2

Introduction to welding and their types, Welding defects: causes and remedies. Rivet and it types. 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.

TEXTBOOK:

F. C. Campbell, "Manufacturing Technology for Aerospace Structural materials", Elsevier Science Ltd; 1 edition (15 August 2006)

REFERENCES:

1. Serope Kalpakjian and Steven R. Schmid, 'Manufacturing Engineering and Technology', Pearson Education Asia, 2000 (fourth ed.) (Indian Reprint 2000).
2. P. K. Mishra, 'Nonconventional Machining process', Narosa Publishing House, 2006.
3. A. Azad, 'Fundamentals of Computer Aided Manufacturing', Jaico Publishing House, 2006.

15AES373 ADVANCED AVIONICS 3 0 0 3

(Prerequisite - 15AES304AVIONICS or equivalent)

Unit 1

Electromagnetic Wave Propagation and its Relevance to Aviation – Electronic Communication Systems: Functional Description of Basic Building Blocks, Antenna, Amplifier, Filter, Modulator and Demodulator – Introduction to Digital Communication and Telemetry.

Unit 2

System Level Description of Radio Navigation Aids: Instrument Landing System, Very High Frequency Omni Range, Automatic Direction Finder, Distance Measuring Equipment, GPS, Radar, Traffic Alert and Collision Avoidance.

Unit 3

Autopilots and Flight Management System: Autopilots, Flight Management Systems – Avionic System Integration: Background, Data Bus Systems, Integrated Modular Avionics.

TEXTBOOKS:

1. R. P. G Collinson, "Introduction to Avionics", Springer, 2002.
2. Frenzel Louis, "Principles of Electronic Communication Systems", 4th Edition, McGraw-Hill, 2015.

REFERENCES:

1. Kaytonand Fried, "Avionics Navigation Systems", 2nd edition, Wiley, 1997.
2. Dale R. Cundy, Rick S. Brown, "Introduction to Avionics", Prentice Hall, 1997.

15AES381 AERO-STRUCTURES LAB. 0 0 2 1

Determination of principal axis in unsymmetrical bending of beams, experiment on constant strength beam, determination of shear centre location for open and closed sections, testing of beam with combined loading, measurement of vibrations of beams, Wagner beam – Tension field beam experiments, determination of stresses in thin wall cylinder and finding the buckling strength of column using the South well plot test.

In addition to the conventional tests, students are assigned to open lab projects that involve experimental studies including fabrication and setting up unconventional testing methods to understand the basic concepts of thin walled member behavior.

15AES382 AVIONICS LAB. 0 0 2 1

Control System Exercises using MATLAB / Kits: Open Loop and Closed Loop Responses for Position, Velocity and Temperature Control Systems.

Mini Projects: Related to Avionics

15AES383 PROPULSION LAB. 0 0 2 1

Euler's Turbomachine Equation – Classification of Turbomachines – Velocity Triangles for Turbines and Compressors – Axial Flow Machines.

Propeller Testing: Estimation of Static Performance, Estimation of Figure of Merit – Nozzle Testing: Mach number Distribution along a Convergent-divergent Nozzle – Flame Speed Measurement: Variation of Flame Speed with Equivalence Ratio – Study of Free Incompressible Jet: Study of Velocity Profiles and the Entrainment Process – Cascade Testing: Measurements of Velocity and Pressure in a Cascade Flow Field: Effect of the Variation in Angle of Attack.

TEXTBOOK:

Phillip Hill and Carl Peterson, "Mechanics and Thermodynamics of Propulsion," 2nd edition, Dorling Kindersely (India), 2010.

15AES384 LOW-SPEED AERODYNAMICS LAB. 0 0 2 1

Wind Tunnel Calibration: Velocity Measurements, Boundary Layer Thickness Characterization - Quantification of Level of Turbulence in the Wind Tunnel: Sphere Test – Pressure or Form Drag Measurements: Finite and Infinite Wings, Fuselage, UAV, Locomotives – Flow Visualization: Smoke, Tuft, Surface Coating – Image Processing: Essential Aspects of Image Enhancement Utilizing Commercial Software MATLAB to extract Flow Structures – Open Projects relevant to Aerodynamics.

15AES385 INNOVATIONS LAB. 0 0 2 1

Identification of Problem – Identification of Criteria and Constraints – Market Study – Brainstorming for Possible Solutions – Generation of Ideas – Exchange of Ideas and Obtaining Feedback from Mentors and Batch-mates – Exploration of Possibilities – Study of Environmental and Social Impact of Innovative Ideas – Convergence on Methodology and Solution to the Problem – Viability for Scaling Up – Build a Model or Prototype – Paper Submissions / Patent Proposals.

15AES390 / 15AES490 LIVE-IN-LAB. 3 cr

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after fourth semester or sixth semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth or seventh semester. The objectives and projected outcome of the project should be reviewed and approved by the Dept. chairperson and a faculty assigned as the project guide. On completion of the project, the student shall submit a detailed project report. The report shall be evaluated and the students shall appear for a viva-voce test on the project.

15AES401 COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE 2 1 0 3**Unit 1**

Introduction to Numerical Methods – Properties of Numerical Solutions: Errors, Consistency, Accuracy, Stability, Convergence, Conservation – Review of Governing Equations of Fluid Dynamics – Review of Classification of PDE's and their Physical Implications for Compressible Flows.

Unit 2

Introduction to the Finite Difference Methods: Discretization of Temporal and Spatial Derivatives, Explicit and Implicit Formulations – McCormack's Scheme, Extensions to Viscous Flows – Shock Capturing – Lax-Wendroff Method.

Unit 3

Stability Analysis: Von Neumann Stability Criteria, CFL Criterion for Stability – Introduction to Grid Generation: Body Conforming Grids, Algebraic and Elliptic Grids, 2D Unstructured Grids, C-Grids, O-Grids and H-Grids for Flow Past Airfoils and Wings – Simulation of External and Internal Flows as Applied to Aerospace Components.

TEXTBOOK:

John D Anderson, "Computational Fluid Dynamics – The Basics with Application", McGraw Hill, 1995.

REFERENCES:

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

15AES402 AERO-DESIGN 2 2 2 5

Unit 1

Review of Aircrafts and Spacecrafts – Introduction to Design Process: Design Requirements, Data Collection & Statistical Study, Conceptual, Preliminary and Detailed Designs, Regulatory Requirements.

Unit 2

Weight, Volume and Size Estimates: Fixed Wing, Flapping Wing and Rotary Wing Vehicles, Launch Vehicles, Satellites, Lunar and Interplanetary Vehicles, Atmospheric Re-Entry Vehicles, Missiles, Airships, Aerostats and Parachutes – Aerodynamic and Control Surface Design for Atmospheric Vehicles and Space Vehicles – Selection and Design of Propulsion System.

Unit 3

Weight Distribution and Stability Estimates – Estimation of Control Characteristics – Performance Evaluation and Trade-Off Studies – Current Technological and Regulatory Trend Studies – Market Study.

TEXTBOOK:

Daniel P. Raymer, "Aircraft Design - A Conceptual Approach," 5th edition, AIAA Education Series, 2012.

REFERENCES:

1. Ajay Kumar Kundu, "Aircraft Design," Cambridge University Press, 1st Edition, 2010.
2. Leeland M Nicolai and Grant E. Carichner, "Fundamentals of Aircraft and Airship Design - Volume I," AIAA, 1st Edition, 2010.
3. Leeland M Nicolai and Grant E. Carichner, "Fundamentals of Aircraft and Airship Design - Airship Design & Case Studies - Volume II," AIAA, 1st Edition, 2013.
4. Anderson. J. D, "Aircraft Performance and Design", McGraw-Hill, 2010.

15AES403 FLIGHT DYNAMICS AND CONTROL 3 0 0 3

Unit 1

Review of Static Stability – Concepts and Introduction to Dynamic Stability – Review: Body Axis, Stability Axis, Earth Axis – Euler Angles – Transformation between Axis – Advantages of Axis – Aircraft Equations of Motion – Kinematic Equations.

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

Flying and Handling Qualities – Autopilots – Stability - Augmentation System (Longitudinal and Lateral Control) – Fly-By-Wire Aircraft – Active Control System – Control Configured Vehicles – Introduction to Relaxed Static Stability – Gust Load Alleviation – Smart Airplanes – Introduction to Digital Control and Stability.

TEXTBOOK:

M. V. Cook, *Flight Dynamics Principles, "A Linear Systems Approach to Aircraft Stability and Control," 3rd Edition, Elsevier, 2013.*

REFERENCES:

1. Robert C Nelson, "Introduction to Flight Stability and Automatic Control," 2nd Edition, Mcgraw-Hill, 1998.
2. Warren F Phillips, "Mechanics of Flight", Wiley, 2004.

15AES430 ROCKET AND SPACECRAFT PROPULSION 3 0 0 3

(Prerequisite AES212 COMPRESSED FLUID FLOW or equivalent)

Unit 1

Principle of Rocket Propulsion – Rocket Equation – Development of Thrust – Nozzle Design – Effect of Atmosphere – Thermodynamic Thrust Equation – Characteristic Velocity – Performance Parameters.

Unit 2

Liquid Propellant Rocket Engine – Cryogenic and Semi-cryogenic Engines – 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," 3rd edition, Springer, 2009.
2. Sutton. G. P, Biblarz. O, "Elements of rocket propulsion," 7th edition, John Wiley & Sons Inc, 2010.

15AES432 AIR BREATHING ENGINES 3 0 0 3

Unit 1

Review of Cycle Analysis of Air-Breathing Engines – Application of Euler’s Turbo Machinery Equation to Axial and Centrifugal Machines: Velocity Diagrams, Stage Parameters, Three Dimensional Flows in Turbo-Machinery – Components of Axial and Centrifugal Turbines – Performance Maps – Compressor Turbine Matching – Surge Control.

Unit 2

Thermal Limits of Blades and Vanes – Blade Cooling, Film Cooling and Regenerative Cooling – Subsonic, Supersonic and Hypersonic Inlets – Inlet Sizing – Inlet Performance – The Combustion Process: Stability, Length Scaling.

Unit 3

Fuels – Types of Combustors – Combustor Performance – Afterburners – Flame Stabilization – Nozzles, Thrust Vectoring – Nozzle Performance.

TEXTBOOK:

Mattingly. Jack. D, “Elements of Propulsion: Gas Turbines and Rockets,” AIAA Education Series, 2006.

REFERENCES:

1. Flack. R. L, “Fundamentals of Jet Propulsion with Applications,” Cambridge University Press, 2005.
2. Hill and Peterson, “Mechanics and Thermodynamics of Propulsion,” Dorling Kindersely (India), 2010.

15AES440 TURBULENT FLOWS 3 0 0 3

Unit 1

Onset of Turbulence: Laminar Flow, Transition, Turbulent Flow – Laminar - Turbulent Transition: Taylor’s Rotating Cylinder Experiment, Benard’s Natural Convection Experiment, Reynolds Experiment, Reynolds Number Concept Based on Volume Flux and Pressure Gradient – Stability Theory of Laminar Flows: Method of Small Disturbances, Orr-Sommerfeld Equation, Modes of Stability, Curve of Neutral Stability, Indifference Reynolds Number, Absolute and Convective Instabilities.

Unit 2

Inviscid Instability: Rayleigh Equation, Point of Inflection Criteria, Critical Layer – Fundamentals of Turbulent Flow: Mean Motion, Fluctuations, Quasi-steady Approach, Apparent Viscosity, Reynolds Stresses (Momentum Theorem & Navier-Stokes Equations), Classical Empirical Results on Turbulence, Wind-tunnel Turbulence.

Unit 3

Semi-empirical Hypothesis: Eddy Viscosity, Prandtl Mixing Length – Isotropic Turbulence: Kolmogorov Hypothesis, Kolmogorov Length and Time Scales - Free Turbulent Flows: Jet Boundary, Free Jet, Wake.

TEXTBOOK:

Herrmann Schlichting, Klaus Gersten, “Boundary Layer Theory,” 8th edition, Springer-Verlag, 2000.

REFERENCES:

1. Pijush K. Kundu, Ira M. Cohen, David R. Dowling, “Fluid Mechanics,” 5th edition, Academic Press, 2012.
2. Davidson, P. A., “Turbulence: An Introduction for Scientists and Engineers,” Oxford University Press, 2004.

15AES441 ADVANCED COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

Unit 1

Strong and Weak Form of Conservation of Equations – Introduction to Finite Volume Method: Discretization Schemes and their Properties for Finite Volume Method.

Unit 2

Finite Volume Method for Convection - Diffusion Problems: Central Differencing, Upwind Differencing, Power-Law Differencing, Quick and TVD Schemes with their Assessments – Staggered and Collocated Grids – Introduction to Multigrids – Flux-Vector Splitting.

Unit 3

Introduction to Solution Algorithms: SIMPLE, SIMPLER, SIMPLEC and PISO Algorithms – Introduction to Turbulence Models and Associated Parameters – Introduction to Aerodynamic Shape Optimization – Introduction to Spectral Methods.

TEXTBOOKS:

1. Hirsch, “Numerical Computation of Internal and External Flows- Vol1-2”, 2nd edition, Elsevier, 2007.
2. Veertseeg. H, Malalasekara. W, “An Introduction to Computational Fluid Dynamics - The Finite Volume Approach”, 2nd ed., Pearson Education Ltd., 2008.

REFERENCES:

1. T.J. Chung, “Computational Fluid Dynamics,” 2nd edition, Cambridge University Press, 2010.
2. John Tannehill, Dale Anderson, Richard Pletcher, “Computational Fluid Mechanics and Heat Transfer,” 3rd Edition, CRC Press, 2013.
3. Canuto C., Hussaini M. Y., Quarteroni A., and Zang T. A., “Spectral Methods. Fundamentals in Single Domains.” Springer-Verlag, 2006.

15AES442 HYPERSONIC FLOW THEORY 3 0 0 3

Unit 1

Introduction – Basic Considerations and Definitions – Videos of Atmospheric Re-Entry – Thin Shock Layer – Entropy Layer – Viscous Interaction – Low Density Flows – High Temperature Effects – Visual Presentation of Damages due to High Temperature Effects – Hypersonic Flight Paths.

Unit 2

Inviscid Hypersonic Flow Theory: Shock Expansion Method, Surface Inclination Methods – Small Disturbance Equations and Approximate Methods – Similarity Laws.

Unit 3

Exact Methods – Method of Characteristics Review – Unit Processes for Method of Characteristics: Planar, Axisymmetric and 3-D Flows – Blunt Body Problem and Shock Interaction Types – 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 and Ronald F. Probstein, "Hypersonic Flow Theory," 2nd edition, Academic Press, 1959.

15AES450 SURFACE ENGINEERING, COATING AND JOINING TECHNOLOGIES 3 0 0 3

Unit 1

Introduction: Engineering components, surface dependent properties and failures, importance and scope of surface engineering. Surface and surface energy: Structure and types of interfaces, surface energy and related equations. Surface modification of steel and ferrous components, Surface modification using gaseous medium: Nitriding carbonitriding (diffusion from gaseous state) (principle and scope of application).

Unit 2

Surface engineering by energy beams: General classification, scope and principles, types and intensity / energy deposition profile. Surface engineering by energy beams: Laser assisted microstructure modification – surface melting, hardening, shocking and similar processes. Surface engineering by spray techniques: Plasma coating (principle and scope of application). Characterization of surface microstructure and properties.

Unit 3

Fundamentals of Adhesive Bonding, Stress Distribution in Adhesive Bonding, Adhesive Bonding geometry and fracture analysis, Adhesive bonding of similar and dissimilar materials, Fundamentals of welding, Stress Distribution in welding.

TEXTBOOK:

Peter M. Martin (2011), *Introduction to Surface Engineering and Functionally Engineered Materials*, ISBN 978-0-470-63927-6, Scrivener Publishing LLC.

REFERENCES:

1. Arthur A. Tracton (2006), *Coatings Technology Handbook*, ISBN 978-1-57444-649-4, Taylor & Francis Group LLC.
2. Samuel Benavides (2009), *Corrosion Control in the Aerospace Industry*, ISBN 13: 9781845693459, Woodhead Publishing Ltd.

15AES452 ENGINEERING FRACTURE MECHANICS 3 0 0 3

Unit 1

Introduction to fracture mechanics (FM), historical development of FM-Linear and elasto-plastic fracture mechanics introduction, modes of loading, crack growth on fracture mechanics, brittle failure and ductile failure concept study. Study on energy release rate, review of theory of elasticity, Airy's stress theory on 2D models. Double cantilever beam energy release rate (ERR) definition, Energy release rate derivation on different geometries, ERR based on displacement of crack faces mechanisms, Necessary and sufficient condition of FM and stable and unstable FM.

Unit 2

Stress field analysis – different approaches to predict stresses, displacement formulation, compatibility conditions, principal of superposition. Crack-tip stress and displacement field - Cauchy-Riemann conditions, Westergaard's stress function, stress intensity factors derivations. Crack opening displacement (CTOD/COD), very near-tip displacement field (Mode - I, II, III), multi-parameter stress field, K for different load conditions. Crack opening displacement (CTOD/COD).

Unit 3

Energy release rate by J-integral approach, relation study between K and G. Study of surface cracks, stress intensity factor study on finite body Evaluation of SIF by experimental and numerical approaches and also using strain gauges. Fracture toughness tests – plane strain test, Compact tension test, three-point bending test, C-specimen test, Chevron notch test.

TEXTBOOK:

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

REFERENCES:

1. Ramesh, K., "e-book on Engineering Fracture Mechanics", IIT-Madras publisher.
2. Prashant Kumar, "Elements of Fracture Mechanics" Tata McGraw-Hill Education, 2009.

15AES453 AERO-ELASTICITY 3 0 0 3

Unit 1

Free vibration analysis of basic structural members with different boundary conditions, analytical and approximate solutions, response of basic structural members to periodic and non-periodic forces, mode synthesis, approximate solutions.

Unit 2

Static aero-elasticity, divergence of a typical airfoil section, aileron reversal, divergence of one dimensional structures: straight and swept wings, aileron reversal of one dimensional straight wing.

Unit 3

Aeroelastic flutter, stability characteristics, aeroelastic analysis of a typical airfoil section: single degree and two degree freedom, classical flutter analysis, classical unsteady aerodynamic theory, engineering solution for flutter, U-g and p-k methods, response to gust loads.

TEXTBOOK:

Dewey H. Hodges, and G. Alvin Pierce, "Introduction to structural dynamics and aeroelasticity," Cambridge University Press, 2002

REFERENCES:

1. Raymond L. Bisplingoff, Holt Ashley, Robert L. Haffman., "Aeroelasticity", Dover Publications, 1996.
2. Raymond L. Bisplingoff, Holt Ashley, "Principles of Aeroelasticity", Dover Publications, 2002.

15AES454 ADVANCED COMPOSITE STRUCTURES 3 0 0 3

Unit 1

Concept of aviation and space environments. Ionizing and non ionizing radiation at Low Earth Orbit (LEO) and Geo Synchronous Earth Orbit (GEO). Charged plasma and atomic oxygen in space. Different thermosetting and thermoplastic polymers and their applications as structural and semi structural components for aviation and spacecraft.

Unit 2

Durability of thermosetting and thermoplastic polymers under aviation and space environments. Scope of high performance polymers. Scope of high performance and ultra high performance polymers. Defects of composites under mechanical fatigue, thermal fatigue, humidity, lightning strike, ultra violet radiation, ultra high vacuum and high energy radiations.

Unit 3

Simulation of test facilities in laboratory. State of the art technologies to repair composite defects. Importance of nano composite and nano adhesive bonding. Importance of fire resistant polymeric composites and electrically conductive composites.

TEXTBOOK:

Omari V. Mukbaniani, Marc J. M. Abadie, Tamara Tatrishvili (2015), High-Performance Polymers for Engineering-Based Composites, ISBN 9781771881197 - CAT# N11265, CRC Press.

REFERENCES:

1. Yu Bai, Thomas Keller (2014), High Temperature Performance of Polymer Composites, ISBN: 978-3-527-32793-5, Wiley-VCH.
2. Eric Baer (1991), High Performance Polymers: Structures, Properties, Composites, Fibers, ISBN-13: 978-1569900024, Amazon Prime

15AES460 SPACE FLIGHT MECHANICS 3 0 0 3

Unit 1

Elements of Conics – The n-Body Problem and Reduction to Two-Body Problem – Types of Orbits – Conservation of Energy and Angular Momentum in Orbits – Spherical Trigonometry – Geocentric-Equatorial, Heliocentric-Ecliptic, Right Ascension Declination, Topocentric-Horizon and Perifocal Co-Ordinate Systems and Transformations Between Them – Classical Orbital Elements.

Unit 2

Orbital Elements Determination from Position and Velocity at a Point – Determining Position and Velocity from Orbital Elements – Orbit Determinations from a Single Radar Observation, Three Position Vectors and Optical Sightings – Ellipsoidal Earth Model: Geodetic and Geocentric Latitudes – Ground Trace of Satellites – Solar and Sidereal Times – Precession of The Equinoxes – Low and High Earth Orbits: Orbital Perturbations due to Oblateness of Earth – Orbital Maneuvers: General Coplanar Orbit Transfer, Hohmann Transfer, Simple Plane Changes to an Orbit.

Unit 3

Time-of Flight and Eccentric Anomalies for Elliptic, Parabolic And Hyperbolic Orbits – Kepler's Problem and Solution Algorithm – Gauss Problem: General Methods of

Solution – Intercept and Rendezvous with Examples – Ballistic Missile Trajectories: Effect of Earth Rotation – Interplanetary Trajectories: Spheres of Influence and the Patched Conic Approximation, Synodic Periods – Satellite Attitude Dynamics: Torque Free Motion, Stability of Torque Free Motion, Spin Stabilization, Gyroscopic Attitude Control, Gravity Gradient Attitude Control.

TEXTBOOKS:

1. Roger R Bate, Donald D Mueller, Jerry E White and William W Saylor, "Fundamentals of Astrodynamics," 2nd edition, Dover, 2015.
2. Marshall H Kaplan, "Modern Spacecraft Dynamics and Control," Wiley, 1976.

REFERENCES:

1. Howard Curtis, "Orbital Mechanics for Engineers and Scientists," 3rd edition, Elsevier, 2010.
2. Marcel J. Sidi, "Spacecraft Dynamics and Control: A Practical Engineering Approach," Cambridge University Press, 1997.

15AES461 PRINCIPLES OF AIRPORT MANAGEMENT 3 0 0 3

Unit 1 Introduction

History of Aviation - Development of Air transportation in India - Major players in Airline Industry - Swot analysis in Airline Industry - Market potential of Indian Airline Industry - Current challenges in Airline Industry - Completion in Airline Industry - IATA & ICAO.

Airport management:

Airport planning - Operational area and Terminal planning, design, and operation - Airport operations - Airport functions - Organization structure of Airline and Airports sectors - Airport authorities - Global and Indian scenario of Airport management – DGCA – AAI.

Unit 2 Air transport services:

International trends - Emerging Indian scenario – PPP - Public Private Participation in Indian Airports - Environmental regulations - Private participation in International developments - Environment regulations - Regulatory issues - Meteorological services for Aviation - Airport fees, rates, and charges.

Airline operations:

Airline Terminal Management - Flight Information Counter / Reservation and Ticketing - Check In/Issue of Boarding pass - Customs and Immigration formalities - Co-ordination - Security Clearance - Baggage and Handling of Unaccompanied minors and Disabled Passengers - Handling of Stretcher Passengers and Human Remains - Handling of CIP, VIP & VVIP - Co-ordination of Supporting Agencies / Departments.

Unit 3

Logistics and air cargo management:

Concept of Logistics - Role of Ware Housing - trend in material handling - Global Supply Chain - Quality concept and Total Quality Management - improving Logistic performance - Air Cargo Concept - Cargo Handling - Booking of Perishable Cargo and Live Animals - Industry Relation - Type of Air Cargo - Air Cargo Tariff, ratios and Charges - Airway Bill, Function, Purpose.

TEXTBOOKS:

1. Wells. A, "Airport Planning and Management," 4th edition, McGraw-hill, London, 2000.
2. Alexander T. Well, Seth Young, "Principles of Airport Management," McGraw Hill 2003

15AES462 HELICOPTER THEORY 3 0 0 3

Unit 1

Historical development, configurations of helicopters, rotor system, flight control and mechanism, hovering theory, momentum theory for hover and vertical flight, blade element theory for hover and vertical flight, combined blade element momentum (BEM) theory.

Unit 2

Momentum theory for forward flight, various non-uniform inflow models, blade element theory for forward flight, non-dimensional hub forces and moments, estimation of power for forward flight.

Unit 3

Idealization of rotor blades, flap-lag and torsional dynamics of the blade, rotor blade flapping motion: A simple model, helicopter trim analysis.

TEXTBOOK:

C. Venkatesan, "Fundamentals of helicopter dynamics," CRC Press, 2015

REFERENCES:

1. W. Johnson, "Helicopter theory", Princeton University, 1980.
2. R. S. Bramwell, "Helicopter dynamics", Edward Arnold Publications, 1976

15AES470 STATE SPACE TECHNIQUES 3 0 0 3

Unit 1

Concepts of Matrix Algebra and Vector Spaces (revision) – Solution of Simultaneous Equation for Squares – Under-Determined and Over-Determined Systems – Concepts of Basis Vector Transformations; Similarity and Adjoint Transformation – Eigen Values and Eigen Vectors: Canonical Forms, Jordan Forms, Characteristic Equations, Analytical Functions of Square Matrices, Cayley-Hamilton Theorem.

Unit 2

Concepts of State, State-Space and State-Vector – Mathematical Modes in the State Space Form – State Equation and High-Order Differential Equations – State Space Form for Aerospace Systems, for e.g., Dynamic Behavior of Aircraft, Missile, Satellites, INS., etc. – Solution of Homogenous State Equations.

Unit 3

Solution of Non-Homogenous State Equations – Controllability and Observability of Systems – Concepts of Output Feedback and Full State Feedback, Pole-Placement Design – Concept of an Observer – Basics of Optimal Control.

TEXTBOOKS:

1. Friedland, B. "Control System Design", Dover, 2005.
2. Nise, Norman S. "Control Systems Engineering," 4th Edition, Wiley, 2004.

15AES471 MULTIDISCIPLINARY DESIGN OPTIMIZATION 3 0 0 3

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, Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method.

Unit 2

Multivariable Optimization: Optimality Criteria – Gradient Based Methods: Steepest Descent Method, Conjugate Direction Method, Conjugate Gradient Method and Newton's Method – Constrained Optimization: Karush-Kuhn-Tucker Optimality Criteria, Direct Methods, Indirect Methods, Penalty Function Methods.

Unit 3

Global Optimization: Simulated Annealing, Genetic Algorithm, Particle Swarm Optimization, Multi-Objective Optimization – Pareto Optimality – Global Function / Weighted Sum.

TEXTBOOK:

Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", 2nd edition, Prentice Hall of India, New Delhi, 2012.

REFERENCES:

1. Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", Wiley, 2010.
2. J. Arora, "Introduction to Optimum Design," 3rd Edition, Elsevier, 2012.

15AES481

UAV LAB.

0 0 2 1

Flight testing using a 3.5 Kg UAV or simulator, to determine following:

- Glide performance;
- Climb rate;
- Range and endurance;
- Turn rate;
- Short period and Phugoid mode;
- Roll subsidence.

15AES495

PROJECT PHASE I

2 cr

Various project titles based on areas covered up to 7th semester are allotted to batches of 3 to 4 students.

Preliminary studies and investigations on the allotted topic.

15AES499

PROJECT PHASE II

10 cr

To achieve objectives and to carry out detailed investigation towards the outcome of each allotted project.

15AVP201 /

AMRITA VALUES PROGRAMME I /

1 0 0 1

15AVP211

AMRITA VALUES PROGRAMME II

1 0 0 1

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning

of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahansa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. 'Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Unity in Diversity' and it has led to the most diverse

expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

15CHY100 CHEMISTRY 3 0 0 3

Unit 1

Chemical Bonding

Review of orbital concept and electronic configuration, electrovalency and ionic bond formation, ionic compounds and their properties, lattice energy, solvation enthalpy and solubility of ionic compounds, covalent bond, covalency, orbital theory of covalency - sigma and pi bonds - formation of covalent compounds and their properties. Hybridization and geometry of covalent molecules - VSEPR theory - polar and non-polar covalent bonds, polarization of covalent bond - polarizing power, polarisability of ions and Fajan's rule, dipole moment, percentage ionic character from dipole moment, dipole moment and structure of molecules - coordinate covalent compounds and their characteristics, molecular orbital theory for H₂, N₂, O₂ and CO, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 2

Thermodynamic Parameters

Stoichiometry - mole concept, significance of balanced chemical equation - simple calculations - Conditions for occurrence of chemical reactions - enthalpy, entropy and free changes - spontaneity – Thermochemistry - heats of reactions - (formation, combustion, neutralization) - specific heats - variation of enthalpy change with temperature - Kirchhoff' relation (integrated form) - bond enthalpy and bond order - Problems based on the above.

Kinetics

Review of molecularity and order of a reaction, rate law expression and rate constant - first, second, third and zero order reactions, pseudo-first order reactions (pseudo-unimolecular reactions) - complex reactions - equilibrium and steady state approximations - mechanism of these reactions - effect of temperature on reaction rates - Arrhenius equation and its significance, Michaelis Menden kinetics-enzyme catalysis.

Unit 3

Electrochemistry

Electrolytes - strong and weak, dilution law, Debye-Huckel theory, faraday's laws, origin of potential, single electrode potential, electrochemical series, electrochemical cells, Nernst equation and its application, reference electrodes - SHE, Ag/AgCl, Calomel.

Photochemistry

Photochemistry, laws of photochemistry - Stark-Einstein law, Beer-Lamberts law, quantum efficiency-determination, photochemical processes - Jablonsky diagram, internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo sensitization, photo polymerization.

REFERENCE BOOKS:

Physical chemistry, Puri and Sharma

Inorganic chemistry, Puri and Sharma

15CHY181 CHEMISTRY LAB. 0 0 2 1

1. Acid base titration (double titration)
2. Complexometric titration (double titration)
3. Redox (permanganimetry) titration (double titration)
4. Conductometric titration
5. Potentiometric titration
6. Ester hydrolysis

15CHY231 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".

15CHY232 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.

15CHY233 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).

15CHY234 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 - ferromagnets and ferrimagnets. One-dimensional conductors - quasi one and two-dimensional super conductor. Fullerides - paramagnetic conductors and superconductors. Electron transfer salt based ferromagnets: nitroxide, metallocene and ferric magnet-based ferromagnets - 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 - fluorescence and phosphorescence – photosensitization.

High energy materials: Preparation, properties and application of ammonium nitrate (AN), NH₄NO₃, ammonium perchlorate (AP), NH₄ClO₄, ammonium dinitramide (AND), NH₄N(NO₂)₂, hydrazinium nitroformate (HNF), N₂H₅C(NO₂)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", Dhanpat Rai & 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).

15CHY235 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 - piezo 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 (Groth's-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 - H₂S - PH₃ - CO₂ - 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.

15CHY236 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 C₆₀ - superconductivity in C₆₀, 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, TiO₂ 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. Lafrate, "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).

15CHY237 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).

15CHY238 COLLOIDAL AND INTERFACIAL CHEMISTRY 3 0 0 3**Unit 1**

Introduction to surfaces, interfaces and colloids: Molecular origin, Surface phenomena and structure of interfaces, Surfactants structure, colloids in action - shapes and size distribution, Types of interaction forces - Physical and Chemical interaction, Classification of physical forces - Vander Waals force, electrostatic forces.

The Adsorption Phenomena - Structure and Properties of Adsorption Layers at the Liquid-Gas Interface, Principles of adsorption thermodynamics, The Gibbs equation, Structure and properties of the adsorption layers at the air-water interface.

Unit 2

Interfaces between Condensed Phases - Wetting, The interfaces between condensed phases in two-component systems, Adsorption at interfaces between condensed phases.

Thermodynamics - Adsorption, energy consideration of physical adsorption vs chemisorptions, Gibbs adsorption equation, Langmuir isotherm, BET isotherm, adsorption at solid-liquid interfaces. Emulsions - formation and stability, HLB number, PIT (Phase Inversion Temperature) foams, aerosols, Microemulsions, vesicles, micelles and membranes - applications of various colloidal systems.

Unit 3

Characterization of Colloids, Rheological properties - Classification, Interfacial rheology, Interfacial tension, Electrochemistry of interfaces - Electric double layer.

Stability of charge stabilized colloids, DLVO theory, Hamaker constant, Boltzmann distribution, Debye length, specific ion adsorption, stern layer, electrostatic, steric and electrosteric stabilization, zeta potential, surface tension, wetting and spreading, contact angle - Young's modulus, practical application- solid surfaces- surface mobility, characteristics and formation.

TEXTBOOKS:

1. D. Myers, "Surfaces, Interfaces and Colloids: Principles and Applications", 2nd Edition, Wiley-VCH, 1999.
2. T. Cosgrove, "Colloid Science: Principles, Methods and Applications", 2nd Edition, Wiley-Blackwell, 2010.

REFERENCES:

1. P. C. Hiemenz and R. Rajagopalan (Editors), "Principles of Colloid and Surface Chemistry", 3rd Edition, Academic Press, New York, 1997.
2. J. W. Goodwin, "Colloids and Interfaces with Surfactants and Polymers", John-Wiley and Sons Ltd, 2004
3. William Harde, "Colloids and Interfaces in Life Sciences", Marshall Dekker Inc. 2003

15CHY239 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. *K. I. Ramachandran, G Deepa and K Namboori, "Computational Chemistry and Molecular Modeling - Principles and Applications", Springer-Verlag, Berlin, Heidelberg, 2008, ISBN-13 978-3-540-77302-3.*
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).*

15CHY241 ELECTROCHEMICAL ENERGY SYSTEMS 3 0 0 3 AND PROCESSES

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 A J, "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).

15CHY242 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. Van Loon 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 V P and Ritu, "Environmental Chemistry", Pragati Prakashan, Meerut, (2000).

15CHY243 FUELS AND COMBUSTION 3 0 0 3

Unit 1

Fuels - Solid fuels - Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum - origin, production, composition, classification, petroleum processing, properties, testing - flow test, smoke points, storage and handling.

Secondary liquid fuels - Gasoline, diesel, kerosene and lubricating oils. Liquid fuels - refining, cracking, fractional distillation, polymerization. Modified and synthetic liquid fuels. ASTM methods of testing the fuels.

Unit 2

Gaseous fuels - Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets.

Flue gas analysis by chromatography and sensor techniques.

Unit 3

Combustion: Stoichiometry, thermodynamics. Nature and types of combustion processes - Mechanism - ignition temperature, explosion range, flash and fire points, calorific value, calorific intensity, theoretical flame temperature. Combustion calculations, theoretical air requirements, flue gas analysis. combustion kinetics – hydrogen - oxygen reaction and hydrocarbon - oxygen reactions. Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

TEXTBOOK:

Fuels and Combustion, Samir Sarkar, Orient Longman Pvt. Ltd, 3rd edition, 2009.

REFERENCES:

1. *Fuels - Solids, liquids and gases - Their analysis and valuation, H. Joshua Philips, Biobliolife Publisher, 2008.*
2. *An introduction to combustion: Concept and applications - Stephen R Turns, Tata Mc. Graw Hill, 3rd edition, 2012.*
3. *Fundamentals of Combustion, D P Mishra, 1st edition, University Press, 2010*
4. *Engineering Chemistry - R. Mukhopadhyay and Sriparna Datta, Newage International Pvt. Ltd, 2007.*

15CHY244 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 behaviour and solvent attributes of supercritical CO₂, 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 CO₂ 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.*

15CHY245 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.

Electroanalytical 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 spectrophotometry - 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 J R, "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).

15CHY246 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, anaesthetics, antihypertensive drugs, analgesics, histamine and anti-histamine agents.

TEXTBOOKS:

1. Rama Rao Nadendla, "Principles of Organic Medicinal Chemistry", 1st edition, New age international (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", 7th edition, J. B. Lippincott company, Philadelphia, (1977).
2. Burger A, "Medicinal Chemistry", 3rd edition, Wiley Interscience, Newyork, (1970).
3. Graham L P, "An Introduction to Medicinal Chemistry", 3rd edition, Oxford university Press, (2005).

15CHY247 MODERN POLYMER COMPOSITES 3 0 0 3**Unit 1**

General introduction to composite materials: Concept and definition, classification of composites (CMC, MMC, PMC). Functional roles of reinforcement and matrix and importance of interface. Polymer matrix composites (PMCs): Fiber reinforced and particulate filled polymer composites. Reinforcements (glass, carbon / graphite, Kevlar), Matrices - Thermoset matrices - polyesters, epoxides, phenolics, vinyl esters, polyimides, cyanate esters - Thermoplastic matrices. Choice of reinforcements and matrices for different application needs.

Unit 2

Fiber reinforced polymer composites (FRPs): Basic rule of mixtures, stress-strain relationships. Tailoring of structural properties through laminar-sequencing and choice of fiber fractions / fiber orientations, to meet design requirements. Mechanical behavior of FRP composites: Fiber controlled and matrix dependent properties. Fibre volume fraction, tensile, shear, compressive, flexural, thermo elastic and off - axis responses of lamina and laminates - notched strength - fracture toughness - nondestructive testing. Effect of environmental conditions on properties.

Unit 3

Composite precursors: SMCs, DMCs, BMCs prepreg materials and their choice in specific applications. Fabrication processes for FRP Composites: hand layup, spray up, vacuum bag moulding, compression moulding, filament winding, braiding,

pultrusion, RTM, RIM, RRIM, RFI, autoclave moulding, injection moulding etc. Room temperature and hot curing of composites, Nanocomposites: Introduction; Nanoscale Fillers – Clay, POSS, CNT, nanoparticle fillers; Processing into nanocomposites; Modification of interfaces; Properties. Applications. Joining composite elements and repairs, Recycling of polymer composites.

TEXTBOOKS:

1. B. Astrom, "Manufacturing of Polymer Composites", CRC Press, 1997.
2. P K Mallick, "Fiber-Reinforced Composites: Materials, Manufacturing, and Design", CRC Press, 2007.

REFERENCES

1. F. C. Campbell (Ed), *Manufacturing processes for advanced composites*, Elsevier, 2004.
2. S T Peters (Ed.), "Handbook of Composites", Springer, 1998.

15CHY248 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 - SN1 and SN2 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 - benzylic acid rearrangement - reaction mechanism in basic media - Mannich reaction - enols and enolates.

Reaction involving acids and other electrophiles: 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 benzyne - Baeyer-Villiger 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 - SRN 1 reaction - radical ions - Birch reduction - Hofmann-Löffler-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, McGraw Hill, (2004).

15CHY249 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.

TEXTBOOKS:

1. E. L. Eliel, "Stereochemistry of Carbon Compounds", McGraw-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).

15CHY250 POLYMER MATERIALS AND PROPERTIES 3 0 0 3**Unit 1**

Structure of polymers – thermoplastic, thermoset, rubber - Linear, branched, crosslinked, and network polymers – polymerization types – addition, condensation, mechanism, methods – bulk, solution, suspension and emulsion - crystalline, amorphous, orientation – molecular weight – intermolecular forces, solubility parameter - glass transition temperature.

Unit 2

Manufacturing, mechanical, thermal, electrical and chemical properties and applications of commodity plastics - PE, PP, PVC, PS, Engineering plastics - ABS, PC, PMMA, polyamide, polyacetal, PET, PBT, PTFE, High performance polymer - PES, PEI, PEEK, conducting polymer.

Unit 3

Thermoset materials - PF, UF, MF, epoxy and unsaturated polyester resin, Rubber - natural rubber, synthetic rubber - SBR, PB, nitrile, chloroprene, butyl, silicone - compounding and additives.

TEXTBOOKS:

1. J. A. Brydson, "Plastics Materials" Butterworth-Heinemann – Oxford, 7th Ed., London, 1999
2. Maurice Morton, "Rubber Technology", 3rd Ed, Kluwer Academic Pub, Dordrecht, Netherlands, 1999
3. Manas Chanda and Salil K. Roy, "Plastics Technology Handbook", CRC Press, Atlanta, 2007

REFERENCE BOOKS:

1. D. W. Van Krevelena and P. J. Hoftyzen, "Properties of Polymer", 3rd Edition Elsevier Scientific Publishing Company Amsterdam – Oxford – Newyork. 1990.
2. Jozef Bicerano, "Prediction of Polymer Properties", Second Edition, Marcel Dekker Inc. New York, 1995.

15CHY251 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:

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

REFERENCES:

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).

15CHY252 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 piezoelectric 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).

15CHY331 BATTERIES AND FUEL CELLS 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 batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

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

Unit 3

Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

Fuels for Fuel Cells: Hydrogen, methane, methanol - Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

TEXTBOOKS:

1. Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, (2001).
2. M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).

REFERENCES:

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. Curtis, 'Electroforming', London, (2004).

5. F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).
6. G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).

15CHY332 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, McGraw-Hill, (1987).
2. Uhlig H H and Revie 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.

15CSE100 COMPUTATIONAL THINKING AND PROBLEM SOLVING 3 0 2 4

Unit 1

Basics: Introduction, Information and data, Data encoding. Logic: Boolean logic, Applications of propositional logic.

Unit 2

Problem Solving and Algorithmic Thinking: Problem definition, Logical reasoning, Problem decomposition, Abstraction. Flowcharting, Name binding, Selection, Repetition, Modularization. Data organization: List and Arrays. Simple algorithms, comparison of performance of algorithms.

Unit 3

Problem Solving Techniques: Factoring and Recursion Techniques, Search and Sort techniques, Text processing and Pattern matching.

TEXTBOOKS:

1. David Riley and Kenny Hunt, *Computational Thinking for Modern Solver*, Chapman & Hall/ CRC, 2014
2. R. G. Dromey, "How to solve it by Computer", PHI, 2008

15CSE102 COMPUTER PROGRAMMING 3 0 0 3

Unit 1

Introduction to C language: Structure of a C program, comments, Data types, Variables, constants, Data input and output statements, input assertions; expressions and evaluation. Functions: inter function communication, standard functions, scope. Selection: two way selection, multi-way selection, repetition: concept of loop, loop invariant, pretest and post-test loops, initialization and updating, event and counter controlled loops. Recursion: recursive definition, recursive solution, designing recursive functions, limitations of recursion.

Unit 2

Files and streams, file input output. Arrays - 1D numeric, searching and sorting, 2D numeric arrays: problems with matrices. Pointers: introduction, compatibility, arrays and pointers, Dynamic memory allocation, array of pointers, pointer arithmetic.

Unit 3

Strings: fixed length and variable length strings, strings and characters, string input output, array of strings, string manipulation functions, sorting of strings. Enumerated types, Structures: Structure vs array comparison, complex structures, Structures and functions, Union, binary input output, Command line arguments.

TEXTBOOK:

Behrouz A. Forouzan and Richard F. Filberg, "Computer Science A structured programming approach using C", Third Edition, Cengage Learning, 2006.

REFERENCES:

1. Brian W. Kernighan, Dennis M. Ritchie, "The C Programming Language", Second Edition, Prentice Hall, 1988.

2. Eric S. Roberts, "Art and science of C", Addison Wesley, 1995.
3. Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

15CSE180 COMPUTER PROGRAMMING LAB. 0 0 2 1

Solving simple problems with operators, programs on conditional control constructs, programs on loops (while, do-while, for), programs using user defined functions and library functions, programs on Files, arrays, matrices (single and multi-dimensional arrays), programs using DMA, programs on strings, structures.

REFERENCE:

Behrouz A. Forouzan and Richard F. Filberg, "Computer Science A structured programming approach using C", Third Edition, Cengage Learning, 2007.

15CUL101 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 - Purusharthas; Introduction to Vendanta and Bhagavat Gita.

Unit 3

Introduction to Yoga; Nature and Indian Culture; Values from Indian History; Life and work of Great Seers of India.

TEXTBOOKS:

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

15CUL111 CULTURAL EDUCATION II 2 0 0 2

Unit 1

1. Relevance of Sri Rama and Sri Krishna in this Scientific Age
2. Lessons from the Epics of India
3. Ramayana & Mahabharata

Unit 2

4. Who is a Wise Man?
5. A Ruler's Dharma
6. The Story of King Shibi

Unit 3

7. Introduction to the Bhagavad Gita
8. Bhagavad Gita – Action without Desire

Unit 4

9. Role and Position of Women in India
10. The Awakening of Universal Motherhood

Unit 5

11. Patanjali's Astanga - Yoga System for Personality Refinement
12. Examples of Heroism and Patriotism in Modern India

TEXTBOOKS:

Common Resource Material II (in-house publication)

Sanatana Dharma- The Eternal Truth (A compilation of Amma's teachings on Indian Culture)

15CUL230 ACHIEVING EXCELLENCE IN LIFE - AN INDIAN PERSPECTIVE 2 0 0 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 – Pancha Kosas (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 ‘Shraddha’ – 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 Advaita Ashram, Kolkatta.*
7. *Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development- Swami Budhananda published by Advaita Ashram, Kolkatta*
9. *Ultimate Success - Swami Ramakrishnananada Puri published by Mata Amritanandamayi Math, Kollam*
10. *Yoga In Daily Life - Swami Sivananda – published by Divine Life 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 Advaita 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 Nagaratra 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.*

15CUL231

EXCELLENCE IN DAILY LIFE

2 0 0 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 indispensable 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.

15CUL232

**EXPLORING SCIENCE AND TECHNOLOGY
IN ANCIENT INDIA**

2 0 0 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;

- "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

15EEE180 **WORKSHOP B** **0 0 2 1**

Part A - Electronics

Identification of electronic components (Passive and Active)

Study of measuring instruments (Voltmeter, Ammeter and Multimeter)

Measurement and theoretical Verification of series and parallel combination of resistors and capacitors

Calibration of CRO and measurements of signal parameters (RMS, maximum value, peak value, time and frequency)

Calibration of function generator using CRO

Soldering practice

Part B - Electrical

1. Study on power supply and protective devices

2. Study on tools and electrical accessories

3. Study on sources of light

4. Study on energy efficiency

5. Study on water pump

6. Study on house hold appliances:

a. Iron box

b. Fan

c. Refrigerator

d. Air conditioner

7. House wiring I – Glow an incandescent lamp using SPST switch

8. House wiring II – Glow a fluorescent lamp using SPST switch

9. House wiring III – Operate a fan and an incandescent lamp using two independent SPST switch

10. House wiring IV – Operate a fluorescent lamp and a 3 pin socket using two independent SPST switch

11. House wiring V – Staircase wiring

12. House wiring VI – Godown wiring

15ENG111 **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 – Any two pieces from the text.

Unit 2

Writing: Prewriting techniques - Kinds of paragraphs - basics of continuous writing.

Grammar & Usage: Parts of Speech, Tenses, Concord, Phrasal Verbs, Modal Auxiliaries, Modifiers (Workbook) - Any two pieces from the text.

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 - Any two pieces from the text.

Activities: Short speeches, seminars, quizzes, language games, debates, and discussions, Book Reviews, etc.

Text: Language through Reading: Compilation by Amrita University for internal circulation

Poems:

i. The Poplar Field by William Cowper

ii. Telephone Conversation by Wole Soyinka

Prose:

i. Higher Mathematics by R. K. Narayan

ii. Wings of Fire by Abdul Kalam (Part III.11)

Short Stories:

i. Best Investment I Ever Made by A. J. Cronin

ii. Death of an Indian by Krishna Charan Das

1. Language through Practice: Compilation by Amrita University for internal circulation

15ENG230 **BUSINESS COMMUNICATION** **1 0 2 2**

OBJECTIVES: To introduce business vocabulary; to 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

Business Vocabulary - Writing: Drafting Notices, Agenda, and Minutes - Reading: Business news, Business articles.

Unit 2

Writing: Style and vocabulary - Business Memorandum, letters, Press Releases, reports – proposals – Speaking: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings.

Unit 3

Active Listening: Pronunciation – information gathering and reporting - Speaking: Cross-Cultural Issues, Group Dynamics, 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. Levi, Daniel. *Group Dynamics for Teams*. 3 ed. Sage Publications India Pvt. Ltd. New Delhi, 2011.
4. Owen, Roger. *BBC Business English*. BBC. 1996.
5. Henderson, Greta Lafollette & Price R Voiles. *Business English Essentials*. 7th Edition. Glencoe / McGraw Hill.
6. Sweeney, Simon. *Communicating in Business*. CUP. 2000.

15ENG231 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 psyche; to develop an understanding about the societal changes in the recent past.

Unit 1 Poems

Rabindranath Tagore's Gitanjali (1-10); Nizzim Ezekiel's Enterprise; A.K. Ramanujam's Small-Scale Reflections on a Great House.

Unit 2 Prose

Khushwant Singh's The Portrait of a Lady; Jhumpa Lahiri's Short Story - Interpreter of Maladies.

Unit 3 Drama and Speech

Vijay Tendulkar's Silence, the Court is in Session; Motivational speeches by Jawaharlal Nehru/ S. Radhakrishnan / A.P. J. Abdul Kalam's My Vision for India etc. (any speech).

REFERENCES:

1. Lahiri, Jhumpa. *Interpreter of Maladies*, Harper Collins Publications, 2000.
2. Ramanujan A. K. ed. K.M. George, *Modern Indian Literature: An Anthology*, Vol. I, Sahitya Akademi, 1992.
3. Singh, Khushwant. *The Portrait of a Lady: Collected Stories*, Penguin, 2009.
4. Tagore, Rabindranath. *Gitanjali*, Penguin Books India Pvt. Ltd, 2011.
5. Tendulkar, Vijay. *Five Plays*, Oxford University Press, 1996.

15ENG232 INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE 1 0 2 2

OBJECTIVES: To expose the students to different genres of Literature; to hone reading skills; to provide deeper critical and literary insights; to enhance creative thinking; to promote aesthetic sense.

Unit 1 Poems

1. W. H. Auden: Refugee Blues; 2. A. K. Ramanujan: Obituary; 3. William Blake: The Little Black Boy; 4. Gieve Patel: Grandparents at a Family Get-together.

Unit 2 Short Stories

1. Chinua Achebe: Marriage is a Private Affair; 2. Ruskin Bond: The Thief; 3. Isai Tobolsky: Not Just Oranges; 4. K A Abbas: The Refugee

Unit 3 Prose

1. A G Gardiner: On The Philosophy Of Hats; 2. Robert Lynd: Mispronunciation

Practicals:

Role plays: The Proposal, Chekov / Remember Ceaser, Gordon Daviot / Final Solutions, Mahesh Dattani , Book reviews, Movie reviews.

SUGGESTED READING: *The Old Man and the Sea*, Hemingway / *Any one of the novels of R. K. Narayan*, etc.

15ENG233 TECHNICAL COMMUNICATION 1 0 2 2

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 3

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

Practice in oral communication and Technical presentations

REFERENCES:

1. Hirsh, 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. E B. "The Elements of Style" New York. Alliyen & Bacon, 1999.
4. Riordan, G. Daniel and Pauley E. Steven. "Technical Report Writing Today" VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.

15ENG234 INDIAN SHORT STORIES IN ENGLISH 1 0 2 2

OBJECTIVES: To help the students learn the fine art of story writing; to help them learn the techniques of story telling; to help them study fiction relating it to the socio- cultural aspects of the age; to familiarize them with different strategies of reading short stories; to make them familiar with the morals and values held in high esteem by the ideals of Indianness.

Unit 1

Introduction: Differences between novel and short stories – origin and development of short stories - Rabindranath Tagore: Kabuliwallah; Mulk Raj Anand: The Gold Watch.

Unit 2

R. K. Narayan: Sweets for Angels; K. A. Abbas: The Refugee; Khushwant Singh: The Mark of Vishnu.

Unit 3

Masti Venkatesha Iyengar: The Curds-Seller; Manohar Malgonkar: Upper Division Love; Romila Thapar: The Spell; Premchand: The Voice of God.

TEXT:

M. G. Narasimha Murthy (ed), Famous Indian Stories. Hyderabad: Orient Black Swan, 2014

REFERENCE;

Mohan Ramanan (Ed), English and the Indian Short Story: Essays in Criticism, Hyderabad, Orient BlackSwan, 2000.

15ENV300 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY 3 0 0 3

Unit 1

State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.

Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/land degradation/pollution

Unit 2

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Discuss the interrelation of environmental issues with social issues such as: Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3

Common goods and public goods, natural capital / tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment(EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes /Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

TEXTBOOKS / REFERENCES:

1. R. Rajagopalan, *Environmental Studies: From Crisis to Cure*. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.
2. Daniel D. Chiras, *Environmental Science*. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.
3. Andy Jones, Michel Pimbert and Janice Jiggins, 2011. *Virtuous Circles: Values, Systems, Sustainability*. IIED and IUCN CEESP, London. URL: <http://pubs.iied.org/pdfs/G03177.pdf>
4. Annenberg Learner, *The Habitable Planet*, Annenberg Foundation 2015. URL: <http://www.learner.org/courses/envsci/unit/pdfs/textbook.pdf>.

15FRE230 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

15FRE231 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

15GER230 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

Numbers 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.

15GER231 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.

15GER232 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.

15GER233 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.

15HIN101 HINDI I 1 0 2 2

OBJECTIVES: To teach Hindi for effective communication in different spheres of life - Social context, Education, governance, Media, Business, Profession and Mass communication.

Unit 1

Introduction to Hindi Language, National Language, Official Language, link Language etc. Introduction to Hindi language, Devanagari script and Hindi alphabet.

Shabda Bhed, Roopanhar ki Drishti se - Bhasha – Paribhasha aur Bhed - Sangya - Paribhasha Aur Bhed- Sangya ke Roopanhar - kriya.

Unit 2

Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender& number - General vocabulary for conversations in given context – understanding proper pronunciation – Conversations, Interviews, Short speeches.

Unit 3

Poems – Kabir 1st 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit 4

Letter writing – personal and Formal –Translation from English to Hindi.

Unit 5

Kahani – Premchand: Kafan, Abhilasha, Vidroh, Poos ki rath, Julooos.

BOOKS:

1. *Prem Chand Ki Srvashestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi*
2. *Vyavaharik Hindi Vyakaran ,Anuvad thaha Rachana : Dr. H. Parameswaran, Radhakrishna publishing House,New Delhi*
3. *Kamtha Prasad Guru : Hindi Vyakaran, Best Book pub House, New Delhi*
4. *Poetry : Kavya Ras-Ed: T.V. Basker- Pachouri Press; Mathura*

15HIN111 HINDI II 1 0 2 2

OBJECTIVES: *Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided as anthology.*

Unit 1

Kavya Tarang; Dhumil ke Anthim Kavitha [Poet-Dhumil]; Dhabba [Poet-Kedarnath Singh]; Proxy [Poet-Venugopal]; Vakth [Poet-Arun Kamal]; Maachis [Poet-Suneeta Jain].

Unit 2

Communicative Hindi - Moukhik Abhivyakthi

Unit 3

Audio-Visual – Media in Hindi – Movies like Tare Zameen par, Paa, Black etc., appreciation and evaluation. News reading and presentations in Radio and TV channels in Hindi.

Unit 4

Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis

Unit 5

Translation: Theory and Practice - Letter writing: Formal and Personal – Introduction to Hindi Software.

BOOKS:

1. *Kavay Tarang: Dr. Niranjana, Jawahar Pusthakaalay, Mathura.*
2. *Gadya Manjusha: Editor: Govind, Jawahar Pusthakaalay, Mathura*

15HUM230 EMOTIONAL INTELLIGENCE 2 0 0 2

Unit 1

Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.

Unit 2

Components of Emotional Intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills. Emotional Intelligence Competencies, Elements of Emotional Intelligence, Models of Emotional Intelligence: The Ability-based Model, The Trait Model of Emotional Intelligence, Mixed Models of Emotional Intelligence.

Unit 3

Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost – savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

REFERENCES:

1. *Daniel Goleman (1996). Emotional Intelligence- Why it can Matter More than IQ. Bantam Doubleday Dell Publishing Group*
2. *Daniel Goleman (2000). Working with Emotional Intelligence. Bantam Doubleday Dell Publishing Group*
3. *Liz Wilson, Stephen Neale & Lisa Spencer-Arnell (2012). Emotional Intelligence Coaching. Kogan Page India Private Limited*

**15HUM231 GLIMPSES INTO THE INDIAN MIND: 2 0 0 2
THE GROWTH OF MODERN INDIA**

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.*

15HUM232 GLIMPSES OF ETERNAL INDIA 2 0 0 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 samraja 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, Murlī 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. *Arthashastra*.
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)*

15HUM233 GLIMPSES OF INDIAN ECONOMY AND POLITY 2 0 0 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 varnashramadharmā – socio-political structure of the various institutions based on the four purusharthas; 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 Arthashastra; 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. Arthashastra.*
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, Murlī 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.*

15HUM234

HEALTH AND LIFE STYLE

1 0 2 2

Unit 1 Introduction to Health

Health is wealth; Role of lifestyle habits on health; Importance of adolescence; Stages, Characteristics and changes during adolescence; Nutritional needs during adolescence why healthy lifestyle is important for adolescence. Eating Habits - eating disorders, skipping breakfast, junk food consumption.

Practicals - Therapeutic Diets

Unit 2 Food and Nutritional Requirements during Adolescence

Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction etc

Practicals - Ethnic Foods

Unit 3 Need for a Positive Life Style Change

Peer pressure & procrastination, Stress, depression, suicidal tendency, Mini project review and viva, Whole portions revision.

Practical - Cooking without Fire or Wire-healthy Snacks

TEXTBOOKS:

B. Srilakshmi, "Dietetics", New age international (P) ltd, publishers, 2010.
Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Council of Medical Research, ICMR, 2010.

REFERENCE BOOKS:

K Park "Textbook of preventive and social medicine", 2010.
WHO Report on Adolescent Health: 2010

15HUM235 INDIAN CLASSICS FOR THE TWENTY-FIRST CENTURY 2 0 0 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

15HUM236 INTRODUCTION TO INDIA STUDIES 2 0 0 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, Simonand 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.

15HUM237 INTRODUCTION TO SANSKRIT LANGUAGE AND LITERATURE 2 0 0 2

OBJECTIVES: To familiarize students with Sanskrit language; to introduce students to various knowledge traditions in Sanskrit; to help students appreciate and imbibe India's ancient culture and values.

Unit 1

Sanskrit Language – Vakya Vyavahara (प्रथमादीक्षा) - Introduction to Sanskrit language - Devanagari script and Sanskrit alphabet - Vowels and Consonants – Pronunciation - Classification of Consonants – Samyukthakshara Words – Nouns and Verbs - Cases – Introduction to Numbers and Time – Verbs: Singular, Dual and Plural – Sarva Namah: First Person, Second Person, Third Person – Tenses: Past, Present and Future -Words for Communication – Selected Slokas – Moral Stories – Subhashithas – Riddles.

Unit 2

Language Studies - Role of Sanskrit in Indian & World Languages.

Unit 3

Introduction to Sanskrit Classical Literature – KavyaTradition – Drama Tradition - Stotra Tradition – Panchatantra Stories.

Unit 4

Introduction to Sanskrit Technical Literature – Astronomy – Physics – Chemistry – Botany – Engineering – Aeronautics – Ayurveda – Mathematics – Medicine – Architecture - Tradition of Indian Art – Administration – Agriculture.

Unit 5

Indology Studies – Perspectives and Innovations.

TEXTBOOKS AND REFERENCE BOOKS:

1. *Vakya Vyavahara - Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi*
2. *The Wonder that is Sanskrit - Dr. Sampadananda Mishra, New Delhi*
3. *Science in Sanskrit – Samskritha Bharathi, New Delhi*

15HUM238 NATIONAL SERVICE SCHEME 2 0 0 2

Unit 1

Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.

NSS Programmes and Activities: Concept of regular activities, special campaigning, Day Camps, Basis of adoption of village / slums, methodology of conducting survey, financial pattern of the scheme, other youth programme/schemes of GOI, Coordination with different agencies, Maintenance of the Diary.

Unit 2

Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

Unit 3

Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.

Youth and Yoga: History, philosophy and concept of Yoga, Myths and misconceptions about Yoga, Different Yoga traditions and their impacts, Yoga as a preventive and curative method, Yoga as a tool for healthy life style

Unit 4

Youth Development Programmes in India: National Youth Policy, Youth development programmes at the national level, state level and voluntary sector, youth-focused and youth-led organizations.

Youth and Crime: Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice.

Unit 5

Environmental Issues: Environment conservation, enrichment and sustainability, climate change, waste management, rain water harvesting, energy conservation, waste land development.

Project Work / Practical

15HUM239 PSYCHOLOGY FOR EFFECTIVE LIVING 2 0 0 2

Unit 1 Self-Awareness & Self-Motivation

Self analysis through SWOT, Johari Window, Maslow's hierarchy of motivation, importance of self esteem and enhancement of self esteem.

Unit 2 The Nature and Coping of Stress

Conflict, Relationship issues, PTSD. Stress – stressors – eustress - distress, coping with stress, stress management techniques.

Unit 3 Application of Health Psychology

Health compromising behaviours, substance abuse and addiction.

TEXTBOOKS:

1. V. D. Swaminathan & K. V. Kaliappan "Psychology for effective living-An introduction to Health
2. Psychology.2nd edition Robert J. Gatchel, Andrew Baum & David S. Krantz, McGraw Hill.

REFERENCE BOOKS:

1. S. Sunder, 'Textbook of Rehabilitation', 2nd edition, Jaypee Brothers, New Delhi.2002.
2. Weiben & Lloyd, 'Psychology applied to Modern Life', Thompson Learning, Asia Ltd.2004.

15HUM240 PSYCHOLOGY FOR ENGINEERS 2 0 0 2

Unit 1

Psychology of Adolescents: Adolescence and its characteristics.

Unit 2

Learning, Memory & Study Skills: Definitions, types, principles of reinforcement, techniques for improving study skills, Mnemonics.

Unit 3

Attention & Perception: Definition, types of attention, perception.

TEXTBOOKS:

1. S. K. Mangal, "General Psychology", Sterling Publishers Pvt.Ltd.2007
2. Baron A. Robert, "Psychology", Prentice Hall of India. New Delhi 2001

REFERENCE BOOKS:

1. Elizabeth B. Hurlock, *Developmental Psychology - A life span approach*, 6th edition.
2. Feldman, *Understanding Psychology*, McGraw Hill, 2000.
3. Clifford Morgan, Richard King, John Scholper, "Introduction to Psychology", Tata Mcgraw Hill, Pvt Ltd 2004.

15HUM241 SCIENCE AND SOCIETY – 2 0 0 2
AN INDIAN PERSPECTIVE

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. Anma, 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.
15. Bajaj, Jitendra & M. D. Srinivas. *Indian Economy and Polity*. Chennai: Centre for Policy Studies.
16. Bajaj, Jitendra & M. D. Srinivas. *Timeless India, Resurgent India*. Chennai: Centre for Policy Studies.
17. Joshi, Murlī 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.

15HUM242 THE MESSAGE OF BHAGWAD GITA 2 0 0 2

Unit 1

Introduction: Relevance of Bhagavad Gita today – Background of Mahabharatha.

ArjunaVishada Yoga: Arjuna's Anguish and Confusion – Symbolism of Arjuna's Chariot.

Sankhya Yoga: Importance of Self-knowledge – Deathlessness: Indestructibility of Consciousness – Being Established in Wisdom – Qualities of a Sthita-prajna.

Unit 2

Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Concept of Swadharma.

Dhyana Yoga: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence.

Unit 3

Bhakti Yoga: Yoga of Devotion – Form and Formless Aspects of the Divine – Inner Qualities of a True Devotee.

Gunatraya Vibhaga Yoga: Dynamics of the Three Gunas: Tamas, Rajas, Sattva – Going Beyond the Three Gunas – Description of a Gunatheetha.

TEXTBOOKS / REFERENCES:

1. Swami Chinmayananda, "The Holy Geeta", Central Chinmaya Mission Trust, 2002.
2. Swami Chinmayananda, "A Manual of Self Unfoldment", Central Chinmaya Mission Trust, 2001.

15HUM243 THE MESSAGE OF THE UPANISHADS 2 0 0 2

OBJECTIVES: To give students an introduction to the basic ideas contained in the Upanishads; and explores how their message can be applied in daily life for achieving excellence.

Unit 1

An Introduction to the Principal Upanishads and the Bhagavad Gita - Inquiry into the mystery of nature - Sruti versus Smrti - Sanatana Dharma: its uniqueness - The Upanishads and Indian Culture - Upanishads and Modern Science.

Unit 2

The challenge of human experience & problems discussed in the Upanishads – The True nature of Man – the Moving power of the Spirit – The Message of Fearlessness – Universal Man - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different manifestations of consciousness.

Unit 3

Upanishad Personalities - episodes from their lives and essential teachings: Yajnavalkya, Aruni, Uddalaka, Pippalada, Satyakama Jabala, Svetaketu, Nachiketas, Upakosala, Chakrayana Ushasti, Raikva, Kapila and Janaka. Important verses from Upanishads - Discussion of Sage Pippalada's answers to the six questions in Prasnopanishad.

REFERENCES:

1. *The Message of the Upanishads* by Swami Ranganathananda, *Bharatiya Vidya Bhavan*
2. *Eight Upanishads with the commentary of Sankaracharya*, *Advaita Ashrama*
3. *Indian Philosophy* by Dr. S. Radhakrishnan, *Oxford University Press*
4. *Essentials of Upanishads* by R L Kashyap, *SAKSI, Bangalore*
5. *Upanishads in Daily Life*, *Sri Ramakrishna Math, Myslapore.*
6. *Eternal stories of the Upanishads* by Thomas Egenes and Kumuda Reddy
7. *Upanishad Ganga series – Chinmaya Creations*

15HUM244 UNDERSTANDING SCIENCE OF FOOD AND NUTRITION 1 0 2 2

Unit 1 Food and Food Groups

Introduction to foods, food groups, locally available foods, Nutrients, Cooking methods, Synergy between foods, Science behind foods, Food allergies, food poisoning, food safety standards.

Cookery Practicals - Balanced Diet

Unit 2 Nutrients and Nutrition

Nutrition through life cycle, RDA, Nutrition in disease, Adulteration of foods & Food additives, Packaging and labeling of foods.

Practicals - Traditional Foods

Unit 3 Introduction to Food Biotechnology

Future foods - Organic foods and genetically modified foods, Fortification of foods value addition of foods, functional foods, Nutraceuticals, supplementary foods, Processing and preservation of foods, applications of food technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Practicals - Value added foods

TEXTBOOKS:

1. N.Shakuntalamanay, M. Shadaksharaswamy, "Food Facts and principles", New age international (P) Ltd, publishers, 2005.
2. B.Srilakshmi, "Dietetics", New age international (P) Ltd, publishers, 2010.

REFERENCE BOOKS:

1. B. Srilakshmi, "Food Science", New age international (P) Ltd, publishers, 2008.
2. "Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Council of Medical Research, ICMR, 2010.

15JAP230 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.

15JAP231 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.

15KAN101

KANNADA I

1 0 2 2

OBJECTIVES: To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.

Unit 1

Adalitha Kannada: bhashe, swaroompa, belavanigeya kiru parichaya
Paaribaashika padagalu
Vocabulary Building

Unit 2

Prabhandha – Vyaaghra Geethe - A.N.Murthy Rao
Prabhandha – Baredidi...baredidi, Baduku mugiyuvudilla allige...- Nemi Chandra
Paragraph writing – Development: comparison, definition, cause & effect
Essay – Descriptive & Narrative

Unit 3

Mochi – Bharateepriya
Mosarina Mangamma – Maasti Venkatesh Iyengar
Kamalaapurada Hotelnalli – Panje Mangesh Rao
Kaanike – B. M. Shree
Geleyanobbanige bareda Kaagada – Dr. G. S. Shivarudrappa
Moodala Mane – Da .Ra. Bendre
Swathantryada Hanate – K. S. Nissar Ahmed

Unit 4

Letter Writing - Personal: Congratulation, thanks giving, invitation, condolence

Unit 5

Reading Comprehension; nudigattu, gaadegalu
Speaking Skills: Prepared speech, pick and speak

REFERENCES:

1. H. S. Krishna Swami Iyengar – Adalitha Kannada – Chetana Publication, Mysuru
2. A. N. Murthy Rao – Aleyuva Mana – Kuvempu Kannada Adyayana Samste
3. Nemi Chandra – Badhuku Badalisabahudu – Navakarnataka Publication
4. Sanna Kathegalu - Prasaraanga, Mysuru University , Mysuru
5. B. M. Shree – Kannadada Bavuta – Kannada Sahitya Parishattu
6. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna Book House (P) Ltd.
7. Dr. G. S. Shivarudrappa – Samagra Kavya – Kamadhenu Pustaka Bhavana

15KAN111 KANNADA II 1 0 2 2

OBJECTIVES: To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.

Unit 1

Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2

Nanna Hanate - Dr. G. S. Shivarudrappa
Mankuthimmana Kaggada Ayda bhagagalu – D. V. Gundappa (Padya Sankhye 5, 20, 22, 23, 25, 44, 344, 345, 346, 601)
Ella Marethiruvaga - K. S. Nissaar Ahmed
Saviraru Nadigalu – S Siddalingayya

Unit 3

Sayo Aata – Da. Ra. Bendre

Unit 4

Sarva Sollegala turtu Maha Samelana - Beechi
Swarthakkaagi Tyaga - Beechi

Unit 5

Essay writing: Argumentative & Analytical
Précis writing

REFERENCES:

1. H. S. Krishnaswami Iyengar – Adalitha Kannada – Chetan Publication, Mysuru
2. Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana
3. Shrikanth - Mankuthimmana Kaggada – Taatparya – Sri Ranga Printers & Binders
4. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house
5. Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication
6. Beechi – Sahukara Subbamma – Sahitya Prakashana

15MAL101 MALAYALAM I 1 0 2 2

OBJECTIVES: To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Unit 1

Ancient poet trio: Adhyatmaramayanam ,
Lakshmana Swanthanam (valsa soumitre... mungikidakayal), Ezhuthachan -
Medieval period classics – Jnanappana (kalaminnu... vilasangalingane), Poonthanam.

Unit 2

Modern Poet trio: Ente Gurunathan, Vallathol Narayana Menon - Critical analysis of the poem.

Unit 3

Short stories from period 1/2/3, Poovanpazham - Vaikaom Muhammed Basheer -
Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: Ithihasa studies - Bharatha Paryadanam - Vyasante Chiri -
Kuttikrishna Mararu - Outline of literary Criticism in Malayalam Literature - Introduction to Kutti Krishna Mararu & his outlook towards literature & life.

Unit 5

Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation –
Thettillatha Malayalam

Writing - a. Expansion of ideas; b. Precis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. P. K. Balakrishnanan, Thunjan padhanangal, D. C. Books, 2007.
2. G. Balakrishnan Nair, Jnanappanayum Harinama Keerthanavum, N. B. S, 2005.
3. M. N. Karasseri, Basheerinte Poonkavanam, D. C. Books, 2008.
4. M. N. Vijayan, Marubhoomikal Pookkumbol, D. C. Books, 2010.
5. M. Thomas Mathew, LavanyanubhavathinteYukthisasthram, National Book Stall, 2009.
6. M. Leelavathy, Kavitha Sahityacharithram, National Book Stall, 1998.
7. Thayattu Sankaran, Vallathol Kavithapadhanam, D. C. Books, 2004.

15MAL111 MALAYALAM II 1 0 2 2

OBJECTIVES: To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Unit1

Ancient poet trio: Kalayana sougandhikam, (kallum marangalun... namukkennarika vrikodara) Kunjan Nambiar - Critical analysis of his poetry - Ancient Drama: Kerala Sakunthalam (Act 1), Kalidasan (Transilated by Attor Krishna Pisharody).

Unit 2

Modern / romantic / contemporary poetry: Manaswini, Changampuzha Krishna Pillai – Romanticism – modernism.

Unit 3

Anthology of short stories from period 3/4/5: Ninte Ormmayku, M. T. Vasudevan Nair - literary contributions of his time

Unit 4

Part of an autobiography / travelogue: Kannerum Kinavum, V. T. Bhattathirippadu - Socio-cultural literature - historical importance.

Unit 5

Error-free Malayalam - 1. Language; 2. Clarity of expression; 3. Punctuation - Thettillatha Malayalam

Writing - a. Expansion of ideas; b. Précis Writing ; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. Narayana Pillai. P. K, *Sahitya Panchanan. Vimarsanathrayam, Kerala Sahitya Academy, 2000*
2. Sankunni Nair. M. P, *Chathravum Chamaravum, D. C. Books, 2010.*
3. Gupthan Nair. S, *Asthiyude Pookkal, D. C Books.2005*
4. Panmana Ramachandran Nair, *Thettillatha Malayalam, Sariyum thettum etc., D. C. Book, 2006.*
5. M. Achuthan, *Cherukatha-Innale, innu, National Book Stall, 1998.*
6. N. Krishna Pillai, *Kairaliyude Katha, National Book Stall, 2001.*

15MAT111 CALCULUS AND MATRIX ALGEBRA 2 1 0 3

Unit 1 Calculus

Graphs: Functions and their Graphs. Shifting and Scaling of Graphs.

Limit and Continuity: Limit (One-Sided and Two-Sided) of Functions. Continuous Functions, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity.

Unit 2 Differentiation and its Applications: Derivative of a function, non differentiability, Intermediate Value Property, Mean Value Theorem, Extreme Values of Functions, Monotonic Functions, Concavity and Curve Sketching, Integration: Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques.

Unit 3 Matrix Algebra

Review: System of linear Equations, linear independence

Eigen values and Eigen vectors: Definitions and Properties, Positive definite, Negative Definite and Indefinite Matrices, Diagonalization and Orthogonal Diagonalization, Quadratic form, Transformation of Quadratic Form to Principal axes, Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian Matrices and Orthogonal Matrices Iterative Methods for the Solution of Linear Systems, Power Method for Eigen Values and Eigen Vectors.

TEXTBOOKS:

1. 'Calculus', G. B. Thomas Pearson Education, 2009, Eleventh Edition.
2. 'Advanced Engineering Mathematics', Erwin Kreyszig, John Wiley and Sons, 2015, Tenth Edition.

REFERENCE BOOKS:

1. 'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.
2. 'Advanced Engineering Mathematics', by Dennis G. Zill and Michael R. Cullen, second edition, CBS Publishers, 2012.

15MAT121 VECTOR CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1

Vector Differentiation: 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: 9.4, 9.5, 9.6, 9.9, 9.10, 9.11)

Vector Integration: Line Integral, Line Integrals Independent of Path. Green's Theorem in the Plane (Sections: 10.1, 10.2, 10.3, 10.4).

Unit 2

Surface Integral: Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem. (Sections: 10.5, 10.6, 10.7, 10.9) First Order Differential Equations: First Order ODE, Exact Differential Equations and Integrating Factors (Sections 1.1and 1.4).

Unit 3

Second Order Differential Equations: Homogeneous and non-homogeneous linear differential equations of second order (Review), Modelling: Free Oscillations,

Euler-Cauchy Equations, Solution by Undetermined Coefficients, Solution by the Method of Variation of Parameters (Sections 2.1, 2.2, 2.4, 2.5, 2.6, 2.7, 2.10).

System of Order Differential Equations: Basic Concepts and Theory, Constant Coefficient systems – Phase Plane method, Criteria for Critical Points, Stability. (Sections 4.1 – 4.4).

TEXTBOOK:

'Advanced Engineering Mathematics', Erwin Kreyszig, John Wiley and Sons, Tenth Edition, 2015.

REFERENCE BOOKS:

1. *'Advanced Engineering Mathematics', Dennis G. Zill and Michael R. Cullen, second edition, CBS Publishers, 2012.*
2. *'Calculus', G. B. Thomas Pearson Education, 2009, Eleventh Edition.*
3. *'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.*

15MAT202 LINEAR ALGEBRA 2 1 0 3

Unit 1

Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis - Dimension - Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process.

Unit 2

Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle. Linear Transformations: Positive definite matrices - Matrix norm and condition number – QR - Decomposition

Unit 3

Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations - Similarity of linear transformations - Diagonalisation and its applications - Jordan form and rational canonical form.

TEXTBOOK:

Howard Anton and Chris Rorres, "Elementary Linear Algebra", Tenth Edition, John Wiley & Sons, 2010.

REFERENCES:

1. *Gilbert Strang, "Linear Algebra and Its Applications", Fourth Edition, Cengage, 2006.*
2. *Kenneth Hoffmann and Ray Kunze, Linear Algebra, Second Edition, Prentice Hall, 1971.*

15MAT204 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS 2 1 0 3

Unit 1

Laplace Transform: 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.

Unit 2

Convolution, Integral Equations, Partial Fractions, Differential Equations, Systems of Differential Equations. (Sections: 6.1 to 6.7)

Fourier Series: Fourier series, Half range Expansions, Parseval's Identity, Fourier Integrals, Fourier integral theorem. Sine and Cosine Integrals. (Sections: 11.1 - 11.3)

Unit 3

Fourier Transforms: Sine and Cosine Transforms, Properties, Convolution theorem. (Sections: 11.1 -11.3, 11.7-11.9)

Partial Differential Equations: Basic Concepts, Modeling; Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series, Heat Equation; Solution by Fourier Series. (Sections: 12.1-12.5)

TEXTBOOK:

Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Ninth Edition, 2012.

REFERENCE BOOKS:

1. *Advanced Engineering Mathematics by Dennis G. Zill and Michael R. Cullen, second edition, CBS Publishers, 2012.*
2. *Larry C. Andrews and Bhimson. K. Shivamoggi, The Integral Transforms for Engineers, Spie Press, Washington, 1999.*
3. *J. L. Schiff, The Laplace Transform, Springer, 1999.*

15MAT211 CALCULUS OF VARIATIONS AND NUMERICAL METHODS 2 1 0 3

Unit 1

Calculus of Variations: Maxima and minima - The simplest case - Illustrative examples - Natural boundary conditions and transition conditions – Concept of functional with simple example – Variation of a functional (only necessary conditions) - Simple variational problem - Euler equation - The more general case of variational problems - Constraints and Lagrange multipliers - Variable end points.

Unit 2

Sturm-Liouville problems - Hamilton's principle - Lagrange's equations - Generalized dynamical entities - Constraints in dynamical systems - Applications in dynamics of particles, vibrating string, vibrating membranes, theory of elasticity - The variational problem of a vibrating elastic plate – Direct methods in calculus of variations - The Rayleigh-Ritz and finite difference methods. (Book-1)

Unit 3

Numerical Methods: Solution of Equations by iteration methods. Interpolations.

Numerical Integration and Differentiation. (Book-2: Sections: 19.1-19.5)

TEXTBOOK:

1. M. Gelfand and S. V. Fomin, *Calculus of Variations*, Dover Publications, 2000
2. *Advanced Engineering Mathematics*, E Kreyszig, John Wiley and Sons, Ninth Edition, 2012.

REFERENCE BOOK:

1. A. S. Gupta, *calculus of Variations with Applications*, Prentice Hall of India, 1997
2. M. K. Venkatraman, *Advanced Engineering Mathematics*, 2010.
3. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical methods for Scientific and Engineering Computation*, New Age International Publishers, Fifth ed., 2007.
4. Steven Chapra and Raymond Canale, *Numerical Methods for Engineers*, McGraw Hill, 2007.

15MEC100 ENGINEERING DRAWING - CAD 2 0 2 3

Introduction, Drawing Instruments and their uses, Layout of the Software, standard tool bar/menus, navigational tools. Co-ordinate system and reference planes. Creation of 2 dimensional environment. Selection of drawing size and scale. Commands and Dimensioning.

Orthographic Projections: Introduction, Planes of projection, reference line. Projection of points in all the four quadrants. Projection of straight lines, Projection of Plane Surfaces, and Projection of Solids in first angle projection system.

TEXTBOOK:

Bhat N. D. and Panchal V. M., "Engineering Drawing Plane and Solid Geometry", 42e, Charoatar Publishing House, 2010

REFERENCES:

1. James D. Bethune, "Engineering Graphics with AutoCAD", Pearson Education, 2014
2. K. R. Gopalakrishna, "Engineering Drawing", 2014, Subhas Publications
3. Narayan K. L. and Kannaiah P, *Engineering Drawing*, SciTech Publications, 2003

15MEC102 ENGINEERING MECHANICS 3 0 0 3**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 dimension: Moment of a force about a point - moment of a couple - equivalent force - couple system. Rigid body equilibrium: Beams - support reactions.

Unit 2

Friction - block friction, ladder friction. Analysis of trusses - Method of joints, method of sections.

Centroid of lines, areas - composite areas. 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.

TEXTBOOKS:

1. Hibbeler, R. C., "Engineering Mechanics - Statics", 12/e, Pearson Education Pvt. Ltd., 2007.
2. Beer, F. P. & Johnston, E. R., "Vector Mechanics for Engineers-Statics and Dynamics", 8/e, McGraw Hill International Book Co., 2008.

REFERENCES:

1. Meriam, J. L., "Dynamics", 5/e, John Wiley & sons, 2003
2. Shames, I. H., "Engineering Mechanics-Statics and Dynamics", 4/e., Prentice-Hall of India Pvt. Ltd., 2003.
3. Dubey, N. H. "Engineering Mechanics" McGraw Hill

15MEC180 WORKSHOP A 0 0 2 1**1. Product Detailing Workshop**

Disassemble the product of sub assembly - Measure various dimensions using measuring instruments - Free hand rough sketch of the assembly and components - Name of 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.

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*, McGraw 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.

15PHY233 BIOPHYSICS AND BIOMATERIALS 3 0 0 3

OBJECTIVE: To equip the students with the knowledge on different kinds of biomaterials and other medical need, basic research, and to provide an over view of theory and practice of bio materials.

Unit 1

Quantum mechanics – Schrodinger's time dependent and independent equations – Pauli's exclusion principle – ionization energy – electron affinity – chemical binding – electro negativity and strong bonds - secondary bonds – inter atomic potential for strong bonds and weak bonds – bond energies – spring constants – free energy – internal energy – reaction kinetics.

Definition and classification of bio-materials, mechanical properties, visco-elasticity, wound-healing process, Application of biomaterial for the human body, body response to implants, blood compatibility. Implementation problems - inflammation, rejection, corrosion, structural failure. Surface modifications for improved compatibility.

Unit 2

Bioceramics, Biopolymers, Metals, ceramics and composites in medicine: Properties, applications, suitability & modifications required for certain applications.

X-ray diffraction and molecular structure – Nuclear Magnetic Resonance – scanning tunneling microscope – Atomic force microscopy – optical tweezers – patch clamping – molecular dynamics – potential energy contour tracing – SEM – TEM – spectroscopy methods differential thermal analysis, differential thermo gravimetric analysis – NDT methods.

Unit 3

Materials for bone and joint replacement – dental metals and alloys – ceramic – bioinert – bioactive ceramics – polymers - dental restorative materials – dental amalgams – cardiovascular materials – cardiac prosthesis; vascular graft materials – cardiac pacemakers – cardiac assist devices – materials for ophthalmology contact lens – intraocular materials – materials for drug delivery.

TEXTBOOKS AND REFERENCES:

1. Rodney M J Cotterill, *Biophysics an introduction*, John Wiley & sons Ltd., NY, 2002
2. Vasantha Pattabhi and N. Gautham, *Biophysics*, Alpha science International Ltd. UK, 2002.
3. Jonathan Black, *Biological Performance of Materials, Fundamentals of Biocompatibility*, Marcel Dekker Inc., New York, 1992.
4. D. F. Williams (ed.), *Material Science and Technology - A comprehensive treatment*, Vol.14, *Medical and Dental Materials*, VCH Publishers Inc., New York, 1992.
5. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, *Instrumental Methods of Analysis*, CBS Publishers, New Delhi, 1986.

15PHY234 INTRODUCTION TO 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:

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

15PHY238 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", Wilely, New York, 1956 (2nd 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 (5th edition).

15PHY239 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).

REFERENCES:

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

15PHY240 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, peritectic 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, superconductivity 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, Birefringence; Dielectric Properties of Materials: Polarization and Permittivity, Mechanisms of polarization, dielectric properties - dielectric constant, dielectric loss, dielectric strength and breakdown, Piezoelectricity, Ferroelectricity, 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.

15PHY241 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, W M, *Laser Material Processing (3rd Edition)*, Springer Verlag, 2003, ISBN 1852336986.
2. Silvast, W T, *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.

15PHY243 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.

15PHY245 NUCLEAR ENERGY: PRINCIPLES AND APPLICATIONS 3 0 0 3**Unit 1**

Basics: Atomic theory, nuclear composition, sizes and masses of nuclei, binding energy, radioactive decay, radioactive chains. Nuclear reactions, transmutation of

elements, conservation laws, neutron cross sections, interaction of charged particles and gamma radiation with matter.

Fission and fusion: The fission process, energetic of fission, byproducts of fission, energy from nuclear fuels. Fusion reactions, electrostatic and nuclear forces, thermo nuclear reactions in plasma. Energetics of fusion. Comparison of fusion and fission reactions.

Unit 2

Neutron chain reactions and nuclear power: Criticality and multiplication, factors governing the multiplication, neutron flux and reactor power, reactor types and reactor operations. Methods of heat transmission and removal, steam generation and electric power generation, waste heat disposal.

Unit 3

Breeder reactors and fusion reactors: The concept of breeding nuclear fuel, isotope production and consumption, fast breeder reactor, breeding and uranium sources. Technical problems in the functioning of fusion reactor, requirements for practical fusion reactors, magnetic confinement, inertial confinements and other fusion concepts. Prospects of fusion power.

Radiation protection and waste disposal: Biological effects of radiation, radiation dose units, protective measures, internal exposure, and radon problem. Nuclear fuel cycle and waste classification, spent fuel storage and transportation, high level waste disposal, low level waste disposal.

TEXTBOOK:

Raymond L Murray, Nuclear Energy: An Introduction to the Concepts, Systems and Applications of Nuclear Processes, Butterworth-Heimann-Elsevier Inc (2009)

REFERENCES:

1. David Bodansky, *Nuclear Energy: principles, practices and prospects*, Springer Verlag
2. S K Rajput, *Nuclear Energy*, Mahaveer & Sons (2009)

15PHY247 PHOTOVOLTAICS 3 0 0 3**Unit 1**

Introduction to semiconductors: Semiconductors: concept of electron and holes, conduction in semiconductors and concentration of charge carriers in semiconductors. Direct and indirect band gap semiconductors (quantum mechanical treatment). Extrinsic semiconductors: n-type, p-type & compensation doping, carrier concentration; PN junction - concept of bands at PN junction, junction under forward and reverse biases (conceptual).

Unit 2

Optical Processes: Optical absorption, Photoelectric Effect, Beer-Lambert law (Qualitative). Wavelength to band gap relation. Generation of electron-hole pairs. Recombination processes - direct and indirect recombination, other recombination processes - Shockley Reed Hall recombination, Auger recombination.

Solar Cell – Principle: Introduction & history of Solar cells. Constituents of solar radiations (Solar Spectrum). Separation of electrons and holes. Transport of charge carriers - diffusion & drift of carriers, continuity equation, field current, diffusion current, total charge current.

Unit 3

Solar Cell – Properties: Measurement of solar cell parameters - short circuit current, open circuit voltage, fill factor, efficiency. Optical losses, electrical losses, surface recombination velocity, quantum efficiency - external and internal, I-V characteristics of Solar cells. Fabrication and design of Solar cells. Performance enhance: Enhance absorption, Reduce series resistance, surface recombination.

Advanced Solar cell technologies (III Generation): Alternatives to conventional Si based solar cells - Thin film solar cells, Hetero junction solar cells, Tandem solar cells: material properties, fabrication and stability (includes nano scale devices). Organic solar cells.

TEXTBOOK:

Wenham S R, "Applied Photovoltaics", 2nd ed., Earthscan Publications Ltd., (2007).

REFERENCES:

1. Peter Wurfel, "Physics of Solar Cells", 2nd Ed., Wiley VCH (2005).
2. S O Kasap, "Principles of Electronic Materials and Devices", McGraw-Hill, New York (2005).

15PHY248 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.

Introduction 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 $\Delta\omega$ 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) CO₂ 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. B B 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. K R Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.
5. T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).

15PHY250 QUANTUM PHYSICS AND 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, McGraw 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*

15PHY251 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 - donor 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.*

15PHY331 ASTRONOMY 3 0 0 3

Unit 1

Astronomy, an Observational Science: Introduction - Indian and Western Astronomy – Aryabhata - Tycho Brahe's observations of the heavens - The laws of planetary motion - Measuring the astronomical unit - Isaac Newton and his Universal Law of Gravity - Derivation of Kepler's third law - The Sun - The formation of the solar system - Overall properties of the Sun - The Sun's total energy output - Black body radiation and the sun's surface temperature - The Fraunhofer lines in the solar spectrum and the composition of the sun - Nuclear fusion - The proton-proton cycle - The solar neutrino problem - The solar atmosphere: photosphere,

chromosphere and corona - Coronium - The solar wind - The sunspot cycle - Solar The Planets - Planetary orbits - Orbital inclination - Secondary atmospheres - The evolution of the earth's atmosphere.

Unit 2

Observational Astronomy

Observing the Universe - The classic Newtonian telescope - The Cassegrain telescope - Catadioptric telescopes - The Schmidt camera - The Schmidt-Cassegrain telescope - The Maksutov-Cassegrain telescope - Active and adaptive optics - Some significant optical telescopes - Gemini North and South telescopes - The Keck telescopes - The South Africa Large Telescope (SALT) - The Very Large Telescope (VLT) - The Hubble Space Telescope (HST) - The future of optical astronomy - Radio telescopes - The feed and low noise amplifier system - Radio receivers - Telescope designs - Large fixed dishes - Telescope arrays - Very Long Baseline Interferometry (VLBI) - The future of radio astronomy - Observing in other wavebands – Infrared – Sub-millimetre wavelengths - The Spitzer space telescope - Ultraviolet, X-ray and gamma-ray observatories - Observing the universe without using electromagnetic radiation - Cosmic rays - Gravitational waves.

Unit 3

The Properties of Stars: Stellar luminosity - Stellar distances - The hydrogen spectrum - Spectral types - Spectroscopic parallax - The Hertzsprung-Russell Diagram - The main sequence - The giant region - The white dwarf region - The stellar mass – luminosity relationship - Stellar lifetimes - Stellar Evolution – White dwarfs - The evolution of a sun-like star - Evolution in close binary systems – Neutron stars and black holes - The discovery of pulsars - Black holes: The Milky Way - Open star clusters - Globular clusters - Size, shape and structure of the Milky Way – observations of the hydrogen line - Other galaxies - Elliptical galaxies - Spiral galaxies - The Hubble classification of galaxies - The universe - The Cepheid variable distance scale - Starburst galaxies - Active galaxies - Groups and clusters of galaxies – Superclusters - The structure of the universe - Cosmology – the Origin and Evolution of the Universe - The expansion of the universe - The cosmic microwave background - The hidden universe: dark matter and dark energy - The Drake equation - The Search for Extra Terrestrial Intelligence (SETI) - The future of the universe.

TEXTBOOK:

Introduction to Astronomy and Cosmology, Ian Morison, Wiley (UK), 2008

REFERENCE BOOK:

Astronomy: Principles and Practice, 4th Edition (Paperback), D. C. Clarke, A. E. Roy, Institute of Physics Publishing

15PHY333 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.*

15PHY335 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)

15PHY338 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. D A Neamen, "Semiconductor Physics and Devices", TMH, 3rd Edn., 2007.

REFERENCES:

1. S M Sze, "Physics of Semiconductor Devices", Wiley, 1996.
2. P Bhattacharya, "Semiconductor Opto- Electronic Devices", Prentice Hall, 1996.
3. M K Achuthan & K N Bhat, "Fundamentals of Semiconductor Devices", TMH, 2007.
4. J Allison, "Electronic Engineering Materials and Devices", TMH, 1990.

15PHY532 ASTROPHYSICS 3 0 0 3**Unit 1**

Historical introduction: Old Indian and western – astronomy - Aryabhata, 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 - Schwarzschild 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. Bradley W. 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.

15PHY535 EARTH'S ATMOSPHERE 3 0 0 3**Unit 1**

Earth's atmosphere: overview and vertical structure. Warming the earth and the atmosphere: temperature and heat transfer; absorption, emission, and equilibrium; incoming solar energy. Air temperature: daily variations, controls, data, human comfort, measurement. Humidity, condensation, and clouds: circulation of water in the atmosphere; evaporation, condensation, and saturation; dew and frost; fog.

Unit 2

Cloud development and precipitation: atmospheric stability & determining stability, cloud development and stability, precipitation processes, collision and coalescence, precipitation types, measuring precipitation. Air pressure and winds: atmospheric pressure, pressure measurement, surface and upper-air charts, surface winds, winds and vertical air motions, measuring and determining winds. Atmospheric circulations: scales of atmospheric motion, eddies, local wind systems, global winds, global wind patterns and the oceans.

Unit 3

Air masses, fronts, and mid-latitude cyclones. Weather forecasting: acquisition of weather information, forecasting methods and tools, forecasting using surface charts. Thunderstorms: ordinary (air-mass) thunderstorms, mesoscale convective complexes, floods and flash floods, distribution of thunderstorms, lightning and thunder. Tornadoes: severe weather and Doppler radar, waterspouts.

Unit 4

Hurricanes (cyclones, typhoons): tropical weather; anatomy, formation, dissipation and naming of hurricanes. Air pollution: a brief history, types and sources, factors that affect air pollution, the urban environment, acid deposition. Global climate: climatic classification; global pattern of climate.

Unit 5

Climate change: possible causes; carbon dioxide, the greenhouse effect, and recent global warming. Light, colour, and atmospheric optics: white and colours, white clouds and scattered light; blue skies and hazy days, red suns and blue moons; twinkling, twilight, and the green flash; the mirage; halos, sundogs, and sun pillars; rainbows; coronas and cloud iridescence.

TEXTBOOK:

C. Donald Ahrens: Essentials of Meteorology: An Invitation to the Atmosphere (6th edition), Brooks-Cole, 2010.

REFERENCE:

Frederick K. Lutgens & Edward J. Tarbuck: The Atmosphere, An Introduction to Meteorology (11th Edition), Prentice Hall, 19 January, 2009

15PHY536 EARTH'S STRUCTURE AND EVOLUTION 3 0 0 3

Unit 1

Introduction: geologic time; earth as a system, the rock cycle, early evolution, internal structure & face of earth, dynamic earth. Matter and minerals: atoms, isotopes and radioactive decay; physical properties & groups of minerals; silicates, important nonsilicate minerals, resources. Igneous rocks: magma, igneous processes, compositions & textures; naming igneous rocks; origin and evolution of magma, intrusive igneous activity, mineral resources and igneous processes.

Unit 2

Volcanoes and volcanic hazards: materials extruded, structures and eruptive styles, composite cones and other volcanic landforms, plate tectonics and volcanic activity. Weathering and soils: earth's external processes; mechanical & chemical weathering, rates; soils, controls of formation, profile, classification, human impact, erosion, weathering and ore deposits. Sedimentary rocks: the importance and origins of sedimentary rocks; detrital & chemical sedimentary rocks, coal, converting sediment into sedimentary rock; classification & structures, nonmetallic mineral & energy resources. Metamorphism and metamorphic rocks: metamorphic textures, common metamorphic rocks, metamorphic environments & zones.

Unit 3

Mass wasting: gravity, mass-wasting and landform development, controls and triggers, classification of mass-wasting processes, slump, rockslide, debris flow, earthflow, slow movements. Running water: hydrologic cycle, running water, streamflow, work of running water, stream channels, base level and graded streams, shaping stream valleys, depositional landforms, drainage patterns, floods and flood control. Groundwater: importance and distribution, water table, factors influencing storage and movement, springs, wells, artesian wells, environmental problems, hot springs and geysers, geothermal energy, geologic work. Glaciers and glaciation: formation and movement, erosion & landforms, deposits, other effects, causes. Deserts and wind: distribution and causes, geologic processes, basin and range, wind transport, erosion & deposits.

Unit 4

Shorelines: coastal zone, waves & erosion, sand movement, shoreline features & stabilization; erosion problems along U.S. coasts, hurricanes, coastal classification,

tides. Earthquakes and earth's interior: faults, seismology, locating the source of an earthquake, measuring intensity, belts and plate boundaries, destruction, damage east of the Rocky Mountains, earthquake prediction, earth's interior. Plate tectonics: continental drift, divergent boundaries, convergent boundaries, transform fault boundaries, testing the plate tectonics model, the breakup of Pangaea, measuring plate motion, what drives plate motions, plate tectonics in the future.

Unit 5

Origin and evolution of the ocean floor: continental margins, features of deep-ocean basins, anatomy of oceanic ridge, oceanic ridges and seafloor spreading, nature of oceanic crust, continental rifting, destruction of oceanic lithosphere. Crustal deformation and mountain building: structures formed by ductile & brittle deformation, mountain building at subduction zones, collisional mountain belts, fault-block mountains, vertical movements of the crust. Geologic time: time scales, relative dating, correlation of rock layers; dating with radioactivity, the geologic time scale, difficulties in dating. Earth's evolution: birth of a planet, origin of the atmosphere and oceans, Precambrian (formation of continents); Phanerozoic (formation of modern continents & earth's first life); Paleozoic (life explodes); the Mesozoic (dinosaurs); Cenozoic era (mammals). Global climate change: climate & geology, climate system, detecting change; atmospheric basics & heating the atmosphere; natural & human causes; carbon dioxide, trace gases, and climate change; climate-feedback mechanisms, aerosols, some possible consequences.

TEXTBOOK:

Frederick K. Lutgens, Edward J. Tarbuck & Dennis G. Tasa: Essentials of Geology (11th edition), Prentice Hall, 8 March, 2012.

REFERENCE:

Graham R. Thompson & Jonathan Turk: Introduction to Physical Geology (2nd Edition), Brooks Cole, 23 June, 1997.

15PHY540 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 neighbours.

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*

15PHY542 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. electroluminescence, 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).

15SAN101 SANSKRIT I 1 0 2 2

OBJECTIVES: To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Unit 1

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit

Unit 2

Verbs - Singular, Dual and plural – First person, Second person, Third person.

Tenses – Past, Present and Future – Atmanepadi and Parasmaipadi - karthariprayoga

Unit 3

Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4

Selected slokas from Valmiki Ramayana, Kalidasa's works and Bhagavad Gita.

Ramayana – chapter VIII - verse 5, Mahabharata - chapter 174, verse-16, Bhagavad Gita – chapter - IV verse 8, Kalidasa's Sakuntalam Act IV – verse 4

Unit 5

Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. Praveshaha; Publisher: Samskrita bharti, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore - 560 085
2. Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally

4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagarpress

15SAN111 SANSKRIT II 1 0 2 2

OBJECTIVES: To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Unit 1

Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2

Ktavatu Pratyaya, Upasargas, Ktvanta, Tumunnanta, Lyabanta.

Three Lakaras – brief introduction, Lot lakara.

Unit 3

Words and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashithas, riddles.

Unit 4

Introduction to classical literature, classification of Kavyas, classification of Dramas - The five Mahakavyas, selected slokas from devotional kavyas- Bhagavad Gita – chapter -II verse 47, chapter - IV verse 7, chapter - VI verse 5, chapter - VIII verse 6, chapter -XVI verse 21, Kalidasa's Sakuntala act IV –verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14- 120, Neetisara chapter - III

Unit 5

Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. Praveshaha; Publisher: Samskrita bharti, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2. Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally
4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar Press.

15SSK221 SOFT SKILLS I 1 0 2 2

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 punctuation: 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; Cryptogrihms.

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.

15SSK321 SOFT SKILLS II 1 0 2 2

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.
 Spatial 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 competitive 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.thegrammarbook.com - online teaching resources
www.englishpage.com - online teaching resources and other useful websites.

15SSK331 SOFT SKILLS III 1 0 2 2

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

15SWK230 CORPORATE SOCIAL RESPONSIBILITY 2 0 0 2

Unit 1

Understanding CSR - Evolution, importance, relevance and justification. CSR in the Indian context, corporate strategy. CSR and Indian corporate. Structure of CSR - In the Companies Act 2013 (Section 135); Rules under Section 13; CSR activities, CSR committees, CSR policy, CSR expenditure CSR reporting.

Unit 2

CSR Practices & Policies - CSR practices in domestic and international area; Role and contributions of voluntary organizations to CSR initiatives. Policies; Preparation of CSR policy and process of policy formulation; Government expectations, roles and responsibilities. Role of implementation agency in Section 135 of the Companies Act, 2013. Effective CSR implementation.

Unit 3

Project Management in CSR initiatives - Project and programme; Monitoring and evaluation of CSR Interventions. Reporting - CSR Documentation and report writing. Reporting framework, format and procedure.

REFERENCES:

1. Corporate Governance, Ethics and Social Responsibility, V Bala Chandran and V Chandrasekaran, PHI learning Private Limited, New Delhi 2011.
2. White H. (2005) Challenges in evaluating development effectiveness: Working paper 242, Institute of Development Studies, Brighton.
3. UNDP (nd) Governance indicators: A users guide. Oslo: UNDP
4. Rao, Subbha (1996) Essentials of Human Resource Management and Industrial Relations, Mumbai, Himalaya
5. Rao, V. S. L. (2009) Human Resource Management, New Delhi, Excel Books,

15SWK231 WORKPLACE MENTAL HEALTH 2 0 0 2

Unit 1

Mental Health – concepts, definition, Bio-psycho-social model of mental health. Mental health and mental illness, characteristics of a mentally healthy individual, Signs and symptoms of mental health issues, presentation of a mentally ill person. Work place – definition, concept, prevalence of mental health issues in the work place, why invest in workplace mental health, relationship between mental health and productivity, organizational culture and mental health. Case Study, Activity.

Unit 2

Mental Health Issues in the Workplace: Emotions, Common emotions at the workplace, Mental Health issues - Anger, Anxiety, Stress & Burnout, Depression, Addictions – Substance and Behavioural, Psychotic Disorders - Schizophrenia, Bipolar Disorder, Personality disorders. Crisis Situations - Suicidal behavior, panic attacks, reactions to traumatic events. Stigma and exclusion of affected employees. Other issues –work-life balance, Presenteeism, Harassment, Bullying, Mobbing. Mental Health First Aid - Meaning. Case Study, Activity.

Unit 3

Strategies of Help and Care: Positive impact of work on health, Characteristics of mentally healthy workplace, Employee and employer obligations, Promoting mental health and well being- corporate social responsibility (CSR), an inclusive work environment, Training and awareness raising, managing performance, inclusive recruitment, Supporting individuals-talking about mental health, making reasonable adjustments, Resources and support for employees - Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations. Case Study, Activity.

REFERENCES:

1. American Psychiatric Association. "Diagnostic and statistical manual of mental disorders: DSM - IV 4th ed." www.terapiacognitiva.eu/dwl/dsm5/DSM-IV.pdf
2. American Psychiatric Association. (2000) www.ccsa.ca/Eng/KnowledgeCentre/OurDatabases/Glossary/Pages/index.aspx.
3. Canadian Mental Health Association, Ontario "Workplace mental health promotion, A how to guide" www.cmhaontario.ca/wmhp
4. Alberta Health Services Mental Health Promotion. (2012). Minding the Workplace: Tips for employees and managers together. Calgary: Alberta Health Services. <http://www.mentalhealthpromotion.net/resources/minding-the-workplace-tips-for-employees-and-managers-together.pdf>
5. Government of Western Australia, Mental Health Commission. (2014) "Supporting good mental health in the work place." http://www.mentalhealth.wa.gov.au/Libraries/pdf_docs/supporting_good_mental_health_in_the_workplace_1.sflb.ashx
6. Mental Health Act 1987 (India) www.tnhealth.org/mha.htm
7. Persons with disabilities Act 1995 (India) socialjustice.nic.in
8. The Factories Act 1948 (India) www.caaa.in/Image/19ulabourlawshb.pdf

15TAM101 TAMIL I 2 0 0 2

Objectives : To introduce the students to different literature - Sangam literature, Epics, Bhakthi literature and modern literature. To improve their ability to communicate with creative concepts, and also to introduce them to the usefulness of basic grammatical components in Tamil.

Unit 1

Sangam literature : Kuruntokai; (2, 6,8,40 pāṭalkaḷ) – puṛaṇāṇūru (74,112,184,192 pāṭalkaḷ) – tirukkuraḷ (iṛaimāṭci, amaiccu)

Unit 2

Epic literature: cilappatikāram maturaik kāṇṭam (vaḷakkuraikkātai 50-55)

Spiritual Literature: tiruppāvai(3,4) – tēvāram (mācilvīṇaiyum)

Medieval Literature: bāratīyar kaṇṇaṇ pāṭṭu (eṇ viḷaiyāṭṭu piḷḷai) – bāratitacaṇ kuṭumpaviḷakku (tāyiṇ tālāṭṭu).

Unit 3

Novel: Jeyakāntaṇ “kuru pīṭam”

Essay: Aṇṇā “ē tāḷnta tamīlakamē”

Unit 4

Tiruṇāṇa campantar – tirunāvukkaracar – cuntarar – māṇikka vācakar – āṇṭāḷ – tirumūlar – kulacēkara āḷvār – cīttalaic cāttanār toṭarpāṇa ceytikal, mērkōḷkaḷ marṛum ciṇṇappu peyarkaḷ

Unit 5

Tamil Grammar: Col vakaikaḷ - vēṛṛumai urupukaḷ - valliṇam mikumiṭam

mikāyiṭam - canti(puṇarcci) - ilakkaṇakkuṇṇippu.

Practical skills: Listening, speaking, writing and reading

Textbooks:

- Aṇṇā “ē tāḷnta tamīlakamē” nakkīraṇ papḷikēṣaṇs.
- Caktitācaṇ cupramaṇiyaṇ “nalla kuṭuntokai mūlamumuraiyum” mullai patippakam, 2008.
- <http://www.Tamilvu.Org/libirary/libindex.Htm>.
- jeyakāntaṇ “kuru pīṭam” mīṇṭēci puttaka nilaiyam, 1971.
- Nā.Pārttacārati “puṇāṇṇūṇṇuc ciṇṇukataikaḷ” tamīḷ puttakālayam, 1978, 2001
- Poṇ maṇimāṇṇaṇ “aṭṭōṇ tamīḷ ilakkaṇam “aṭṭōṇ papḷiṣṭiṇ kurūp, vaṇciyūr, tiruvaṇṇantapuram, 2007.
- puliyūr kēcikaṇ “kuṭuntokai mūlamum uraiyum” cārāta patippakam, 2010.
- Puliyūr kēcikaṇ “puṇāṇṇūṇṇu” srīcēṇpakā patippakam, 2010

15TAM111

TAMIL I I

2 0 0 2

Objectives: To learn the history of Tamil literature. To analyze different styles, language training, to strengthen the creativity in communication, Tamil basic grammar, Computer and its use in Tamil language.

Unit 1

The history of Tamil literature: Nāṭṭupuraṇ pāṭalkaḷ, kataikkaḷ, paḷamolikaḷ - ciṇṇukataikaḷ tōṛramum vaḷarecciyum,

ciṇṇilakkiyaṇkaḷ: Kaliṇkattup paraṇi (pōrpāṭiyatu) - mukkūṭar paḷḷu 35.

Kāppiyaṇkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu marṛum aimperum – aiṇciṇṇuṇ kāppiyaṇkaḷ toṭarpāṇa ceytikal.

Unit 2

tiṇai ilakkiyamum nītiyilakkiyamum - patiṇēṇkīḷkkaṇakku nūlkaḷ toṭarpāṇa pira ceytikal - tirukkuṇṇaḷ (aṇṇu, paṇṇu, kalvi, oḷukkam, naṭṇu, vāymai, kēḷvi, ceynaṇṇi, periyaraittuṇṇakōṭal, viḷippuṇṇarvu pēṇṇa atikarattil uḷḷa ceytikal.

Aṇṇūlkaḷ: Ulaṇāṇi (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṇṇantak kaḷippu –1,4,6,7,8), marṛum akappēy cittar pāṭalkaḷ(1-5).

Unit 3

tamīḷ ilakkaṇam: Vākkiya vakaikaḷ – taṇviṇṇai piṇṇaviṇṇai – nērkūrṇu ayarḷkūrṇu

Unit 4

tamīḷaka aṇṇiṇṇarkaḷiṇṇ tamīḷ toṇṇṭum camutāya toṇṇṭum: Pāratīyār, pāratitācaṇ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṇṇpi, mēṭtā, aptul rakumāṇ, na.Piccamūrtti, akilaṇ, kalki, jī.Yū.Pōp, vīramāmuṇivar, aṇṇā, paritimāṇ kalaiṇar, maṇaimalaiyaṭikaḷ.

Unit 5

tamīḷ mōḷi āyvil kaṇṇiṇṇi payaṇṇpāṭu. - Karuttu parimāṇṇam - viḷampara mōḷiyamaippu – pēccu - nāṭakam paṭaiippu - ciṇṇukatai, katai, putiṇṇam paṭaiippu.

Textbooks:

- <http://www.tamilvu.org/library/libindex.htm>.
- http://www.tunathamizh.com/2013/07/blogpost_24.html
- Mu.Varatarācaṅṅam “tamiḷ ilakkiya varalāru” cāhitya akāṭemi paḷḷikāṣaṅṅam, 2012
- nā.Vāṅamāmalai “paḷḷaṅkataikaḷum, paḷḷamolikaḷum” niyū ceṅcuri puttaka veḷiyiṅṅakam, 1980,2008
- nā.Vāṅamāmalai, “tamiḷar nāṅṅappāṅṅalkal” niyū ceṅcuri puttaka veḷiyiṅṅakam 1964,2006
- poṅ maṅimāṅṅam “aṅṅam tamiḷ ilakkaṅṅam” aṅṅam paḷḷiṅṅiṅṅam kurūp, vaṅṅeyūr, tīruvaṅṅantapuram, 2007.