

<b>15AVP201 /</b>	<b>AMRITA VALUES PROGRAMME I/</b>	<b>1 0 0 1</b>
<b>15AVP211</b>	<b>AMRITA VALUES PROGRAMME II</b>	<b>1 0 0 1</b>

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 H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub> 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 (permanganometry) 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 &amp; 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:**

- Jonathan Black, "Biological Performance of Materials: Fundamentals of Biocompatibility", 4th edition, CRC Press, (2006).
- 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:**

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

**REFERENCES:**

- James E House, "Principles of Chemical Kinetics", Academic Press, (2007).
- 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), NH<sub>4</sub>NO<sub>3</sub>, ammonium perchlorate (AP), NH<sub>4</sub>ClO<sub>4</sub>, ammonium dinitramide (AND), NH<sub>4</sub>N(NO<sub>2</sub>)<sub>2</sub>, hydrazinium nitroformate (HNF), N<sub>2</sub>H<sub>5</sub>C(NO<sub>2</sub>)<sub>3</sub> etc.

**TEXTBOOKS:**

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

**REFERENCES:**

- Mark Ratner and Daniel Ratner, 'Nano technology - A gently introduction to the next big idea', Pearson Education, (2003).
- 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 (Grothues-Draper law - Stark-Einstein's law) - Quantum efficiency - photochemical decomposition of HI and HBr - and Quantum yield.

**Unit 3**

Florescence and Phosphorescence - chemiluminescence - photo sensitization.

Chemistry of Toxic Materials and Toxicology: Principles of Toxicology - Volatile poisons - Gases CO, hydrocyanic acid - H<sub>2</sub>S - PH<sub>3</sub> - CO<sub>2</sub> - SO<sub>x</sub> - NO<sub>x</sub> - 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 C<sub>60</sub> - superconductivity in C<sub>60</sub>, applications of fullerenes. Carbon nanotubes: Classification, properties, synthesis, characterization, and potential applications, growth mechanism of carbon nanotubes.

Other Nanostructures: Quantum Dots: Preparation, properties and applications of Au, CdS and CdSe quantum dots,

**Unit 3**

Fabrication and applications of conducting polymer nanotubes, TiO<sub>2</sub> 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 Lyshovski 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 Phillips, "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 AND PROCESSES 3 0 0 3**
**Unit 1**

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

**Unit 2**

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

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

**Unit 3**

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

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

**TEXTBOOKS:**

1. Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, (1993).
2. Dell, Ronald M Rand, David 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.*

**REFERENCE:**

1. Fuels - Solids, liquids and gases - Their analysis and valuation, H. Joshua Philips, Bioblolife 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 CO<sub>2</sub>, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO<sub>2</sub> 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).

- Burger A, "Medicinal Chemistry", 3rd edition, Wiley Interscience, Newyork, (1970).
- 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:**

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

**REFERENCES**

- F. C. Campbell (Ed), Manufacturing processes for advanced composites, Elsevier, 2004.
- 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 sp<sup>2</sup> 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 - benzoic 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 benzynes - 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 - Hoffmann 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. ManasChanda 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:**

Kiichi 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:**

1. Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).
2. Curtis, 'Electroforming', London, (2004).
3. F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).
4. 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 Reviees R W, "Corrosion and its Control", Wiley, (1985).

**REFERENCES:**

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

**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.

**15CSE301 COMPUTER ORGANIZATION AND ARCHITECTURE 3 0 0 3****Unit 1**

Introduction and Performance of Computing system, Processor Architecture with example as MIPS & Instruction Set, Single Cycle Datapath Design, Control Hardware, Computer Arithmetic, Floating Point Arithmetic, Role of performance.

**Unit 2**

Introduction to multicycle datapath, Pipelining Technique – Design Issues, Hazards: Structural Hazards, Data Hazards and Control Hazards, Static Branch Prediction, Dynamic Branch Prediction, Advanced Concepts in pipelining.

**Unit 3**

Memory Organization - Introduction, Cache Memory Organization, Main Memory & Interleaving, I/O Organization, Modern Processors, Parallel Processing.

**TEXTBOOKS:**

1. Patterson, David A and J L Hennessy, "Computer Organisation & Design, The Hardware/ Software Interface (ARM Edition)", Morgan Kaufmann, Fifth Edition, Newness, 2013.
2. Hennessy and Patterson, "Computer Architecture: A Quantitative Approach", Elsevier, Fifth Edition, 2011.
3. W Stallings, "Computer Organisation & Architecture: Designing for Performance", Pearson, Eighth Edition, 2010
4. V. Carl Hamacher, Zvonko G. Varanescic and Safat G. Zaky, "Computer Organisation", Fifth Edition, McGraw Hill Education (India), 2011.

**15CSE330 INFORMATION TECHNOLOGY ESSENTIALS 3 0 0 3****Unit 1**

Computer hardware and system software concepts: Computer Architecture, system software, Operating Systems, Computer Networking. Programming fundamentals; problem solving concepts, modular approach through use of functions, error handling techniques, structured Programming and data structures, structured statements, string handling functions, sorting and searching, file handling functions, Object oriented concepts; Managing software complexity, concepts of object oriented programming, abstraction, class, object, member data, member methods, encapsulation, data hiding, inheritance, polymorphism, binding.

**Unit 2**

Analysis of algorithms; principles and tools for analysis of algorithms, analysis of popular algorithms, code tuning techniques, intractable problems, Relational Database management; basic RDBMS concepts, database design, SQL comments, embedded SQL concepts, OLTP concepts.

**Unit 3**

System development methodology; software engineering development life cycle (SDLC), quality concepts and quality system procedures, analysis and design methods, structured programming concepts and principles of coding, software testing. User interface design: process of user interface design, elements of user interface design, speech user interface, web design issues. Introduction of web architecture: basic architecture of web application, security, and performance of web based applications, architecture documents.

**REFERENCES:**

1. Andrew. S. Tanenbanum, "Structured Computer Organization", Fourth Edition, PHI, 1999.
2. Abraham Silberschatz, Henry F Korth, S. Sudharshan, "Database System Concepts", Fourth Edition, Tata McGraw, 1997.
3. Roger S Pressman, "Software Engineering – A practitioner's approach", Sixth Edition, McGraw Hill Publishers, 2004.

### 15CSE374      INTRODUCTION TO DATA STRUCTURES      3 0 0 3 AND ALGORITHMS

**Unit 1**

Introduction: Overview of Data Structures – A Philosophy of Data Structures - The Need for Data Structures – Cost and Benefits - Abstract Data Types and Data Structures - Principles, and Patterns. Basic complexity analysis – Best, Worst, and Average Cases - Asymptotic Analysis - Analyzing Programs – Space Bounds, Arrays, Linked Lists and Recursion: Using Arrays - Lists - Array based List Implementation – Linked Lists – LL ADT – Singly Linked List – Doubly Linked List – Circular Linked List - recursion - linear, binary, and multiple recursions.

**Unit 2**

Stacks and Queues: Stack ADT - Array based Stacks, Linked Stacks – Implementing Recursion using Stacks, Queues - ADT, Array based Queue, Linked Queue, Double-ended queue, Circular queue. Trees: Tree Definition and Properties – Tree ADT - Basic tree traversals - Binary tree - Data structure for representing trees – Linked Structure for Binary Tree – Array based implementation. Priority queues: ADT – Implementing Priority Queue using List – Heaps. Maps and Dictionaries: Map ADT – List based Implementation – Hash Tables - Dictionary ADT - Skip List – Complexity.

**Unit 3**

Search trees – Binary search tree, AVL tree, Trees – K-D Trees - B-Trees. Sorting and Selection – Linear Sorting – Heap Sort - Divide and Conquer Strategy – Analysis using Recurrence Tree based Method - Merge Sort - Quick Sort - Studying Sorting through an Algorithmic Lens – Selection.

**TEXTBOOKS:**

1. Goodrich M T and Tamassia R, "Data Structures and Algorithms in Java", Fifth edition, Wiley publication, 2010.
2. Clifford A. Shaffer, "Data Structures and Algorithm Analysis", Third Edition, Dover Publications, 2012.

**REFERENCES:**

1. Goodrich M T, Tamassia R and Michael H. Goldwasser, "Data Structures and Algorithms in Python++", Wiley publication, 2013.
2. Tremblay J P and Sorenson P G, "An Introduction to Data Structures with Applications", Second Edition, Tata McGraw-Hill, 2002.

### 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 - 2 0 0 2  
 AN INDIAN PERSPECTIVE**

**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. (Vols.1 to 3)*
5. *Message of Upanishads, by Swami Ranganathananda 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 Ramakrishnananda 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 Nagaratna published by Swami Vivekananda Yoga Prakashana, Bangalore.*
17. *Mind Sound Resonance Technique (MSRT) Published by Swami Vivekananda Yoga Prakashana, Bangalore.*
18. *Yoga & Memory - Dr H R Nagendra & Dr. Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.*

**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;

**Unit 2**

6. Astronomy & mathematics in Jain and Buddhist literature;
7. The transition to the Siddhantic period; Aryabhata and his time;
8. The Aryabhatiya: concepts, content, commentaries;

9. Brahmagupta and his advances;
10. Other great Siddhantic savants;
11. Bhaskara II and his advances;

**Unit 3**

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

**TEXTBOOK:**

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

**REFERENCE:**

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

**15CUL233 YOGA PSYCHOLOGY 2 0 0 2**

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

**Unit 1**

Introduction

Introduction to Modern Psychology

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

Introduction to Indian Psychology

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

Patanjali Yoga Sutra – 1

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

Patanjali Yoga Sutra – 2

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

**Unit 2**

Patanjali Yoga Sutra – 3

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

Patanjali Yoga Sutra – 4

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

Patanjali Yoga Sutra – 5

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

Patanjali Yoga Sutra – 6

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

Patanjali Yoga Sutra – 7

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

**Unit 3**

Patanjali Yoga Sutra – 8

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

Patanjali Yoga Sutra – 9

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

Patanjali Yoga Sutra – 10

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

Report review

Conclusion

**REFERENCES:**

- The course book will be “The four chapters of Freedom” written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.

- “The message of Upanishads” written by Swami Ranganathananda. Published by Bharathiya Vidya Bhavan.
- Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttaranjal.
- ‘Hatha Yoga Pradipika’ Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India

**15ECE315**

**BIOMEDICAL INSTRUMENTATION**

**3 0 0 3**

**Unit 1**

Cell resting potential and action potentials - Origin of bio potentials - characteristics – Frequency and amplitude ranges - ECG – Einthoven’s triangle – 3 lead ECG system - EEG – 10- 20 electrode system - Origin and characteristics of EMG – EOG - ERG electrodes and transducers. Electrode-electrolyte interface – Electrode – skin interface - Half cell potential – Impedance - Polarization effects of electrode – Nonpolarizable electrodes. Types of electrodes - Surface; needle and micro electrodes – ECG – EMG - EEG Electrodes.

**Unit 2**

Diagnostic and Therapeutic Equipments: Blood pressure monitors – Electrocardioscope - Pulse Oximeter - pH meter - Auto analyzer – Pacemakers – Defibrillator - Heart lung machine - Nerve and muscle stimulators - Dialysis machines - Surgical diathermy equipments – Nebulizer; inhalator - Aspirator – Humidifier - Ventilator and spirometry.

**Unit 3**

Medical imaging techniques: Basics of diagnostic radiology – Production - Nature and properties of X rays - X-ray machine - Block diagram - Digital radiography – CT - Basic Principle - Block diagram – Radioisotopes in medical diagnosis – Physics of radioactivity – Gamma Camera. Block diagram – SPECT Scanner – PET Scanner - Principles of NMR Imaging systems - Block diagram of NMR Imaging System – Ultrasonic Imaging Systems – Physics of Ultrasound waves – Doppler effect – Medical Ultrasound Electrical safety: Physiological effects of electricity. Micro & macro shock hazards – Electrical Safety codes and standards – Protection of patients.

**TEXTBOOK:**

R S Khandpur, “Handbook of Biomedical Instrumentation”, 1st ed., Tata McGraw Hill Publishing Company Limited, 2004.

**REFERENCES:**

- John G Webster, “Medical Instrumentation - Application and Design”, 4th ed., John Wiley and Sons, 2007.
- Leslie Cromwell, Fred. J. Weibell, Erich. A. Pfeiffer, “Biomedical Instrumentation & Measurements, 2nd ed., Pearson Education., 2001.

**15ECE373 VLSI SYSTEM DESIGN 3 0 0 3****Unit 1**

Introduction to verilog HDL: ASIC / FPGA design flow – Advantages of HDL – Overview of digital design with verilog HDL. Hierarchical modeling: Basic concepts – Modules and ports. Overview of different levels of abstractions: Gate level modeling – Dataflow modeling – Behavioral modeling – Switch level modeling.

**Unit 2**

Logic synthesis with verilog HDL: Impact of logic synthesis – Interpretation of a few verilog constructs – Synthesis design flow – Concepts of verification. Introduction to FPGA fabrics: FPGA architectures – SRAM-based FPGAs – Permanently programmed FPGAs – Circuit design of FPGA fabrics – Architecture of FPGA fabrics – Logic implementation of FPGAs – Physical design for FPGAs.

**Unit 3**

Architecture and large scale Systems: Behavioral design – Design methodologies – Buses – Platform FPGAs – Multi FPGA systems – Novel architecture – FPGA design cycle using Xilinx ISE webpack.

**TEXTBOOKS:**

- Wayne Wolf, "FPGA-Based System Design", First Edition, Prentice Hall India Private Limited, 2004.
- Samir Palnitkar, "Verilog HDL", First Edition, Prentice Hall India Private Limited, 2003.

**REFERENCES:**

- Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", First Edition, Tata McGraw Hill Publishing Company Limited, 2002.
- Stephen M. Trimberger, "Field-Programmable Gate Array Technology", Springer, 1994.
- Clive Maxfield, "The Design Warrior's Guide to FPGAs", Elsevier, 2000.

**15EEE111 FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING 4 0 0 4****Unit 1**

Introduction to Electrical Power System; Ideal Independent Current and Voltage Sources, Reference Directions and Symbols; Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Energy and Power - Series parallel combination of R, L and C Components, DC Series-Parallel Circuits - Voltage Divider and Current Divider Rules - Superposition Theorem, Network Analysis - Mesh and Node methods - Generation of sinusoidal voltage; Instantaneous, Average and effective values of periodic functions; Phasor representation.

**Unit 2**

Reactance and Impedance; Response in RLC circuits to sinusoidal voltage; Real and Reactive Power, Power factor; Complex Power and Power Triangle - Introduction to Three Phase Systems; Balanced 3-Phase STAR and DELTA connections of Load, Three phase power - Measuring Instruments for AC and DC quantities; Instruments to measure Voltage, Current, Power and Energy - Electromagnetic Induction; Magnetic Circuit Elements; Self and Mutual Inductances - Classification and Applications of Electrical Machines; Torque, Output Power and Efficiency. 3-Phase Induction Motor - Principle of operation, Slip, Torque-speed relation; Single Phase and Three Phase Transformers - Principle of Operation, turns ratio and Connections.

**Unit 3**

PN junction diode characteristics: unbiased diodes, forward and reverse bias – breakdown – barrier potential – diode approximation - Rectifiers: half wave and full wave - Zener diode – design of regulators and Characteristics - Introduction to BJT: characteristics curves and region of operation; Biasing: Load line – fixed and voltage divider bias - JFET characteristics – 555 Timer – transconductance - Introduction to Operational amplifier: inverting and non-inverting amplifier.

**TEXTBOOK:**

- Edward Hughes, 'Electrical Technology' Seventh edition, Pearson Education Asia, 2011
- A. P. Malvino, Electronic Principles, 7th Edition, Tata McGraw Hill, 2007

**REFERENCES:**

- S K Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson, 2012
- Vincent Del Toro, 'Electrical Engineering Fundamentals', Second Edition, Prentice Hall of India Private Limited, 2003
- David A Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford University Press 2008
- Michael Tooley B A, "Electronic Circuits: Fundamentals and Applications", Third Edition, Elsevier Ltd, 2006

**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

**15EEE201****ANALOG ELECTRONIC CIRCUITS****3 1 0 4****Unit 1**

BJT: Current – Voltage characteristics, BJT as an amplifier and as a switch, brief idea of dc analysis, Biasing circuits, small signal operation and models, single stage BJT amplifiers, BJT internal capacitances and high frequency model - Frequency response of CE amplifier. Emitter follower, Darlington-pair. Applications of Diodes: Design of Clipper, clamper circuits and Voltage doubler.

**Unit 2**

MOS Field Effect Transistors: Introduction, device structures and physical operations, i-v characteristics, brief analysis as an amplifier, and as a switch, Biasing, small signal operation and models, single stage MOS Amplifiers, MOSFET capacitances, frequency response of CS amplifiers.

Differential Amplifiers: MOS differential Pair, Small signal operation, frequency response of differential amplifier, Introduction to differential amplifier with active load.

**Unit 3**

Power amplifier: Analysis and Comparison of power amplifiers in Class A, B, AB, D.

Voltage References and Regulators: Design of linear power supplies, Characteristics of voltage regulators, Analysis of series voltage regulator, Integrated circuit voltage regulators.

Feedback amplifiers, Oscillators - RC, LC and Crystal, Multivibrators - Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using transistors.

**TEXTBOOKS:**

1. Adel S. Sedra, Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press, Fifth Edition, 2005.
2. Thomas L. Floyd, David M. Buchla, Electronics Fundamentals: Circuits, Devices & Applications, 8th Edition, Pearson education, 2014

**REFERENCES:**

1. Donald E. Neaman, "Electronic Circuit, Analysis and Design", Tata McGraw Hill Publishing Company Limited, Second Edition, 2006.
2. David A. Bell, "Electronic devices and Circuits", 5th Edition, Oxford University Press India, 2008.

**15EEE202****ELECTRIC CIRCUITS****3 1 0 4****Unit 1**

Practice of Mesh Current and Node Voltage analysis of circuits with independent and dependent sources.

Network Reduction: Source transformation; Star-Delta transformation.

Network Theorems: Thevenin and Norton's theorems; Superposition theorem, maximum power transfer theorem, Tellegan's theorem, Reciprocity theorem.

Introduction to Graph Theory – Definitions; Incidence matrix, Fundamental tie-set matrix, Fundamental cutest matrix, Formulation of network equations using KCL and KVL.

**Unit 2**

Transient Analysis: Time domain analysis of first and second order circuits - with DC Excitation - Frequency response of Series and Parallel circuits - Resonance - Q-factor and Bandwidth;

Steady State Analysis of single phase AC circuits: Phasor representation and analysis of circuits applying network theorems; Power factor – power factor correction.

Self and mutual inductance - coupled circuits – dot convention; Laplace representation of circuits; solutions using Laplace transforms.

**Unit 3**

Three phase Circuits: Three phase systems – balanced and unbalanced - Three phase 3-wire and 4-wire circuits – Star and Delta connected source and loads; Phasor Diagram analysis; Complex power.

Two-Port Networks: z, y, ABCD, abcd, hybrid and inverse hybrid parameters and relationships among different network parameters.

**TEXTBOOK:**

Alexander C K and Sadiku M N O, "Fundamentals of electric circuits", 5th ed. New York, McGraw Hill, 2013.

**REFERENCES:**

1. Nahvi M and Edminister J, Schaum's Outline of Electric Circuits, 5th ed. New York, McGraw Hill, 2011.
2. Hayt W, Kemmerly J, and Durbin S, Engineering circuit analysis, 7th ed. Boston, McGraw Hill Higher Education, 2007.
3. Van Valkenburg M E, Network Analysis, 3rd ed. New Delhi, Prentice Hall-India, 2011.

**15EEE203 ELECTROMAGNETIC THEORY 3 1 0 4**

**Unit 1**

Vectors and co-ordinate systems: Cartesian, cylindrical and spherical co-ordinate systems- scalar and vector fields.

Electric and Magnetic fields: line, surface and volume integrals - Coulomb's law - Gauss's law - Biot-Savart's law - Ampere's circuital law – applications - boundary conditions for electric and magnetic fields - Lorentz force equation.

**Unit 2**

Maxwell's equations: gradient, curl and divergence - Maxwell's equation in integral form - Law of conservation of charge - Maxwell's equation in differential form - continuity equation - boundary condition for electromagnetic fields.

Electric potential - Poisson's and Laplace's equations – capacitance - energy stored - magnetic scalar and vector potentials - magnetic circuits – inductance - energy stored-conductance.

**Unit 3**

Uniform plane waves and sinusoidally varying waves in time domain and in free space – polarization - power flow and Poynting vector - wave parameters - plane

waves in material media - skin effect - reflection and transmission of uniform plane waves - normal and oblique incidence in conductor and dielectric interfaces.

**TEXTBOOK:**

N. Narayana Rao, "Elements of Engineering Electromagnetics", Sixth Edition, Pearson Education, 2006.

**REFERENCE:**

1. David K. Cheng, "Field and Wave Electromagnetics", Second Edition, Pearson Education, 2002.
2. William H. Hayt, John A. Buck, "Engineering Electromagnetics", Seventh Edition, Tata McGraw Hill Publishing Company Limited, 2007.
3. Sadiku, "Elements of Electromagnetics", Second Edition, Oxford University Press, 2014.

**15EEE211 ANALOG INTEGRATED CIRCUITS 3 0 0 3**

**Unit 1**

Operational amplifiers: Equivalent circuit, voltage transfer curve - Open loop Op-amp configurations – Voltage series, Voltage shunt feedback amplifiers configurations, closed loop differential amplifiers for single and differential outputs.

Output Offset voltage, offset null pins. Minimizing output offset voltage due to input bias current and input offset current, Factors affecting offset parameters. CMRR - Open loop and closed loop frequency response of op-amps, Circuit stability, Slew rate and its effects in applications.

**Unit 2**

Applications of Op Amp: DC & AC amplifiers - Summing, Scaling and Averaging amplifiers - Instrumentation Amplifier - voltage to current converter for floating and grounded loads - Current to voltage converter - Integrator, Differentiator. Voltage comparators – ZCD-Schmitt trigger with voltage limiter - Precision rectifier circuits - Peak detector - Sample and Hold circuit.

Active Filters: Frequency response characteristics of major active filters, first and higher order low pass and high pass filters, all pass filters.

**Unit 3**

Oscillators and waveform generators: Requirements for oscillations, Op-amp RC oscillators, square wave generators, triangle and saw tooth waveform generators, astable and monostable operations, Voltage controlled oscillators - IC 555 timer, astable and monostable operation.

Circuit board layout techniques: General considerations – PCB mechanical construction – Grounding – Decoupling – Input, output isolation.

**TEXTBOOKS:**

1. Ramakant A. Gayakwad, "Op-Amps and Linear integrated circuits", Prentice Hall of India, 4th Edition, 2000.
2. Donald E. Neaman, "Electronic Circuit, Analysis and Design", Tata McGraw Hill Publishing Company Limited, Second Edition, 2002.

**REFERENCES:**

1. Adel S. Sedra, Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press, Fifth Edition, 2004.
2. Sergio Franco, "Design with operational amplifiers and Analog Integrated circuits", Tata McGraw Hill 3rd Edition 2002.
3. Ron Manchini, "Op-Amps for Everyone", Design Reference-Texas Instruments, August 2002, Available from: <http://www.ti.com/lit/an/slod006b/slod006b.pdf>

**15EEE212 ELECTRICAL MACHINES I 3 1 0 4**

**Unit 1**

Basics of electric and magnetic circuits, Principles of electromechanical energy conversion, Basic concepts of rotating machines, Dynamic Equation of Electromechanical Systems.

**Unit 2**

DC Machines: EMF and Torque, Circuit Model, Armature Reaction, Compensating Winding, Commutation, Methods of Excitation, Magnetization Characteristic, Self-excitation, Types – shunt, series, compound generators and Characteristics of DC Generators, Types and Characteristics of DC Motors, Starting of DC Motors, Speed Control of DC Motors, Braking of DC Motors, Efficiency and Testing, Permanent Magnet DC Machine Applications.

**Unit 3**

Transformer: Construction and Practical Considerations, Transformer on No-Load, Ideal Transformer, Real Transformer and Equivalent Circuit, Transformer Losses, Transformer Testing, Efficiency and Voltage Regulation, Excitation Phenomenon in Transformers, Autotransformers, Three-phase Transformers, star-star, star-delta, zig-zag connection. Methods of cooling, Parallel Operation of Transformers, Three-winding Transformers.

**TEXTBOOK:**

Kothari D. P. and Nagrath I. J., "Electric Machines", Tata McGraw Hill Publishing Company Limited, New Delhi 2004.

**REFERENCES:**

1. M. G. Say, "Performance and Design of Direct Current Machines", CBS publishers, New Delhi, 1993.

2. Fitzgerald A. E., Charles Kingsley, Jr. and Stephen D. Umans, "Electric Machinery", Tata McGraw Hill Publishing Company Limited, 2002
3. Albert E. Clayton, "The performance and design of direct current machines", Tata McGraw Hill Publishing Company Limited, New Delhi, Third Edition, 1992.
4. S. K. Bhattacharya, "Electrical Machines", Tata McGraw-Hill Publishing Company Limited, New Delhi

**15EEE213 ELECTRICAL MEASUREMENTS 3 0 0 3**

**Unit 1**

Qualities of measurements: Introduction, performance characteristics, errors in measurements, types of static error, sources of error, dynamic characteristics, statistical analysis, standards.

DC and AC bridges: Wheatstone bridge, Kelvin's Bridge, inductance and capacitance measurements-Maxwell's bridge, De-sauty's bridge, Schering bridge, Wein bridge and Anderson bridge.

Analog meters: Basic meter movement, taut band, Electrodynamometer type (EDM), Moving Iron Instruments. Measurement of current – ammeter, multirange ammeter, Aryton shunt, extension of ammeter ranges. Measurement of voltage – basic meter as voltmeter, multirange voltmeter, extension of voltmeter range, loading effect, AC voltmeter using half wave and full wave rectifier, average, peak and true RMS voltmeters.

**Unit 2**

Instrument Transformers: Current Transformer, ratio and phase angle error, potential transformer.

Measurement of Power and Energy: EDM type wattmeter and Power factor meters, energy meter, calibration of meters.

Oscilloscope: Basic principle, CRT features, block diagram of oscilloscope, sampling, storage oscilloscopes, Digital storage oscilloscope, applications of CRO.

Transducers: Electrical transducers, selecting a transducers, resistive transducers, strain gauge, thermistor, RTD, inductive transducers, LVDT, capacitive transducer, piezo electric, photo voltaic cell, photo diode, photo transistors.

**Unit 3**

Digital Voltmeters: Ramp and dual slope integrating type DVM, Successive approximation type analog to digital conversion techniques, resolution and sensitivity

of digital meters, digital frequency, time and phase measurements. Smart energy meter and net metering.

Instrumentation Systems: Block diagram, Signal conditioning systems, Instrumentation amplifier.

Data Acquisition and Data transmission: Objectives of DAS, single/multichannel DAS, digital to analog converters, data loggers, RTU, data transmission systems, advantages of digital transmission, time division multiplexing.

**TEXTBOOK:**

1. E. W. Golding and F. C. Widdis, "Electrical measurements and measuring instruments", The English Language Book society, 1969
2. H. S. Kalsi, "Electronic Instrumentation", Tata McGraw-Hill Publishing Company Limited, 1995.

**REFERENCE:**

1. A. K. Sawhney, "A Course in Electrical & Electronics Measurements and Instrumentation", Dhanpat Rai and Sons, 1984
2. Deobeling E. O., "Measurement systems, Applications and Design", Tata McGraw Hill Publishing Company Limited, 2004.

**15EEE281                      ELECTRIC CIRCUITS LAB.                      0 0 2 1**

Familiarization of Electrical measuring Instruments, Verification of network theorems, Series – Parallel circuits, Resonance Circuits, Separation of resistance and reactance, Power factor improvement, Three phase power measurement in balanced and unbalanced circuits. Characteristics of semiconductor devices, half wave and full wave rectifiers.

**15EEE282    ELECTRONIC CIRCUITS AND SIMULATION LAB. I    0 0 2 1**

Familiarization with simulation software - simulation of circuits using ORCAD.

Experiments on analog electronic circuits - Design and Testing of Common Emitter Amplifier, Differential Amplifier, Common Collector Amplifier, Common Source Amplifier.

**15EEE285                      ELECTRICAL MACHINES LAB. I                      0 0 2 1**

**DC MACHINES**

Performance characteristics, dc shunt, series and compound generators, study of starters, predetermination of efficiency of dc machines, load test, speed control of dc shunt and series motors.

**TRANSFORMERS**

No load and load test on single phase and three phase transformers, predetermination of efficiency and regulation, three phase transformer connections, phase conversion, parallel operation of transformers.

**15EEE286                      ELECTRICAL MEASUREMENTS LAB.                      0 0 2 1**

Electrical Measurements, Calibration of Voltmeter, Ammeter, Wattmeter and Energy Meter. Extension of Instrument range using Instrument transformers. AC and DC bridges, Study of Transducer, application of Transducer.

**15EEE287    ELECTRONIC CIRCUITS AND SIMULATION LAB. II    0 0 2 1**

Simulation of Electric and Electronics circuits using MATLAB.

Experiments on analog electronic circuits - Schmitt trigger, Linear Voltage Regulator etc.

**15EEE301                      CONTROL SYSTEMS                      3 0 0 3**

**Unit 1**

Introduction to control systems, Mathematical models of physical systems, Block diagram, Signal flow graph, Feedback control system characteristics, reduction of parameter variations, control over system dynamics and disturbance signals, Use of software tools to analyze and design of control system, Performance of feedback control systems.

**Unit 2**

Test input signals, transient and steady state response of second and higher order systems, Performance indices. Concept of Stability, Routh-Hurwitz Stability criterion, Root locus method, concept, procedure, Frequency response analysis, Bode plots, Polar plots.

**Unit 3**

Stability in the Frequency domain, Nyquist criterion, Nichol's chart. Introduction to design of feedback systems, Lead-Lag compensation networks, PID controllers, Control system design case studies - Turbine governor, Robotic hand, ship steering.

**TEXTBOOK:**

Dorf R. C and Bishop R. H, "Modern control systems", Eighth Edition, Addison-Wesley Longman Inc., Indian reprint 1999.

**REFERENCES:**

1. Nagrath I J, Gopal M, "Control Systems Engineering", Fifth Edition, New Age Publishers 2004



2. Katushiko Ogata "Modern control engineering" Third Edition, Pearson Education, 2004.
3. Benjamin C.Kuo "Automatic Control Systems", Sixth Edition, Prentice Hall India Ltd, 2000

**15EEE302 DIGITAL SYSTEMS 3 0 0 3**

**Unit 1**

Introduction to Logic Circuits, Logic Families: Variables and functions, inversion, Truth tables, Logic Gates and Networks, Boolean algebra, Synthesis using AND, OR, NOT, NAND and NOR gates, Design Examples, Introduction to Logic families such as ECL, TTL.

Implementation Technology: Transistor Switches, NMOS Logic Gates, CMOS Logic Gates, Negative Logic System, tri-state logic.

Optimized Implementation of Logic Functions: Karnaugh map, Strategy for minimization, Minimization of Product of sums Forms, Incompletely specified Functions, Multiple – output Circuits, A Tabular Method for minimization.

Number Representation and Arithmetic Circuits: Addition of unsigned Numbers, Signed numbers, Fast Adders.

**Unit 2**

Combinational Circuit Building Blocks: Multiplexers, Decoders, Encoders, Code Converters, Arithmetic Comparison Circuits.

Flip Flops, Registers, Counters: Basic Latch, Gated SR latch, master slave and edge triggered D flip-flops, T flip-flop, JK flip-flop, registers, counters, reset synchronization, other types of counters, Simple Control for MCB.

Synchronous Sequential Circuits: Basic Design Steps, State Assignment Problem, Mealy state Model, Serial Adders Example, State minimization, Sequential Circuit design for drive control.

**Unit 3**

Asynchronous Sequential Circuits: Asynchronous Behavior, Analysis of Asynchronous circuits.

**TEXTBOOK:**

Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital logic with Verilog Design", Tata McGraw Hill Publishing Company Limited, Special Indian Edition, 2007.

**REFERENCES:**

1. Morris Mano, "Digital Design", Pearson Education, Third Edition, 2006.

2. Donald D Givone, "Digital Principles and Design", Tata McGraw Hill Publishing Company Limited, 2003.
3. Allen Dewey, "Analysis and Design of Digital Systems with VHDL", PWS Publishing Company, 1999.
4. John F. Wakerly, "Digital Design Principles and Practices", Pearson Education, Third Edition, 2001.

**15EEE303 ELECTRICAL MACHINES II 3 0 0 3**

**Unit 1**

Induction machines - Construction, time and space harmonics, starting and speed control, testing, circle diagram, equivalent circuit, performance curves, torque speed characteristics, slip ring induction motors.

**Unit 2**

Synchronous machines - construction, generators and motors, salient pole and non-salient pole synchronous machines, characteristics, regulation, parallel operation, operation on infinite Bus, real and reactive power control, power angle curve, stability analysis, Transient and sub transient reactance.

**Unit 3**

The fractional horse power motors, types, Single phase Induction Motor, construction, starting, Equivalent circuit, performance curves, shaded pole motors, hysteresis motors etc.

**TEXTBOOK:**

Kothari D. P. and Nagrath I. J., "Electric Machines", Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.

**REFERENCES:**

1. M. G. Say, "Performance and Design of Alternating Current Machines", CBS publishers, New Delhi, 1993.
2. Fitzgerald A. E., Charles Kingsley, Jr. and Stephen D. Umans, "Electric Machinery", Tata McGraw-Hill Publishing Company Limited, 2002.
3. Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India Private Ltd, 2002.
4. S. K. Bhattacharya, "Electrical Machines", Tata McGraw-Hill Publishing Company Limited, New Delhi.

**15EEE304 SIGNALS AND SYSTEMS 3 0 0 3**

**Unit 1**

Introduction: Integrated approach for continuous and discrete - time cases.

Signals: Classification of signals, Continuous - Discrete time, Even / Odd signals, Periodic/ Non-periodic signals, Deterministic / Random signals, Energy / Power

signals, Basic operations on signals, Basic (Continuous / Discrete) signals - unit step, unit impulse, sinusoidal and complex exponential signals etc.

Systems (Continuous / Discrete): Representation, Classification – Linear / Nonlinear, Causal / Noncausal, Time invariant / Time variant, with / without memory, BIBO stability, Feedback system, LTI system – Response of LTI system, Convolution, Properties (Continuous / Discrete), LTI systems – Differential / Difference equation representation and solution, MATLAB exercises for generation of signals.

### Unit 2

Fourier analysis of continuous time signals and systems: Fourier series for periodic signals, Fourier transform - Properties of continuous time FT, Frequency response of continuous time LTI systems, MATLAB exercises for Fourier Series and Fourier Transforms.

Fourier analysis of discrete time signals and systems: Discrete time Fourier series, Discrete Time Fourier transform - Properties of DTFT, Frequency response of discrete time LTI systems, Laplace Transform analysis of systems: ROC, Inverse LT, Unilateral LT, Solving differential equation with initial conditions.

### Unit 3

Sampling: Sampling theorem, Reconstruction of signal, Aliasing, Sampling of discrete time signals, Sampling of real time signals from PT, Reconstruction and Analysis of such signals, MATLAB exercises for generation of signals.

z-Transform: Definition, ROC, Inverse z-Transform, Properties, Transform analysis of LTI Systems.

Interrelationship amongst different representation and Transforms.

#### TEXTBOOK:

Alan V. Oppenheim, Alan S. Willsky, S, Hamid Nawab, "Signals and Systems", Prentice Hall India Private Limited, 1997.

#### REFERENCES:

1. Simon Haykin, Barry Van Veen, "Signals and Systems", Second Edition, John Wiley and Sons, 2005.
2. Michael J. Roberts, "Fundamentals of Signals and Systems", First Edition, Tata McGraw Hill Publishing Company Limited, 2007.
3. Rodger E. Ziemer, William H. Tranter D. Ronald Fannin, "Signals and Systems", Fourth Edition, Pearson Education, 2004.

**15EEE311****DIGITAL SIGNAL PROCESSING****3 0 0 3**

### Unit 1

Discrete Fourier Transforms: Review of main concepts from Signals and Systems course- Frequency domain sampling and reconstruction of discrete time signals - The DFT as a Linear Transformation - Relationship of the DFT to other Transforms - Properties of DFT - Linear Filtering methods based on DFT - Efficient computation of the DFT-FFT Algorithms. Efficient computation of DFT of Two real sequences - efficient computation of the DFT of a 2N- Point Real sequences - Use of FFT in Linear filtering and correlation.

### Unit 2

Digital Filters: Introduction, Specifications of practical filters.

- a) FIR Filters: Symmetric and anti-symmetric FIR filters, Design of linear phase FIR filter using Windows / optimization techniques. Design of Linear phase FIR Filters. FIR filters for harmonic elimination.
- b) IIR Filters: Design from Analog filters - Design by Approximation of Derivatives, Impulse Invariance and Bilinear Transformation. IIR filters for extraction of fundamental frequency.
- c) Characteristics of commonly used Analog filters, Frequency transformations for analog and digital filters.

### Unit 3

Digital Filters Realizations: Structures for the realization of Discrete time system - Structures for FIR systems - direct form structures, cascade form structures, frequency sampling structures, Lattice structures. Structures for IIR systems - Direct form structures, Cascade form structures, Parallel form structures and Analysis of Finite Word Length Effect and limit cycle oscillations in recursive systems.

Applications of DSP:

Multirate Digital Signal Processing, Sampling rate conversion, Decimation and interpolation, Introduction to QMFs.

Linear predictive coding, forward linear prediction, Levinson-Durbin algorithm, signal synthesis, Application in power systems

#### TEXTBOOK:

Sanjit K. Mitra, "Digital Signal Processing, A Practical approach", Tata McGraw Hill Publishing Company Limited, 2005

**REFERENCES:**

1. John G Proakis, G. Manolakis, "Digital Signal Processing Principles, Algorithms, Applications", Prentice Hall India Private Limited, Fourth Edition, 2007.
2. Allen V. Oppenheim, Ronald W. Schaffer, "Discrete time Signal Processing" Prentice Hall India Private Limited, Fifth Edition, 2000.

**15EEE312 ELECTRICAL ENERGY SYSTEMS I 3 0 0 3**

**Unit 1**

Structure of electric power system, General layout of power system, Methods of electric power generation - Grid systems advantages - EHV AC and HVDC transmission - Variable load on power stations - Load curve and load duration curve - Power factor improvement – Tariff-Transmission line parameters - Skin effect and proximity effect - Inductance of single phase and three phase transmission line single and double circuit lines - symmetrical and unsymmetrical spacing.

**Unit 2**

Capacitance of three phase transmission line - single and double circuit lines - symmetrical and unsymmetrical spacing - bundled conductors -Performance of transmission lines - Efficiency and regulation - Short, medium and long lines - ABCD constants - Ferranti effect - surge impedance - Real and reactive power flow in transmission lines - shunt and series compensation - corona loss. Cables - Construction and characteristics of single and three core cables - Insulation resistance and capacitance of a single core cable, most economical conductor size -Grading of cables.

**Unit 3**

Insulators – types - voltage distribution in suspension type insulators - string efficiency - Grading of insulators - Mechanical design of transmission lines - sag and span - supports at same level and different levels - sag template and stringing chart – Substations - types, general layout, Neutral grounding, Distribution systems: comparison of distribution systems – radial and ring – two wire dc, ac single phase and three phase systems – current and voltage calculations in distributors with concentrated and distributed loads.

**TEXTBOOK:**

Kothari D. P. and Nagrath I. J., "Modern Power System Analysis" Tata McGraw Hill Publishing Company, 2003.

**REFERENCES:**

1. Wadhwa C L, "Electrical Power System", Wiley Eastern Limited, India, 2007.
2. Hadi Saadat, "Power System Analysis" McGraw Hill Publishing Company, 2003.

3. B. R. Gupta, "Power System Analysis and Design", Third Edition, S. Chand & Company Ltd., 2004.
4. Grigsby. L. L, "Electrical Power Engineering Handbook", IEEE Press, 2001.

**15EEE313 POWER ELECTRONICS 3 0 0 3**

**Unit 1**

Power Semiconductor Switches: Controllable switch waveforms and power loss in clamped inductive switching circuit - Desirable characteristics in a switch - Temperature rise and use of heat-sinks. Structure, operation, steady state and switching characteristics, turning on and off, gate drive, rating and protection for power MOSFETs, IGBTs and Thyristors, Phase controlled converters: Single phase and three phase converters in CCM - Performance parameters – DCM operation - Inverter mode of operation -- Effect of source inductance - Gate triggering circuits - Single phase dual converter. Non-sinusoidal analysis.

**Unit 2**

Single phase AC switching controllers with R and R-L loads - Thyristor controlled inductor - Three phase applications of switching control. Choppers: Applications. Step-down chopper with R load with L filter - Transient and steady state operations - Average and ripple load currents- Back emf loads - CCM and DCM - Input filter. Step-up chopper: Analysis, with CCM – Effect of frequency on DCM/CCM - Two Quadrant chopper with static changeover. High power factor front end converter.

**Unit 3**

Inverters: Applications – Half bridge inverter – Full bridge inverter with square wave and single pulse width modulated operations – Sine PWM scheme: Single phase full bridge with unipolar voltage switching, performance parameters, AC and DC side currents - Sinusoidal pulse width modulation for three phase inverters, Expressions for phase to neutral voltages – Current regulated modulation - Rectifier mode of operation of inverters - AC side filters - Schemes to generate triangular carrier and sinusoidal reference - Introduction to Space vector pulse width modulation – Multilevel inverter and UPS.

**TEXTBOOKS:**

1. Joseph Vithayathil, "Power Electronics", Tata McGraw Hill, 2010.
2. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics converters applications and design" Third edition, John Wiley & Sons, 2006.

**REFERENCES:**

1. Muhammad H. Rashid, "Power electronics – circuits, devices and applications" Third edition,
2. L. Umanand, "Power Electronics – Essentials and applications", Wiley India Pvt. Ltd. 2009.

**15EEE314 MICROCONTROLLER AND APPLICATIONS 3 0 0 3****Unit 1 Introduction to Microprocessors**

Registers - File registers - Memory Organization - Tristate logic – Buses - Memory Address register – Read/Write operations. ROM, RAM, PROM, EPROM, E2PROM. Introduction to elementary processor – Organization - Data Transfer Unit (DTU) operation - Enhanced Data Transfer Unit (EDTU) – opcode - machine language - assembly language - pipeline and system clock. Architecture of 8085 – Addressing modes - Data transfer, data processing and program flow control instructions - Simple assembly language programs.

**Unit 2 Introduction to Microcontrollers**

PIC16F877 Architecture - Program and Data memory organization - Special Function Registers - Addressing modes, Instruction set. MPLAB Integrated Development Environment – Introduction to Assembly language and Embedded C programming – Stack – Subroutines - Interrupt structure – Peripherals – Input/Output Ports.

**Unit 3 PIC Peripherals**

Timers/Counters - Watchdog Timer – Capture/Compare/PWM (CCP) - Analog to Digital Converter(ADC) – EEPROM - Serial Communication – USART - Development of Application Programs and interfacing - LED, LCD, Keyboard, DC and Stepper motor interface. Introduction to 8051 Microcontroller: Architecture – Ports - Timers.

**TEXTBOOK:**

T. R Padmanabhan, "Introduction to microcontrollers and applications", First Edition, Narosa publishing house private limited, 2007.

**REFERENCES:**

1. Martin P. Bates, "Programming 8 bit PIC Microcontrollers in C with Interactive Hardware Simulation", Newnes, 2008.
2. PIC Micro Mid-Range MCU Family Reference Manual, Micro Chip Technology Inc.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Prentice Hall, Second Edition, 2005.

**15EEE330 ADVANCED CONTROL SYSTEMS 3 0 0 3****Unit 1**

State Variable Analysis and Design: Introduction, concept of state, state variables and state model, state modeling of linear systems, linearization of state equations. State space representation using physical variables, phase variables & canonical variables.

**Unit 2**

Derivation of transfer function from state model, diagonalization, Eigen values, Eigen vectors, generalized Eigen vectors. Solution of state equation, state transition matrix and its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method, concept of controllability & observability, methods of determining the same.

**Unit 3**

Pole Placement Techniques: stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement, state regulator design, and design of state observer, Controllers- P, PI, PID. Non-linear systems: Introduction, behavior of non-linear system, common physical non-linearity-saturation, friction, backlash, dead zone, relay, multi-variable non-linearity.

Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories. Liapunov stability criteria.

**TEXTBOOK:**

Ogata. Modern Control Engineering. Fifth edition, Prentice Hall of India, 2009.

**REFERENCES:**

1. Franklin and Powell. Feedback Control of Dynamics Systems. Addison-Wesley.
2. Di Stefano. Feedback Control Systems. Schaum's outline Series, McGraw Hill, 1967
3. Luenberger. Introduction to Dynamic Systems. Wiley. 1979
4. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Eleventh Edition, Prentice Hall, Pearson Education, 2008.

**15EEE331 ADVANCED MICROCONTROLLERS 3 0 0 3**

(Prerequisite: 15EEE314 – Microcontroller and Applications)

**Unit 1**

dsPIC 30F series: Introduction to 16 bit microcontrollers - dsPIC 30F – CPU, Data memory, Program Memory - Instruction set - Programming in Assembly and C-Interrupt Structure.

**Unit 2**

Peripherals of dsPIC 30F: I/O Ports, Timers, Input Capture, Output Compare, Motor Control PWM, QE1, 10 bit A/D Converter, UART, CAN Unit, Application Development.

**Unit 3**

MSP430 and peripherals: MSP430f2274 - MSP430X22X2 device pin out, DA Package, Functional Block diagram description, Inputs, Outputs, Timers, ADC. Application Development.

**TEXTBOOKS:**

1. dsPIC 30F, Reference Manual, Microchip.
2. Chris Nagy, "Embedded System Design using the TI MSP 430 Series", First Edition, Newnes, 2003

**REFERENCES:**

1. MSP430F2274, Reference manual, Texas Instruments.
2. www.microchip.com
3. www.ti.com

**15EEE332 COMMUNICATION ENGINEERING 3 0 0 3**

**Unit 1**

Introduction: Communication, Communication systems - Block diagram description of Analog and Digital Systems; Review of Fourier Representation, Waveform Spectra, Bandwidth; Noise - Sources of Noise and their Manifestations into Communication Systems, Noise Figure, Significance of SNR Considerations in Communication Systems.

Modulation: Necessity, Introduction to Analog and Digital Modulation.

**Unit 2**

Amplitude Modulation: Theory, Modulation Index, Spectral Representation of modulated Waves, Power and Bandwidth Considerations, Carrier and side bands, Modulation Schemes: DSBFC, Suppressed Carrier, SSB Techniques – Filter Systems, Phase Shift Method, Carrier Reinsertion System, VSB, Applications.

Frequency Modulation: Introduction, Theory of FM and Phase Modulation, Frequency Spectrum of FM wave, Applications.

Pulse Communication: Introduction, PWM, PPM, PCM.

**Unit 3**

Introduction to Digital Communications: Fundamentals of Data Communication Systems, FSK, PSK and QAM.

Applications in Power Systems: Power line carrier, Elements of carrier channel, transmitter, line traps, carrier communication, carrier relaying, power system communication, telemetry, telecontrol.

**TEXTBOOKS:**

1. George Kennedy, Bernard Davis, "Electronic Communication Systems", Fifth Edition, Tata McGraw Hill Publishing Company Limited, 2006.

2. Wayne Tomasi, "Electronic Communication Systems, Fundamentals through Advanced", Fourth Edition, Pearson Education, 2002.
3. Donald G. Fink, H. Wayne Beaty, "Standard Hand Book for Electrical Engineers" Fourteenth Edition, McGraw Hill Publishing Company Limited, 2001 (For application in Power Systems.)

**REFERENCES:**

1. Simon Haykin, "An Introduction to Analog and Digital Communication", Fourth Edition, John Wiley and Sons, 2003.
2. Taub, Schilling, "Principles of Communication Systems", Tata McGraw Hill Publishing Company Limited, 2004.
3. Dennis Roddy, John Coolen, "Electronic Communications", Fourth Edition, Pearson Education, 2004

**15EEE333 DEREGULATED POWER SYSTEM 3 0 0 3**

**Unit 1**

Power Sector in India – Classical Operation of Power System, Least Cost Operation, Marginal Cost, Incremental Cost – inter utility interchange. Fundamentals of deregulated power system: Requirements and key issues – restructuring models – independent system operator (ISO).

**Unit 2**

Electricity Market: Competitive market - supply and demand functions, market equilibrium, types of market. Market power and mitigation, imperfect market. Transmission open access: transmission pricing, pricing scheme, concept of distribution factors – Location based Marginal Pricing LMPs.

**Unit 3**

Transmission capacity: Available Transfer Capacity (ATC), Open Access Same-time Information Systems (OASIS) – Transmission congestion management – Ancillary services: classification and definition – Indian Electricity Acts and Policies – 2003 acts – Availability Based Tariff (ABT).

**TEXTBOOKS:**

1. Kankar Bhattacharya, Math H J. Bollen and Jaap E. Daalder, "Operation of Restructured Power Systems", Springer, 2001.
2. M. Shahidehpour and M. Alomoush, "Restructured Electric Power Systems – Operations, Trading and Volatility", CRC Press, 2001.
3. Loi Lei Lai (Ed), "Power System Restructuring and Deregulation: Trading, performance and Information Technology," John Wiley publications, 2001.

**15EEE334 DESIGN OF ELECTRICAL APPARATUS 3 0 0 3**  
(Prerequisite: 15EEE303 Electrical Machines II)

**Unit 1**

Introduction: Design factors, Limitations in design, Thermal design aspects, standard specification.

DC machines: Specific loadings, output equation, Design of main dimensions. Design of Armature windings, Design of field system, Design of interpole and commutator.

Transformers: Output equation-volt per turn, main dimensions for three phase and single phase transformers, window dimensions & Yoke design and coil design. Design of tank with tubes.

**Unit 2**

Induction motor: Specific loadings, output equation, main dimensions, stator design, number of slots, shape and area of slots, rotor design for squirrel cage and slip ring types.

Synchronous machines: Output equation, main dimensions for salient pole and cylindrical rotor alternators, stator design, rotor, pole design for salient pole generators, pole winding calculations, design of cylindrical rotor.

**Unit 3**

Optimization techniques as applied to design of electrical machines; Study of cooling systems. Computer aided design: Advantage of computer aided design, Flow chart for computer aided design. Standard specifications: Indian standard specifications for copper conductor, power transformers and induction motor. Recent developments in core and insulation materials used in electrical machines;

**TEXTBOOK:**

A. K. Sawhney and A. Chakarabarti 'A course in Electrical machine Design' Dhanpat Rai & Co., New Delhi, Sixth edition 2006.

**REFERENCES:**

1. Alexander Gray "Electrical Machine Design - The Design and Specification of Direct and Alternating Current", Gray Press, 2007.
2. Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova "Design of Rotating Electrical machines" John Wiley & Son, 2009.
3. S. K. Sen, 'Principles of Electrical Machine Design with Computer Programmes', Oxford and IBH Publishing Co. Pvt Ltd., New Delhi, 1987

**15EEE335 DESIGN OF ELECTRICAL SYSTEMS 3 0 0 3**

**Unit 1**

General Introduction, Gathering specific data, Adoption of design - parameters for the particular project, Selection of basic design philosophies, Detailing the electrical System, Preparation of as - erected drawings and design - manuals.

Maximum-demand – MD estimation, Demand factors for HV motors, Calculation of MD on the MCCs, MD, estimation for an entire load-centre substation and MSS, Statutory Inspector's approach to MD estimation.

**Unit 2**

Sizing of transformer capacity on basis of MD calculations, Consideration and constraints in the sizing of transformers CB ratings, Split bus arrangements, sizing of power-transformer capacity, Sizing of distribution transformer, capacity at ICSS, Techno-economic studies on selection of transformer sizes, sizing the transformer to meet HV motor, starts and voltage dips.

Short-circuit calculations, SC analysis, standards for the SC analysis, Passive and dynamic reactance to be considered for SC analysis, Reactance multipliers for first cycle diagram for SC analysis of 415V system, The computation of AC components of fault currents, Determination of DC component of the fault current and the total fault current, IEC equations, The impact of CB status on fault levels.

**Unit 3**

Selection of cable sizes, Continuous rating of cables (Standard rating and net-rating), Thermal ampacity of cables, Short time short circuit rating of cables, Mechanical withstand of short circuit forces, Techno economic consideration in selection of cables, SC-withstand capacity of 1.1 kV cable, Voltage drops in 415V motor, feeders and voltage drop based ampacity, The use of copper cables for motors of rating less than 7.5 kW.

**TEXTBOOK:**

N. Balasubramanian 'Design of Electrical Systems (For Large projects)', Revised edition, The Rukmini studies, Chennai, 1999.

**REFERENCES:**

1. TNEB Hand book
2. IEEE Hand book

**15EEE336 DIGITAL CONTROL SYSTEMS 3 0 0 3**  
(Prerequisite: 15EEE301 Control Systems)

**Unit 1**

Sampled data - Signal reconstruction, Discrete transfer functions, discrete system stability frequency response analysis, models for sampled continuous systems, state space analysis of discrete time systems, errors and non-linearity due to quantization in ADC.

**Unit 2**

Discrete time sensitivity functions, internal model, principle for digital control, design by pole assignment. System identification, RLS method, minimum variance control, self-tuning methods, dead beat control, state estimation, Luenberger observer,

**Unit 3**

Kalman filter DSP based digital control SCADA, Architecture and design, Introduction to control system tool box. Design of state variables feedback systems, controllability and observability.

**TEXTBOOK:**

M. Gopal, "Digital Control Engineering", Tata McGraw-Hill Publishing Company Limited, 1997.

**REFERENCES:**

1. Graham. C. Goodwin et al, "Control system design", Prentice Hall of India, 2001.
2. Web resources
3. Selected papers from journals

**15EEE337 DIGITAL IMAGE PROCESSING 3 0 0 3**

**Unit 1**

Introduction: Introduction & Applications, Elements of visual perception, Image sensing and acquisition, simple image formation, Image sampling and Quantization, Representing digital pixels, Image quality, Introduction to colour image – RGB and HSI Models.

Image enhancement in Spatial domain: Introduction to image enhancement, basic grey level transforms, Histogram, Histogram-processing equalization, Matching & colour histogram, Enhancement using arithmetic/logic operations, spatial filtering, Smoothing spatial filtering, Sharpening spatial filtering.

**Unit 2**

Image transform: Fourier transform, SHFT, DFT, FFT, DCT, Hadamard Transform, Wavelets transform (CWT, DWT), KLT, SVD, Applications.

Image Enhancement in frequency domain: Smoothing frequency domain filtering, Sharpening frequency domain filtering, A model for Image degradation / restoration process, Noise model, Mean filtering and filtering, estimating degradation function, inverse filtering, minimum mean square error (wiener filter), Colour image smoothening, sharpening.

**Unit 3**

Segmentation & Morphological operations: segmentation and threshold function, Different algorithms in thresholding, Line detection, Edge detection, Edge linking by graph search method, Hough transform, Region based segmentation, Matching, colour segmentation, Morphological-dilation and erosion, opening and closing, Hit/miss transforms, Representation Boundary descriptors, Regional descriptors. Image Compression - need for image compression, Huffman, Run length encoding, shift codes, Vector quantization, Transform coding, JPEG standard, MPEG

**TEXTBOOK:**

R. C. Gonzalez, R. E. Wood "Digital image processing", Addison-wiley, 2002.

**REFERENCES:**

1. K. Jain "Fundamental of digital image processing", Prentice-Hall, 2002.
2. R. C. Gonzalez, R. E. Wood "Digital image processing using MATLAB", Pearson Education, 2004
3. M. Sonka, V. Hlavac, R. Boyle, "Image processing analysis and machine vision" Chapman & Hall, 1998.

**15EEE338 DIGITAL SIGNAL PROCESSORS 3 0 0 3**

**Unit 1**

TMS320C67xx: Basic building blocks of a typical DSP processor – Hardware Multiplier – Barrel Shifter – MAC unit – Modified Harvard architecture - Pipelining. Architecture of TMS320C67xx DSP - Instruction set – Addressing modes.

**Unit 2**

Blackfin Processor: Blackfin 5xx DSP – Architecture-Instruction set – Addressing modes.

**Unit 3**

Programming using TMS320C67xx and Blackfin DSPs: Assembly language and C programming – Integrated Development Environment - Code Composer Studio and Visual DSP++ - Application development.

**TEXTBOOK:**

Rulph Chassaing, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", Wiley-Interscience, 2004

**REFERENCES:**

1. Woon Seng Gan and Sen M Kuo, "Embedded Signal Processing with the Micro Signal Architecture", IEEE Computer Society Press, 2008.
2. Dahnoun N, "Digital signal processing implementation using the TMS320C6000 DSP platform", Prentice Hall, 2000.
3. Andy Bateman, Iain Paterson-Stephens, "The DSP Handbook, Algorithms, Applications and Design Techniques", Prentice-Hall, 2002,
4. [www.ti.com](http://www.ti.com) and [www.analog.com](http://www.analog.com) .

**15EEE339 ELECTRICAL SAFETY 3 0 0 3**

**Unit 1**

Introduction – electrostatics – electromagnetism - stored energy - energy radiation and electromagnetic interference – Working principles of electrical equipment – Indian Electricity Act and Rules - statutory requirements from electrical inspectorate – international standards on electrical safety – first aid - cardio pulmonary resuscitation (CPR).

**Unit 2**

Primary and secondary hazards - Energy leakage - clearances and insulation - voltage classification - heating effects - electrical causes of fire and explosion – ionization - spark and arc-ignition energy – control - Lightning hazards – Fuse – circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage – safe distance from lines – capacity.

**Unit 3**

Earth fault protection - earthing standards - FRLS insulation – grounding - equipment grounding earth leakage circuit breaker (ELCB) - Role of environment in selection - safety aspects in application - protection and interlock self-diagnostic features and fail safe concepts - surge withstand capability test requirements - Classification of hazardous zones - intrinsically safe and explosion proof electrical apparatus - increase safe equipment - their selection for different zones - temperature classification - grouping of gases - use of barriers and isolators -equipment certifying agencies.

**REFERENCES:**

1. Massimo A. G. Mitolo, "Electrical Safety of Low-Voltage Systems", McGraw-Hill, USA, 2008.
2. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, "Electrical Safety Handbook, McGraw-Hill, New York, USA, 2005.
3. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.
4. Palmer Hickman, "Electrical Safety-Related Work Practices", Jones & Bartlett Publishers, London, 2009.

**15EEE340 ELECTROMAGNETIC COMPATIBILITY 3 0 0 3**  
(Pre-requisite: 15EEE203 Electromagnetic Theory)

**Unit 1**

Review of electromagnetic principles: Maxwell's equations, plane waves, transmission lines.

Introduction to Finite Element method, Introduction to electromagnetic compatibility, sources of EMI, Transient EMI, Basic definitions of EMC.

**Unit 2**

EMI Coupling Principles, Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Crosstalk, EMI Control Techniques - Shielding, Grounding, Bonding.

**Unit 3**

Radiated Common Mode and Ground Loop Coupling, EMI Test Instruments, Various Test Methods and Calibration Procedures, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting Units, EMI Specifications, Civilian & Military Standards.

**TEXTBOOK:**

C. R. Paul, "Introduction to Electromagnetic Compatibility", John Wiley and Sons, (Wiley Series in Microwave and Optic Engineering), 2006.

**REFERENCES:**

1. Henry W Ott, "Electromagnetic Compatibility Engineering", John Wiley, 2009
2. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech House, 3rd Edition, 1986
3. V. P. Kodali, "Engineering EMC Principles, Measurements and Technologies," IEEE Press, 1996
4. Rajeev Thottappillil, Course Material on electromagnetic Compatibility, KTH Royal Institute of Technology, Stockholm.

**15EEE341 EMBEDDED SYSTEMS DESIGN 3 0 0 3**  
(Prerequisite: 15EEE314 Microcontroller and Applications)

**Unit 1**

Embedded processors: Introduction to Microprocessors – Microcontrollers – Digital Signal Processors - Embedded processors – ARM Cortex M3 Processor - Architecture - ARM Instruction – Addressing modes.

**Unit 2**

NXP's LPC17xx series Microcontroller: Architecture - Peripherals – Input/Output ports – Timers – ADC – DAC - PWM. Serial Protocols - UART, I2C, CAN, Fire Wire,



USB, Parallel Protocols, PCI Bus, ARM Bus, Wireless Protocols, IrDA, Bluetooth, IEEE 802.11. Application development using Keil IDE.

**Unit 3**

Real time Embedded Systems: Real Time Operating Systems (RTOS) - Task - Task states – Task Management - Scheduler - Intertask Communication and Synchronization – Exceptions and Interrupts – Time management - Memory Management – I/O subsystems. Commercial RTOS - uC/OS-II functions – Porting RTOS on ARM boards.

**TEXT / REFERENCES:**

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", Second Edition, Newnes, 2009.
2. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", CMP Books, 2003.
3. Steve Furber, "ARM System-on-Chip Architecture", Second Edition, Addison Wesley, 2000.
4. Jean J. Labrosse, "MicroC/OS – II - The Real Time Kernel", Second Edition, CMP Books, 1998.
5. NXP LPC 17xx datasheet. ([www.nxp.com](http://www.nxp.com))

**15EEE342 FLEXIBLE AC TRANSMISSION SYSTEMS 3 0 0 3****Unit 1**

FACTS concept and General system considerations - Transmission Interconnections, Flow of power in an AC system, Loading capability, Power flow and dynamic stability considerations of a transmission interconnection, basic types of FACTS controllers, IEEE definitions, FACTS devices in India and abroad.

Shunt compensation and shunt FACTS devices - Concept of shunt compensation, objectives of shunt compensation, variable impedance type shunt compensators (TCR, TSC, FC-TCR, TSC-TCR) - circuit diagram, principle of operation, working, waveforms / characteristics.

**Unit 2**

Switched converter type shunt compensator (STATCOM) - circuit diagram, principle of operation, working, waveforms / characteristics, control schemes for shunt compensators.

Series compensation and Series FACTS devices - Concept of series compensation, objectives of series compensation, variable impedance type series compensators (GCSC, TSSC, TCSC), Switching converter type series compensators - circuit diagram, principle of operation, working, waveforms/characteristics, control schemes for series compensators.

**Unit 3**

Static voltage and phase angle regulators - Objectives of voltage and phase angle regulators, power flow control, improvement of transient stability, power oscillation damping, thyristor-controlled voltage and phase angle regulators.

Combined FACTS compensators and other special purpose FACTS devices - Unified Power flow Controller (UPFC) - objectives and need, principle of operation, Interline power flow controller (IPFC) - objectives and need, principle of operation. NGH-SSR damper, thyristor-controlled braking resistor (TCBR).

Case studies of practical applications of various FACTS devices.

**TEXTBOOK:**

Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTS – Concepts and technology of Flexible AC transmission system", IEEE power Engineering Society, 1999.

**REFERENCES:**

1. T. J. E. Miller, "Reactive power control in Electric systems", Wiley-Interscience Publication, John Wiley and sons, 1982.
2. R. Mohan Mathur and Rajiv K. Varma, "Thyristor-based FACTS controller for electrical transmission system, IEEE series on power Engineering", Wiley Interscience, 2002.
3. Padiyar K. R, "FACTS controllers in power transmission and distribution", New Age Publishers, India, 2007.

**15EEE343 FUNDAMENTALS OF SOFT COMPUTING 3 0 0 3****Unit 1**

Basic concepts: Single layer perception, Multi-Layer Perception, Supervised and Unsupervised learning, Back propagation networks, Kohonen's Self-organizing networks, Hopfield networks, Distance measures.

**Unit 2**

Fuzzy Sets: Properties, Membership functions, Fuzzy operations, Applications, Classification and Regression tree, Data Clustering Algorithms, Rule-based Structure identification and Regression trees, neuro fuzzy systems.

**Unit 3**

Simulated Annealing: Evolutionary Computing, Survival of the Fittest, Fitness Computation, Crossover, Mutation, Reproduction, Rank Method, Rank Space methods, Case Studies on applications of soft computing.

**TEXTBOOKS:**

1. Jang. J. S. R, sun. C. T, Mizutani. E, "Neuro fuzzy and Soft Computing", Prentice Hall of India Private Limited, 2002.

2. Klir and Yuan, "Fuzzy sets and Fuzzy Logic; Theory and Applications", Prentice Hall of India Private Limited 2009.

**15EEE344                      HIGH VOLTAGE ENGINEERING                      3 0 0 3**

**Unit 1**

Introduction: different types of dielectrics, uniform and non-uniform electric field, electric field in some geometric boundaries.

Conduction and breakdown in gases: Collision process, ionization process, Townsend's theory, streamer theory, Pashen's law, breakdown in non-uniform fields and corona discharges - Vacuum insulation.

Conduction and breakdown in liquid dielectrics; Classification of liquid dielectrics, breakdown in liquid dielectric. Different types of solid dielectric materials - breakdown in solid dielectrics - field configuration in the presence of voids.

Breakdown in composite dielectric.

**Unit 2**

Generation of high voltages - ac voltages, dc voltages, impulse voltages. Generation of impulse currents.

Measurement of high voltages and currents - High DC, AC and impulse voltages, Direct, Alternating and Impulse currents.

**Unit 3**

Non-destructive insulation test techniques, measurement of insulation resistance under dc voltage, measurement of loss angle and capacitance, partial discharge measurement.

Testing of high voltage apparatus based in International and Indian standards - non-destructive testing - testing of insulators – bushings – cables - isolators and circuit breakers – transformers - surge arresters.

**TEXTBOOK:**

M. S. Naidu and V. Kamaraju, "High voltage Engineering", Second Edition Tata McGraw-Hill, Publishing Company Limited, 1995.

**REFERENCES:**

1. C. L. Wadhwa, "High voltage Engineering", New age international (p) Ltd, Publishers, Reprint, 2001
2. Kuffel. E and Abdullah. M, "High Voltage Engineering", Pergamon press, Oxford, London, 1970.

3. Gallghar P. J. and Pearmain A. J, "High voltage measurement, Testing and Design", John Wiley & Sons, New York, 1982.
4. Kuffel E. and Zaengl W. S, "High voltage Engineering. Fundamentals", Pergamon press, Oxford, London, 1986.

**15EEE345                      ILLUMINATION ENGINEERING                      3 0 0 3**

**Unit 1**

Radiant energy and visible spectrum, energy conversion to light, colour, eye and vision; different entities of illuminating systems.

Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers; Energy efficient lamps; Luminaries, wiring, switching and control circuits.

**Unit 2**

Laws of illumination; illumination from point, line and surface sources. Photometry and spectrophotometry; photocells. Environment and glare. General illumination design, Illumination levels, loss factors, lamp selection and maintenance.

Interior lighting – industrial, residential, office departmental stores, indoor stadium, theater and hospitals.

**Unit 3**

Exterior lighting - flood, street, aviation and transport lighting, lighting for displays and signaling - neon signs, LED-LCD displays beacons and lighting for surveillance.

Energy Conservation codes for lighting; lighting controls – daylight sensors and occupancy sensors; controller design.

**TEXTBOOK:**

Craig DiLouie, "Advanced Lighting Controls: Energy Savings, Productivity, Technology and Applications", CRC Press, 2005

**REFERENCES:**

1. Kao Chen, "Energy Management in Illuminating Systems", Carlsons Consulting Engineers, San Diego, California, USA, CRC Press, 1999
2. Mark Stanley Rea, "IESNA Lighting Handbook", Illuminating Engineering Society of North America, 2000
3. Soni, Gupta and Bhatnagar, "A Course in Electrical Power", Fourth Edition, Dhanpat Rai & Sons, 1996.

**15EEE346 INDUSTRIAL ELECTRONICS 3 0 0 3**  
(Prerequisite: 15EEE201 Analog Electronic Circuits)

**Unit 1**

Input transducers and Sensors: Position, displacement, velocity, acceleration, force, flow pressure, level temperature, humidity. Telemetry 0-10V and 4-20mA systems.

Thermocouples, RTD, LVDT, Servo-pots, strain gauges, P, PI, PID converters, average to rms converters.

Actuators, DC and AC stepper motors, Dosing equipment weigh feeders, dosing pumps, extrusion – bulk and film electronic components. Medical equipments.

**Unit 2**

Programmable controllers and PLCs. Rotary encoders, digipots.

Automation: Transfer machines, robotics basics, Application of PLCs,

Industrial heating: Arc furnace, high frequency heating, High frequency source for induction heating, dielectric heating and microwave heating, Ultrasonic- Generation and applications.

**Unit 3**

High voltage equipments: voltage multipliers, electrostatic charging, precipitation, and painting. Plasma torches, particle accelerators electron beam welding, ion implantation, thrusters and gas lasers. Case studies of industrial applications.

**TEXTBOOK:**

Charles A. Schuler and William L. Mc. Namee, "Industrial Electronics and Robotics" International McGraw Hill, 1986.

**REFERENCES:**

1. S. K. Bhattacharya and S. Chatterjee, "Industrial Electronics & Control", Tata McGraw Hill, 2003.
2. Terry. L. M. Bartell, "Industrial Electronics", Delmer Publishers, 1997
3. Thomas E. Kissell, " Industrial Electronics", 2002

**15EEE347 INTRODUCTION TO COMPUTER NETWORKS 3 0 0 3**

**Unit 1**

Introduction to computer networks:

Uses of Computer Networks, Network Hardware, Network Software, Network Reference Models, Example Networks - The Internet, Connection-Oriented Networks: X.25, Frame Relay, ATM, Ethernet,

Physical Layer

Guided Transmission Media, Wireless Transmission, Public Switched Telephone Network - Structure of the Telephone System, Local Loop: Modems, ADSL, Multiplexing, Switching.

Data Link Layer (Logical Link layer)

Data link layer design issues: Framing, Error Control, Flow Control.

Error detection and correction, Error-Correcting Codes, Error-Detecting Codes, Data link protocols: Stop-and-Wait protocol, Sliding Window Protocols.

**Unit 2**

Data Link layer (MAC Layer)

MULTIPLE ACCESS CONTROL PROTOCOLS – ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, ETHERNET, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.

Network Layer - Network Layer Design Issues, IP addressing, Routing Algorithms, ARP, RARP.

**Unit 3**

Transport Layer

Transport Service, Elements of Transport Protocols, Internet Transport Protocols - TCP, UDP Application Layer: DNS, electronic mail.

Security in Computer Networks.

Principles of Cryptography, Symmetric-Key Algorithms, Public-Key Algorithms.

**TEXTBOOKS:**

1. William Stallings, "Data and Computer Communications", 7th Edition, Pearson Education Asia, 2004.
2. Andrew S Tanenbaum, "Computer Network", Fourth Edition, Pearson Education, 2003

**REFERENCES:**

1. James F Kurose and Keith W Ross, "Computer Networking – a Top Down Approach Featuring the Internet", Second Edition, Pearson Education, 2003
3. Berhouz A Forouzan, "Data Communication and Networking", 3rd Edition, Tata McGraw Hill, 2004.

**15EEE348 MANAGEMENT OF POWER DISTRIBUTION 3 0 0 3**

**Unit 1**

Introduction: Energy security, Future of electricity, Electricity Acts and Regulations. Demand Forecasting: Forecasting techniques and forecasting modelling.

Cogeneration, Wheeling and banking, Power pooling and trading, Energy storage schemes. Distribution reform, Quality of supply and Bench marking.

**Unit 2**

Change management in Power Distribution: Change management: Concepts and processes, Change requirement, Emerging developments.

Energy Management: Supply side management – issues and remedial measures. Demand Side Management, demand response, storage.

**Unit 3**

Distribution in deregulated market, Micro Economics in distributed generation, Micro grid, Distribution automation, SCADA, Smart Meters and its applications.

**TEXTBOOKS / REFERENCES:**

1. Pabla. A. S., "Electrical Power System Planning", Macmillan India Ltd., 1998.
2. Heinz Wehrich, Harold Koontz, "Management - A Global Perspective", Tenth Edition, Tata McGraw Hill, 2001.
3. IEEE working group on distribution automation, IEEE tutorial course 88EH0280-8-PWR, 1998.
4. M. Shahidehpour and M. Alomoush, "Restructured Electric Power Systems – Operations, Trading and Volatility", CRC Press, 2001.

**15EEE349 NETWORK SYNTHESIS 3 0 0 3**

**Unit 1**

Network functions, two port parameters, Interconnection of two ports, incidental dissipation, analysis of ladder networks.

Elements of realizability theory, causality and stability, Hurwitz polynomial, Positive real functions, synthesis procedure.

**Unit 2**

Synthesis of one port network with two kind of elements, properties of LC immitance function, synthesis of LC driving point immitance, properties of RC driving point impedance, synthesis of RC and RL admittance, properties of RL impedance and RC admittance, synthesis of RLC function.

**Unit 3**

Elements of transfer function synthesis, properties of transfer function, zero of transfer function, synthesis of Y21 and Z21 with 1O termination, synthesis of constant resistive network.

Filter design, filter design principles, approximate problem, transient response of low pass filter, synthesis of low pass filter, magnitude and frequency normalization, frequency transformation.

**TEXTBOOKS:**

1. Franklin F Kuo, "Network Analysis and Synthesis", John Wiley & Sons, Third Edition, 1966, reprint 2002.
2. A Sudhakar, Shyammoan S Palli, "Circuits and Networks – Analysis and Synthesis", Second Edition, Tata Mc Graw Hill Publication, 2006.

**15EEE350 OPTOELECTRONICS AND LASER INSTRUMENTATION 3 0 0 3**

**Unit 1**

Introduction - Characteristics of optical radiation, luminescence, irradiance - Optical Sources - Photo Detectors - Opto-couplers and their application in analog and digital devices. Optical Fiber Fundamentals - modes, types of optical fibers - fiber coupling - Fiber optic sensors for common industrial parameters - V, I, pressure, temperature - IR sources and detectors - fiber optic gyroscope.

**Unit 2**

Characteristics of LASERS - Einstein's equations - population inversion two, three and four level system. Laser rate equation, properties – modes - Resonator configurations - Q switching and mode locking, cavity dumping, single frequency operation - Types of Lasers. Applications - Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, pollutants.

**Unit 3**

Material processing applications - Laser heating, melting, scribing, splicing, welding and trimming of materials, removal and vaporization.

Holographic Interferometry and Applications – Holography for non-destructive testing – medical applications - lasers and tissue interaction -surgery – dermatology.

**TEXTBOOKS:**

1. Wilson and Hawkes, "Opto Electronics - An Introduction", Third Edition, Pearson Education, 1998.
2. John Ready, "Industrial Applications of Lasers", Second Edition, Academic Press, 1997.

**REFERENCES:**

1. Bhattacharya P, "Semiconductor Optoelectronics", Second Edition, Pearson Education, 1998.
2. Djafar K. Mynbaev, Lowell L. Scheiner, "Fiber-Optic Communications Technology", First Edition, Prentice Hall of India Pvt. Limited, 2000.
3. R. P. Khare, "Fiber Optics and Optoelectronics", Oxford Press, 2004

**15EEE351 POWER CONVERTERS 3 0 0 3**

(Prerequisite: 15EEE313 Power Electronics)

**Unit 1**

DC-DC Switched Mode Converters: Operating principles, Steady state analysis for continuous and discontinuous current operations, Performance calculations of Buck converter, Boost converter, Buck-boost converter, Cuk converter & Full bridge converter - Comparison of DC-DC converters.

**Unit 2**

Switched Mode DC Power Supplies: Overview of linear and switched mode power supplies, Other types of converters: Flyback converter, Forward converter, Push pull converter, Half bridge converter & Full bridge converter.

**Unit 3**

Design of snubbers, drive circuits, magnetics, Voltage feed forward - PWM control and current mode control, Feedback compensators, unity power factor rectifiers.

Introduction to resonant converters - classification of resonant converters - Basic resonant circuit concepts. Zero current and Zero voltage switching.

Simulation of DC-DC converters and complete SMPS systems.

**TEXTBOOK:**

Ned Mohan et.al, 'Power Electronics', Third edition, John Wiley and Sons, 2003.

**REFERENCES:**

1. George C. Chryssis, 'High Frequency Switching Power Supplies', McGraw-Hill International, 1999.
2. Otmar Kit Genstein, 'Switched Mode Power Supplies', John Wiley & Sons, 1994.
3. Abraham I. Pressman, 'Switching Power Supply Design', McGraw-Hill Company Inc, 1999.
4. Rashid, 'Power Electronics circuits, Devices, and Applications', Third Edition, Pearson Education, 2003

**15EEE352 POWER PLANT INSTRUMENTATION 3 0 0 3**

**Unit 1**

Introduction to Unit operation and Unit Process: Material and Energy Balance. Significance of Instrumentation and layout of thermal, hydroelectric, nuclear, gas turbine, solar, wind Power plants.

Instrumentation and Equipments of Various Unit Operations: Evaporation, Distillation, leaching, Gas Absorption, Heat exchangers, Humidification and Dehumidification, Drying, Size Reduction, Crystallization, Mixing.

**Unit 2**

Boiler Instrumentation and Optimization: Combustion control, 3 element drum level control, steam pressure, oxygen / CO / CO<sub>2</sub> – flue gases control, furnace draft, boiler interlocks, SCADA controls - Boiler inspection and safety procedures.

Turbine Instrumentation and Control: Valve actuation, auto-start up, start up and shut down, thermal stress control, condition monitoring and Power Distribution Instrumentation. Auxiliary control of water treatment plant, Electrostatic Precipitator and Oil Automation System.

**Unit 3**

Automation: Thermal power plant, Boiler Automation – Diagnostic Functions and Protection – Digital Electro – Hydraulic Governor, Man-Machine Interface - Graphic Display of Automated Power plant.

**TEXTBOOKS:**

1. McCabe W. L, Smith J, Peter Harriot, "Unit operation of chemical Engineering", Seventh Rev Edition, Tata McGraw Hill Publishing Company, 2005.
2. Popovic and Bhatkar, "Distributed Computer control in Industrial automation", Second Edition, CRC Press, 1990.

**REFERENCE:**

B. G. Liptak, "Instrument Engineers Handbook: Process Measurement and Analysis", Third Edition, Butterworth Heinemann, 1995.

**15EEE353 POWER QUALITY 3 0 0 3**

**Unit 1**

Introduction to power quality concepts: Need for PQ improvement, causes & effects - effects on utility side, and effects on customer side, Terms & definitions of power quality indices, PQ standards - IEEE / IEC.

**Unit 2**

Harmonic Analysis: Major sources, Minor sources of harmonics, Measurement and analysis techniques for harmonics.

**Unit 3**

Power Quality Improvement: Conventional compensation & FACTS compensation, Types of FACTS controllers, Control of FACTS devices, Tuned filters, Design of filters, Active filters- review of active filters, basic functioning of shunt & series active filters, Control of active filters, Hybrid filters - review of hybrid filters, working.

Improved power quality converters (IPQC) - review of IPQCs. Custom power-park, Custom power devices.

**TEXTBOOK:**

M. H. J Bollen, 'Understanding power quality problems', IEEE Press, 1999.

**REFERENCES:**

1. J. Arillaga, N. R. Watson and S. Chen, 'Power system quality assessment', Wiley, 1999.
2. Narian G. Hingorani, and Laszlo Gyugyi, 'Understanding FACTS concepts and technology', IEEE Press, 2003.
3. T. J. E Miller, 'Reactive power control in electric systems', John Wiley & Sons, 1982.
4. C Sankaran, "Power Quality", CRC Press, 2001

**15EEE354****POWER SYSTEM MANAGEMENT****3 0 0 3****Unit 1**

Introduction: Energy security, Future of electricity, Electricity Acts and Regulations. Demand Forecasting: Forecasting techniques and forecasting modelling. Utility Planning: Generation mix, Conventional and non-conventional generation, Cogeneration, Wheeling and banking, Power pooling and trading, Energy storage schemes. Concepts of smart grid.

**Unit 2**

Power System Economics: Time value of money, Methods of depreciation, Payback Calculation, Cost-benefit analysis, Internal rate of return, Net present value, Life cycle coating. Power Supply Reliability: Power system reliability indices, reliability evaluation.

**Unit 3**

Energy Management: Supply side management – issues and remedial measures. Demand Side Management. Operation Planning: Operation and maintenance, reactive power management. Energy Audit.

**TEXTBOOKS / REFERENCES:**

1. Pabla A. S., "Electrical Power System Planning", Macmillan India Ltd., 1998.
2. Wood A. J. and Wollenberg B. F., "Power Generation, Operation and Control", Wiley Interscience, 1996.
3. Stoll H. G., "Least Cost Electric Utility Planning", Wiley Interscience, 1996.
4. Khan E., "Electrical Utility Planning and Regulation", American Council for Energy Efficient Economy, Washington DC, 1968.

**15EEE355 POWER SYSTEM PROTECTION AND SWITCHGEAR 3 0 0 3****Unit 1**

Nature, causes and consequences of faults - Fault statistics - Need for protection - Essential qualities of protection - Types of protection – Primary and back up protection - Instrument Transformers - Basics of switchgear - Fuses, isolators, Earthing switches.

Development of protective relays - Recent developments - Operating principle - Classification of relays based on construction - Electromagnetic relays, Thermal relays, Overview of Static and Microprocessor relays, Numerical Relays - Introduction, Block diagram, Sampling theorem, Anti-Aliasing Filter, Least square method for estimation of phasor, concept of Discrete Fourier Transform to estimate the phasor.

**Unit 2**

Apparatus protection - Bus Bar protection, Transmission Line protection - realization of distance relays using numerical relaying algorithm, Introduction to wide area measurement (WAM) system - Generator protection - Motor Protection - Transformer Protection.

Overvoltage protection - Lightning arresters - Operating principle and types of arresters, Surge absorbers - Insulation co-ordination.

**Unit 3**

Circuit breakers - Operating principle - Arc phenomenon, principle, DC and AC Circuit Breaking - Problems of circuit interruption - Interruption of capacitive currents, Current chopping, Resistance Switching and methods of arc extinction - Arc interruption theories - Arc voltage, restriking voltage, Recovery voltage.

Types of circuit breaker – Construction and Operating Principle – HVDC circuit breaker - Selection of circuit breaker and its ratings - Auto reclosing.

**TEXTBOOKS:**

1. Ravindra P. Singh, "Switchgear and power system protection", Prentice Hall of India, 2009
2. Badri Ram & D N Vishwakarma, "Power system protection and switch gear", Tata McGraw Hill Education, 2001.
3. T. S. Madhava Rao, "Power system protection: Static Relays", Tata McGraw Hill Education, 1989.

**REFERENCES:**

1. A. S. Ingole, "Switchgear and protection" Umesh publication, 2006
2. B. Ravindranath and M. Chander, "Power system protection and switchgear", New age International (P) Ltd., 2003
3. C. Christopoulos and A. Wright, "Electrical power system protection", Springer International edition, 2010.
4. Hadley, et al. Securing Wide Area Measurement Systems, Pacific Northwest National Laboratory. June 2007. URL:[http://www.oe.energy.gov/DocumentsandMedia/Securing\\_WAMS.pdf](http://www.oe.energy.gov/DocumentsandMedia/Securing_WAMS.pdf)

**15EEE356 POWER SYSTEM STABILITY 3 0 0 3**

**Unit 1**

Introduction to power system stability problem - Basic concepts and definitions of rotor angle stability, voltage stability and voltage collapse - Mid term and long term stability - Classification of stability - Small signal stability - Fundamental concepts of stability of dynamic systems - Small signal stability of a single machine infinite bus system - Effects of excitation system.

**Unit 2**

Small signal stability of multi-machine systems - Characteristics of small signal stability problems - Transient stability - An elementary view of transient stability - Simulation of power system dynamic response - Performance of protective relaying - Case study.

**Unit 3**

Sub synchronous oscillations - Introduction - Torsional interaction with power system - Voltage stability - Basic concepts - Voltage collapse - Prevention of voltage collapse - Mid term and long term stability - Nature of system response severe upsets - Case studies.

Methods of improving stability - Transient stability enhancement - Small signal stability enhancement.

**TEXTBOOK:**

Prabha Kundur, "Power system stability and control", Tata McGraw Hill, 2006

**REFERENCES:**

1. K. R. Padiyar, "Power system dynamics - stability and control", B. S. Publications, 2008
2. Peter W. Sauer and M. A. Pai, "Power system dynamics and stability", Pearson Education, 2003.

**15EEE357 POWER SYSTEMS OPERATION, CONTROL AND STABILITY 3 0 0 3**

(Prerequisite: 15EEE402 Electrical Energy Systems II)

**Unit 1**

Power system operation - state transition and control - data acquisition, state estimation, security assessment and security enhancement - functions of control centers - system load variations - system load characteristics - Real and Reactive power flows and control.

**Unit 2**

Basic P-f and Q-V loops, Load frequency control - modeling, analysis and control of single and multi-area - tie line with frequency bias control. Need for Automatic Voltage regulator - Modeling - static and dynamic analysis - Reactive power-voltage control devices. Economic load dispatch with and without losses - solution by iteration method (no derivation of loss coefficient) - Base point and participation factor - Economic controller added to LFC.

**Unit 3**

Power System stability - classifications - Rotor angle stability - small signal stability - Effects of excitation system - Power system stabilizer - sub synchronous oscillations - Voltage stability - Voltage collapse - Methods to improve stability.

**TEXTBOOK:**

1. Olle I. Elgerd, "Electric Energy Systems Theory - An Introduction", Tata McGraw Hill Publishing company, 2004.

2. Prabha Kundur, "Power System stability and control", Tata McGraw Hill, 2006.

**REFERENCES:**

1. Kothari, D. P. and Nagrath, I. J., "Modern Power System Analysis", Tata McGraw Hill Publishing Company, 2003.
2. Allen J. Wood and Bruce F. Wollenberg, "Power Generation Operation and Control", John Wiley & Sons, 1984.
3. L. K. Kirchmayer, "Economic operation of Power System", John Wiley & Sons, 1953.

**15EEE358 PROCESS CONTROL AND INSTRUMENTATION 3 0 0 3**

**Unit 1**

Introduction to process control, process variables, degree of freedom, Industrial measurement systems - different types of industrial variables and measurement systems elements - sensors and transducers for different industrial variables like pressure, torque, speed, temperature etc. - sensor principles - examples of sensors - sensor scaling - Industrial signal conditioning systems - Amplifiers - Filters - A/D converters for industrial measurements systems - review of general Industrial instruments - I/P and P/I converters, pneumatic and electric actuators, valve positioned, control valves - characteristics of control valves, inherent and installed characteristics, valve body, globe, butterfly, diaphragm, ball valves, control valve sizing, cavitations and flashing, selection criterion, Servo drives, Stepper motor drives.

**Unit 2**

Process modeling, characteristics of liquid systems, gas systems, thermal systems, mathematical model of first order level, pressure and thermal process - higher order process, interacting non-interacting systems.

Basic control actions, characteristics of ON-OFF, P, I and D control, PI, PD and PID control modes, Response of controllers for different types of test inputs, pneumatic and electronic controllers to realize various control actions, selection of control mode for different processes, optimum controller settings, tuning of controllers - process reaction curve method, continuous cycling method, damped oscillation method, Ziegler Nichols methods.

1/4 decay ratio, feed forward control, ratio control, cascade control, averaging control, multivariable control, hybrid control, expert systems.

Distillation column, control of top and bottom product compositions, reflux ratios, control of chemical reactors, control of heat exchanger, steam boiler, drum level control and combustion control, P&I diagrams

### Unit 3

Model predictive control - Batch Process control - Plant-wide control & monitoring – Plant-wide control design - Instrumentation for process monitoring - Statistical process control - Introduction to Fuzzy Logic in Process Control - Introduction to OPC - Introduction to environmental issues and sustainable development relating to process industries.

Process Automation - Role of digital computer system in process control, Distributed instrumentation and control system - PLC, DCS, SCADA.

#### TEXTBOOK:

Stephanopoulos. G, "Chemical Process Control", Prentice Hall of India, New Delhi, 1984

#### REFERENCES:

1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, "Process Dynamics and Control", Wiley Dreamtech India (P) Ltd, New Delhi, 2004
2. Ernest O. Doebelin "Measurement systems application and design", McGraw Hill International Editions, McGraw Hill Publishing Company, 2004
3. B. Wayne Bequette, "Process control, modeling, Design and simulation", Prentice Hall of India (P) Ltd., 2003
4. Steve Mackay, Edwin Wright, John Park, "Practical Data Communications for Instrumentation and Control", Newness Publications, UK, 2003

## 15EEE359 RENEWABLE ENERGY AND ENERGY CONSERVATION 3 0 0 3

### Unit 1

Historical development of energy demand and supply systems. Impact of fossil fuel based systems. Energy scenario – global and national; Renewable energy potential – global and national. Renewable energy technologies – stand-alone, hybrid and grid-connected systems.

Solar Energy: Solar radiation, its measurements and analysis. Solar angles, day length, angle of incidence on tilted surface, Sunpath diagrams, Shadow determination. Extraterrestrial characteristics, Effect of earth atmosphere, measurement & estimation on horizontal and tilted surfaces.

Principle of Photovoltaic Conversion - Dark and illumination characteristics, Figure of merits of solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature. Equivalent circuit. Crystalline and thin-film cells. Multi-junction cells. Concentrated PV cell.

Module, panel and array – series and parallel connections. Maximum power point tracking. SPV applications - battery charging, pumping and lighting, power plant. PV system design.

Small Hydro Power - Resource assessment, Environmental restrictions, SHP schemes – types, construction and equipment selection, Load frequency control.

### Unit 2

Wind Energy: Atmospheric circulations. Wind shear and turbulence. Wind monitoring and resource assessment; Weibull parameters. Classification of wind regimes.

Aerodynamic principles - lift and drag forces. Power coefficient and Betz limit. Types and characteristics of wind turbines.

Wind electric generation systems – grid-connected systems: WT-IG, WT-DWIG, WT-DOIG, WT-PMG and WT-VSIG. Comparison of performance. Economic performance.

Development of windfarms, site selection, wake effect, performance indices.

Small WEGs – stand-alone and hybrid systems.

### Unit 3

Biomass energy – Gasifiers and dual fuel engines; Ocean-thermal energy conversion; Tidal energy conversion; Wave energy conversion; Geothermal energy conversion; MHD; Hydrogen and fuel cells.

Energy Conservation in electrical equipment: Energy efficient lighting – luminous efficiency of lamps, efficient lamps, energy conservation codes and lighting design.

Energy conservation in motors – estimation of operating efficiency of industrial motors, right selection of motor ratings, energy efficient motors; auto-stop control, delta-star operation, voltage control; Energy conservation in variable speed operation



of pumps and fans – demerits of mechanical resistance control, advantages of variable speed drives, specific energy consumption, system design using VSD.

**TEXTBOOKS / REFERENCES:**

1. Thomas B Johansson et al, "Renewable Energy sources for fuel and electricity", Earthscan Publishers, London, 1993
2. J W Twidell and A D Weir, "Renewable Energy Resources", ELBS, 1998.
3. G. N. Tiwari, M. K. Ghosal, "Fundamentals of renewable energy sources", Alpha Science International Ltd., 2007.
4. Garg H P., Prakash J., "Solar Energy: Fundamentals & Applications", Tata McGraw Hill, New Delhi, 1997
5. Kastha D, Banerji S and Bhadra S N, "Wind Electrical Systems", Oxford University Press, New Delhi, 1998
6. Tony Burton, David Sharpe, Nick Jemkins and Ervin Bossanyi, "Wind Energy Hand Book", John Wiley & Sons, 2004
7. S. C. Tripathy, "Electric energy utilization and conservation", Tata McGraw Hill Publishing company Ltd., 1987

**15EEE360 SMART GRID 3 0 0 3**

**Unit 1**

Concept of Smart Grid, Definitions, Need and Functions of Smart Grid, Opportunities & Barriers of Smart Grid. Today's grid versus smart grid.

Present development & International policies in Smart Grid. Smart Grid – Overview and stakeholders.

**Unit 2**

Smart Grid Technologies: Communication Technologies for Smart Grid, Interoperability and connectivity,

Layered Architecture and Protocols, Standards for Information Exchange. Information Security in smart grid - Encryption and decryption, Authentication, Digital Signatures, Cyber Security standards. Smart Meters, Demand response. Distribution Side automation and Transmission side automation – PMU. Power electronics in Smart grid.

**Unit 3**

Renewable Energy and Storage Technologies – Distributed generation and storage. Interfacing of RE generation systems and energy storage systems on Smart Grid.

**TEXTBOOKS / REFERENCES:**

1. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley-IEEE Press, March 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, February 2012.
3. Nouredine Hadjsaid, Jean-Claude Sabonnadière, "Smart Grids", Wiley-ISTE, May 2012.
4. Ali Keyhani and Muhammad Marwali, "Smart Power Grids 2011", Springer, 2011.

**15EEE361 SPECIAL ELECTRIC MACHINES 3 0 0 3**

**Unit 1**

Stepping Motors

Introduction to all kinds of special machines, stepper motor, reluctance motors, hysteresis motors, brushless motors etc. Constructional features, Principle of operation, Variable reluctance motor, Hybrid motor, Single and multi-stack configurations, Torque equations, Modes of excitations, Characteristics, Drive circuits, Microprocessor control of stepping motors, Closed loop control.

**Unit 2**

Synchronous Reluctance Motors

Constructional features, Types, Axial and Radial flux motors, Operating principles, Variable Reluctance and Hybrid Motors, Voltage and Torque Equations, Phasor diagram, Characteristics.

Switched Reluctance Motors

Constructional features, Rotary and Linear SRMs, Principle of operation, Torque production, Steady state performance prediction, Analytical method, Power Converters and their controllers, Methods of Rotor position sensing, Sensor less operation, Closed loop control of SRM, Characteristics.

**Unit 3**

Permanent Magnet Synchronous Motors

Permanent Magnet materials, Magnetic Characteristics, Permeance coefficient, Recoil of a magnet, Principle of operation, Ideal PMSM, EMF and Torque equations,

Armature reaction MMF.

Brushless D.C. Motors

Principle of Operation, Types, Magnetic circuit analysis, EMF and torque equations, Commutation, Power Controllers, Motor characteristics and control, Torque/speed characteristics,

**TEXTBOOK:**

S. A Nasar and I. Boldea, L. E. Unnewehr permanent magnet, "Reluctance and self-synchronous motors", CRC Press inc.1993.

**REFERENCES:**

1. Miller, T. J. E. "Brushless permanent magnet and reluctance motor drives", Clarendon Press, Oxford, 1989.
2. T. J. E. Miller (Ed.), "Electronic Control of Switched Reluctance Motor", Newman Power Engineering Series, 2001.
3. Paul Acamley, "Stepping Motor – A Guide to Theory and Practice", IEE London. 2002.
4. B. K. Bose, "Modern power electronics and AC drives", Prentice Hall of India, N J, 2002.

**15EEE362 UTILISATION OF ELECTRIC ENERGY 3 0 0 3**

**Unit 1**

Electric Lighting - Definition of terms; laws of illumination; Luminaries; Lighting requirements; Illumination levels; lamp selection and maintenance; Lighting schemes, calculations & design – Interior lighting – industrial, Factory, residential lighting; Exterior lighting - Flood, street lighting, lighting for displays and signaling - neon signs, LED-LCD displays beacons and lighting for surveillance; Energy Conservation codes for lighting; lighting controls – daylight sensors and occupancy sensors; controller design.

**Unit 2**

Electric Drives - Selection of motors in various applications; Electric drive systems in various industries; speed control of motors, variable speed drives, Specifications of commonly used motors. Energy efficient drives.

Space conditioning systems - Heating, Ventilation, and Air Conditioning (HVAC) systems: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants; Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers;

Electrochemical Processes - Electrolysis. Electroplating. Electrodeposition. Extraction of metals.

**Unit 3**

Electric Heating – Comparison with other heating methods; Resistance heating, Induction heating, Arc furnace, Dielectric heating; Electric welding – types, equipment and modern techniques.

Electric Traction - Traction systems; Speed-time curves and mechanics of train movement; Traction motors; Control of motors; Electric braking methods;

Regeneration. Electric Vehicles – Types of electric vehicles and hybrid vehicles; motors and batteries for EV; Drive systems for electric traction.

**TEXTBOOK:**

S C Tripathy, "Electric Energy Utilisation and Conservation", Tata McGraw Hill, 1987.

**REFERENCES:**

1. H Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai & Co., 2014
2. Howard B Cary and Scott C Helzer, "Modern Welding Technology", Prentice Hall, 2004
3. Craig Di Louie, "Advanced Lighting Controls: Energy Savings, Productivity, Technology and Applications", CRC Press, 2005
4. William C. Whitman, William M. Johnson "Refrigeration & Air Conditioning Technology", Thomson Delmar, 2005

**15EEE381 DIGITAL SYSTEMS AND SIGNALS LAB. 0 0 2 1**

Half adder and full adder implementation - Boolean Equation Implementation - Multiplexer and Demultiplexer implementation - Asynchronous and Synchronous counters Implementation using D, T and JK flip flops.

Generation of signals - ramp, sine, exponential, etc. using MATLAB; Discrete Linear Convolution implementation; Fourier transform and Fourier Series Implementations; DFT Implementation; Power signal analysis using FT/DFT.

**15EEE382 ELECTRICAL MACHINES LAB. II 0 0 2 1**

No load and load characteristics of three phase alternators - Regulation by different methods and efficiency calculation - no load, blocked rotor and load tests on single phase and three phase induction machines - Characteristics of synchronous induction motor and induction generator -Speed control and starting methods of AC machines - synchronization to infinite bus bars - V curves and inverted V curves of synchronous motor.

**15EEE385 DSP AND MICROCONTROLLER LAB. 0 0 2 1**

Simple logic programs to understand MPLAB; LED Blinking Program, Timer 0,1 and Timer 2 Programming; key board Interfacing; ADC-PWM interfacing with dc motor using PROTEUS.

DFT analysis' Circular convolution using m file; Filter Design using FDA tool and Testing; SIMULINK analysis of harmonic signal.

**15EEE386 POWER ELECTRONICS LAB. 0 0 2 1**

SCR characteristics, MOSFET switching characteristics, AC phase control using SCR, Triac and Diac, Single phase half controlled bridge converter, UJT Relaxation Oscillator for SCR triggering application, Series Inverter, Single phase transistorized inverter, Speed control of DC Motor using Chopper Drive, Simulation of full bridge converter, single phase single pulse width modulated MOSFET inverter, sinusoidal unipolar pulse width modulation.

**15EEE387 OPEN LAB. 0 1 2 2**

This is a hands - on sections for the students. By the sixth semester, the students are adept in different core streams like Power Electronics, Power Systems, Electrical machines, Energy systems, Digital Signal Processing etc. The students will apply their acquired knowledge and develop an application related to one or more of the core areas and implement a pragmatic setup, justifying the application.

**15EEE390 / 15EEE490 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.

**15EEE401 ELECTRIC DRIVES AND CONTROL 3 1 0 4**  
(Pre-requisite: 15EEE313 Power Electronics)**Unit 1**

Introduction: Concepts, and classification of Electric drives. Selection of motors. Dynamics of Electric drives: Types of loads, Multi quadrant operations, motor dynamics steady state stability and transient stability. Rating and Heating of motors: Heating effects, heating and cooling curves, classes of duty, load equalization, environmental factors.

DC motor drives: Basic characteristics, Operating modes, Single phase and three phase controlled rectifier fed DC drives, Dual converters drives, Chopper drives, Rheostatic and regenerative braking, effects of changes in supply voltage and load torque, closed loop control schemes.

**Unit 2**

AC motor drives: Induction motor drives, stator voltage control, stator impedance control, rotor voltage control - Slip power recovery, Concepts of Static Kramer drives and Static Scherbius drive, V/f control, Current control method. Need for harmonic filter, Closed loop control. Introduction to vector control scheme.

**Unit 3**

Synchronous motors: Speed torque characteristics and torque angle characteristics. Fixed and variable frequency operation modes, Self-control modes.

Special machines: Brushless DC motor, Switched Reluctance Motor, introduction to the relevant converter circuits.

**TEXTBOOK:**

Gopal K. Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House, 2001.

**REFERENCES:**

1. Pillay. S. K, *A First Course on Electric Drives*, Wiley Eastern Limited, Bombay, 2012
2. B. K Bose, 'Modern Power Electronics and AC Drives', Prentice Hall, New Jersey, 2002.
3. V. Subrahmanyam, 'Thyristor Control of Electric Drives', Tata McGraw Hill, New Delhi, 1988.
4. R. Krishnan, 'Electric Motor Drives, Modeling, Analysis and Control', Prentice Hall, NJ, 2001.
5. Muhammad H. Rashid, *Power Electronics, Circuits, Devices and Applications*, Third Edition, Pearson Education Press, 2004.

**15EEE402 ELECTRICAL ENERGY SYSTEMS II 3 1 0 4**  
(Pre-requisite: 15EEE312 Electrical Energy Systems I)**Unit 1**

Single line diagram – per unit representation – power system modeling – bus admittance and impedance matrix – Load flow analysis – Gauss seidel, Newton Raphson and Fast decoupled load flow methods – comparison of methods.

**Unit 2**

Short circuit analysis – symmetrical faults – behavior of short circuit transients in generator and transmission line – selection of circuit breaker – symmetrical components – sequence diagram – unsymmetrical faults – open conductor fault – LG, LL and LLG faults.

**Unit 3**

Power System stability – dynamics of synchronous machine – swing equation – steady state and transient stability – equal area criterion – critical clearing time – Multi machine stability.

**TEXTBOOK:**

Kothari, D. P. and Nagrath, I. J., "Power System Engineering", Third Edition, Tata McGraw Hill Publishing Company, 2003.

**REFERENCES:**

1. Kothari, D. P. and Nagrath, I. J., "Modern Power System Analysis", Tata McGraw Hill Publishing Company, 2003.
2. Hadisaadat, "Power System Analysis", McGraw Hill Publishing Company, 2003.
3. Wadwa, C. L., "Electrical Power Systems", Wiley Eastern Limited, India, 2007.
4. John J. Grainger and Stevenson Jr. W. D., "Power System Analysis", McGraw Hill International edition, 1996.

**15EEE481 DRIVES AND CONTROLS LAB. 0 0 2 1**

DC Machine modeling and simulation; Phase-controlled DC Motor Drives; DC/DC Chopper Controlled DC Motor Drives; Induction Motor Drives; Stepper motor drive; Servo drive.

**15EEE482 POWER SYSTEMS LAB. 0 0 2 1**

Development of software packages to calculate line parameters, Load flow analysis, Short circuit analysis, Transient stability analysis, Power system transients, Load frequency dynamics and Economic dispatch.

**15EEE495 PROJECT PHASE I 2 cr**

Each student is to do a project and prepare a seminar paper related to Electrical Engineering in an approved format and present it at the end of the semester.

**15EEE499 PROJECT PHASE II 10 cr**

The project shall be focused on the synthesis of the knowledge gained over the past seven semesters, by taking up a work of relevance to Electrical and Electronics Engineering covering Design / Development / Realization / Application / Performance Analysis / State-of-the-art Technology.

**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, Roopanthar ki Drishti se - Bhasha – Paribhasha aur Bhed - Sangya - Paribhasha Aur Bhed - Sangya ke Roopanthar - 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, Juluos.

**BOOKS:**

1. Prem Chand Ki Sravshrestha 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; Dhumi 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 Pusthakalay, Mathura.
2. Gadya Manjusha: Editor: Govind, Jawahar Pusthakalay, 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 paramourty – Kautilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

**Unit 2**

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

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

The arrival of Europeans, British paramourty 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 varnashramadharm – 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) – Yudhishthira'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, Murlu 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:**

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

**REFERENCE BOOKS:**

1. 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, Simon and Schuster, New York.
- 11 Eternal Values for a Changing Society, Swami Ranganathananda, Bharatiya Vidya Bhavan.
- 12 Universal Message of the Bhagavad Gita, Swami Ranganathananda, Advaita Ashrama.
- 13 Awaken Children: Conversations with Mata Amritanandamayi
- 14 Indian Aesthetics, V. S. Seturaman, Macmillan.
- 15 Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.
- 16 Web of Indian Thought, Sister Nivedita
- 17 Essays on Indian Nationalism, Anand Kumaraswamy
- 18 Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi
- 19 The Invasion That Never Was, Michel Danino
- 20 Samskara, U. R. Ananthamurthy, OUP.
- 21 Hayavadana, Girish Karnard, OUP.
- 22 Naga-Mandala, Girish Karnard, OUP.

**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 – Kavya Tradition – 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 Sastry, 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 – AN INDIAN PERSPECTIVE 2 0 0 2**

**Unit 1**

Introduction

Western and Indian views of science and technology

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

**Unit 2**

Indian sciences

Introduction; Ancient Indian medicine: towards an unbiased perspective; Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD.

Science and technology under the British rule

Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

**Unit 3**

Science and technology in Independent India

Introduction; An assessment of traditional and modern energy resources; Green

revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition

Introduction; Regeneration of Indian national resources; Annamahatmyam and Annam Bahu Kurvita: recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration of Indian agriculture to ensure food for all in plenty.

Conclusion

**REFERENCES:**

1. Joseph, George Gheverghese. *The Crest of the Peacock: Non-European Roots of Mathematics*. London: Penguin (UK), 2003.
2. Iyengar, C. N. Srinivasa. *History of Hindu Mathematics*. Lahore: 1935, 1938 (2 Parts).
3. Amma, T. A. Saraswati. *Geometry in Ancient and Medieval India*. Varanasi: Motilal Banarsidass, 1979.
4. Bag, A. K. *Mathematics in Ancient and Medieval India*. Varanasi: Motilal Banarsidass, 1979.
5. Sarma K. V. & B. V. Subbarayappa. *Indian Astronomy: A Source-Book*. Bombay: Nehru Centre, 1985.
6. Sriram, M. S. et. al. eds. *500 Years of Tantrasangraha: A Landmark in the History of Astronomy*. Shimla: Indian Institute of Advanced Study, 2002.
7. Bajaj, Jitendra & M. D. Srinivas. *Restoring the Abundance: Regeneration of Indian Agriculture to Ensure Food for All in Plenty*. Shimla: Indian Institute of Advanced Study, 2001.
8. Bajaj, Jitendra ed. *Report of the Seminar on Food for All: The Classical Indian Discipline of Growing and Sharing Food in Plenty*. Chennai: Centre for Policy Studies, 2001.
9. Bajaj, Jitendra & M. D. Srinivas. *Annam Bahu Kurvita: Recollecting the Indian Discipline of Growing and Sharing Food in Plenty*. Madras: Centre for Policy Studies, 1996.
10. Parameswaran, S. *The Golden Age of Indian Mathematics*. Kochi: Swadeshi Science Movement.
11. Somayaji, D. A. *A Critical Study of Ancient Hindu Astronomy*. Dharwar: 1972.
12. Sen, S. N. & K. V. Sarma eds. *A History of Indian Astronomy*. New Delhi, 1985.
13. Rao, S. Balachandra. *Indian Astronomy: An Introduction*. Hyderabad: Universities Press, 2000.
14. Bose, D. M. et. al. *A Concise History of Science in India*. New Delhi: 1971.
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, Murl 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 BHAGAVAD GITA 2 0 0 2**

**Unit 1**

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

Arjuna Vishada 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 foodvalue 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, swaroppa, belavanigeya kiru parichaya  
Paaribhaashika 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. Nissaar 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 .PrecisWriting; 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, Lavanyanubhavathinte Yukthisasthram, 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.

**Unit 1**

Ancient poet trio: Kalayanasougandhikam, (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 1.1 and 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.

**15MAT203 TRANSFORMS AND COMPLEX ANALYSIS 3 1 0 4**

**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. Convolution, Integral Equations, Partial Fractions, Differential Equations, Systems of Differential Equations.

**Unit 2**

Fourier Series: Fourier series, Half range Expansions, Parseval's Identity, Fourier Integrals, Fourier integral theorem. Sine and Cosine Integrals.

Fourier Transforms: Sine and Cosine Transforms, Properties, Convolution theorem.

**Unit 3**

Complex Analysis: Complex Numbers, Complex Plane, Polar Form of Complex Numbers. Powers and Roots, Derivative. Analytic Functions, Cauchy - Riemann Equations, Laplace Equation, Conformal mapping, Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarithms, General Power, Linear Fractional Transformation. Complex Line Integral, Cauchy Integral Theorem, Cauchy Integral Formula, Derivatives of Analytic Functions.

Power Series, Taylor Series and Maclaurin Series. Laurent Series, Zeros and Singularities, Residues, Cauchy Residue Theorem, Evaluation of Real Integrals using Residue Theorem.

**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

**15MAT214 PROBABILITY AND STATISTICS 2 1 0 3**

**Unit 1**

Probability Concepts: Review of probability concepts - Bayes' Theorem.

Random Variable and Distributions: Introduction to random variable – discrete and continuous distribution functions - mathematical expectations – moment generating functions and characteristic functions. Binomial, Poisson, Geometric, Uniform, Exponential, Normal distribution functions (MGF, mean, variance and simple problems) – Chebyshev's theorem

**Unit 2**

Sampling Distributions: Distributions of Sampling Statistics, Chi-square, t and F distributions (only definitions and use). Central Limit Theorem. Theory of estimation: Point Estimation, Unbiased estimator - Maximum Likelihood Estimator - Interval Estimation.

**Unit 3**

Testing of Hypothesis: Large and small sample tests for mean and variance – Tests based on Chi-square distribution.

**TEXTBOOK:**

Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, (2005) John Wiley and Sons Inc.

**REFERENCE BOOKS:**

1. J. Ravichandran, "Probability and Random Processes for Engineers", First Edition, IK International, 2015.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition (2007), Pearson Education Asia.

3. Sheldon M Ross, *Introduction to Probability and Statistical Inference, 6th Edition, Pearson.*
4. A. Papoulis, and Unnikrishna Pillai, *"Probability, Random Variables and Stochastic Processes", Fourth Edition, McGraw Hill, 2002.*

**15MAT303 OPTIMIZATION TECHNIQUES 2 1 0 3**

**Unit 1**

Introduction

Optimization - optimal problem formulation, engineering optimization problems, optimization algorithms, numerical search for optimal solution.

**Unit 2**

Single Variable optimization

Optimality criteria, bracketing methods - exhaustive search method, bounding phase method - region elimination methods - interval halving, Fibonacci search, golden section search, point estimation method - successive quadratic search, gradient based methods.

**Unit 3**

Multivariable Optimization

Optimality criteria, unconstrained optimization - solution by direct substitution, unidirectional search – direct search methods evolutionary search method, simplex search method, Hook-Jeeves pattern search method, gradient based methods – steepest descent, Cauchy's steepest descent method, Newton's method, conjugate gradient method - constrained optimization. Kuhn-Tucker conditions.

**TEXTBOOK:**

S. S. Rao, *"Optimization Theory and Applications", Second Edition, New Age International (P) Limited Publishers, 1995.*

**REFERENCES:**

1. Kalyanmoy Deb, *"Optimization for Engineering Design Algorithms and Examples", Prentice Hall of India, New Delhi, 2004.*
2. Edwin K. P. Chong and Stanislaw H. Zak, *"An Introduction to Optimization", Second Edition, Wiley-Interscience Series in Discrete Mathematics and Optimization, 2004.*
3. M. Asghar Bhatti, *"Practical Optimization Methods: with Mathematics Applications", Springer Verlag Publishers, 2000.*

**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*

**15MEC111 FUNDAMENTALS OF MECHANICAL ENGINEERING 3 0 0 3**

**Unit 1**

Principles of Statics – Introduction to Mechanics, Basic Concepts, Fundamentals and Principles. Statics of Particles in two dimension-Resolution of forces, Resultant force, equilibrium of particle, Freebody diagram, Lami's theorem. Statics of Rigid Bodies in two dimensions-Moment of a force about a point, Varignon's theorem, moment of a couple, resolution of a force system into a force couple system, reduction to a single force system. Equilibrium of rigid bodies-Analysis of beams, supports and reactions.

**Unit 2**

Thermodynamics – Introduction, Concepts of thermodynamic system, properties – specific volume, pressure, temperature – Zeroth law of thermodynamics, energy forms – work and heat.

First Law of Thermodynamics – for a closed system undergoing a cycle, for a process, energy as a property, specific heats, first law of TD applied to steady flow devices.

Second Law of Thermodynamics – concept of heat engines and refrigerators, Kelvin plank and Clausius statements, irreversibility, Carnot cycle, Clausius inequality, thermodynamic temperature scale, concept of entropy, principle of increase of entropy.

**Unit 3**

Engineering Materials – Types and applications of Ferrous & Non-ferrous metals and alloys, Composites: Introduction, Definition, Classification and applications Soldering, Brazing and Welding - Definitions, classification and method of soldering, brazing and welding. Differences between soldering, brazing and Welding. Description of Electric Arc Welding and Oxy-Acetylene Welding.

**TEXTBOOKS:**

1. R. C. Hibbeler. "Engineering Mechanics - Statics", Pearson Education Asia, 2012
2. Y. A. Cengel and Michael A. Boles, "Thermodynamics – An Engineering Approach", Tata McGrawHill, 2013
3. V. K. Manglik. "Elements of Mechanical Engineering", PHI Learning Pvt. Ltd. 2013

**REFERENCES:**

1. J L Meriam & L. G Kraige. "Engineering Mechanics - Statics", 7th edition, Wiley India Pvt. Ltd, 2013
2. Beer and Johnston, "Vector Mechanics for Engineers", Tata McGraw Hill Publishing Company Ltd 2012
3. N. H Dubey. "Engineering Mechanics Statics and Dynamics", McGraw Hill, 2012
4. R. E. Sonntag, C. Borgnakka and G. J. Van Wylen, "Fundamentals of Thermodynamics", John Wiley & Sons, 2002
5. Hajra Choudhury, "Elements of Workshop Technology", Volume I, 15e

**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.

**2. Pneumatics and PLC Workshop**

Study of pneumatic elements - Design and assembly of simple circuits using basic pneumatic elements - Design and Assembly of simple circuits using Electro-pneumatics. Study of PLC and its applications - Simple programming using ladder diagrams.

**3. Sheet Metal Workshop**

Study of tools and equipments - Draw development drawing of simple objects on sheet metal (cone, cylinder, pyramid, prism, tray etc.) Fabrication of components using small shearing and bending machines - Riveting and painting practice.

**4. (a) Welding Workshop**

Study of tools and equipments - Study of various welding methods - Arc welding practice and demonstration of gas welding and cutting.

**(b) Demo and practice Workshop**

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

Carpentry: Study of tools, planning practice and making joints

**REFERENCE:**

Concerned Workshop Manual

**15MEC305 THERMAL ENGINEERING AND FLUID MACHINERY 3 0 0 3**

**Unit 1**

Vapour Power Systems: Pure substance, formation of steam, components of vapour power plant, ideal Rankine cycle, effect of boiler and condenser pressure, improving performance – super heat and reheat.

Gas Power Systems: Components of diesel power plant, Internal combustion engines - terminology, classification, air standard Otto cycle and Diesel cycle, indicated power, brake power, efficiencies, specific fuel consumption. Components of gas turbine power plant, modelling of gasturbine power plant, air standard Brayton cycle, generative gas turbines.

**Unit 2**

Fluid Machinery: Classification of fluid flow, properties of fluid, pressure variation in a fluid at rest, measurement of pressure, continuity, momentum and energy equations, applications of Bernoulli equation, Components of hydro power plant, centrifugal pumps – working principle, performance characteristics. Hydraulic turbines – classification, principles and operations of Pelton wheel, Francis turbine and Kaplan turbine.

**Unit 3**

Heat Transfer: Modes of heat transfer – conduction, convection and radiation. One dimensional steady state heat conduction through plane wall and cylinder, concept of insulation, critical thickness of insulation, heat transfer from extended surfaces, heat transfer with heat generation.

**TEXTBOOKS:**

1. Michael J. Moran, Howard N. Shapiro, Bruce R. Munson, David P. DeWitt, "Introduction to Thermal Systems Engineering", John Wiley & Sons, 2003
2. R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, 2015

**REFERENCE BOOKS:**

1. Yunus A.Cengel and Michael A. Boles, "Thermodynamics – An engineering approach", Tata McGraw Hill, 2008
2. Yunus A. Cengel and John M. Cimbala, "Fluid Mechanics – Fundamentals and applications", Tata McGraw Hill, 2005
3. Yunus A. Cengel, "Heat Transfer – A Practical approach", Tata McGraw Hill, 2005
4. Incropera F. P and DeWitt D. P., "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1988

**15PHY100 PHYSICS 3 0 0 3**

**Unit 1 Review of Classical Physics and dual nature of Waves /particle**

Review of Kinematics, Force, Newton's Laws, Linear Momentum, Work, Energy, Power, Angular Motion - Kinematics and Mechanics, Angular momentum Torque, Conservation laws (linear and angular).

Particle properties of waves: Photoelectric effect, quantum theory of light, X-ray diffraction, Compton effect, pair production. Wave properties of particles: Waves, De Broglie waves, Group velocity and phase velocity, uncertainty principle.

**Unit 2 Atomic Structure and Quantum Mechanics**

Atomic Structure: Various models of atom, Atomic Spectra, Energy Levels, Correspondence Principle, Nuclear Motion, Atomic Excitation, and Rutherford Scattering.

Quantum Mechanics: Introduction - wave equation - Schrodinger's equation (time dependent and independent) - expectation values, operators, Eigen value (momentum and energy) - 1D potential box (finite and infinite) - tunnel effect - harmonic oscillator.

**Unit 3 Statistical Mechanics and Solid State Physics**

Statistical Mechanics: Classical Distribution - Maxwell's Boltzmann-Molecular energies of an ideal gas - most probable speed. Quantum Statistics - Bose-Einstein and Fermi-Dirac. Applications - Black Body Radiation, Specific heat of solids, free electrons in metals, Electron energy.

Solid State Physics: Types of solids, Crystallography, Bonds - Ionics, Covalent, and Van der Waals, Band Theory and energies, Semiconductor Devices, and Superconductivity.

**TEXTBOOK:**

"Concept of Modern Physics", Arthur Beiser, Tata-McGraw Hill, edition.

**REFERENCE BOOK:**

"Principles of Physics" by Halliday, Resnick and Walker, 9th edition

**15PHY181 PHYSICS LAB. 0 0 2 1**

Young's Modulus – Non Uniform Bending  
 Newton's Rings  
 Laser - Determination of Wavelength and Particle Size Determination Spectrometer  
 Carey Foster's Bridge

Rigidity Modulus - Tensional Pendulum  
 Viscosity of Liquid by Stokes's method  
 Ultrasonic Interferometer  
 Hysteresis – B H curve

**15PHY230 ADVANCED CLASSICAL DYNAMICS 3 0 0 3**

**Unit 1**

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

**Unit 2**

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

Rotational kinematics and dynamics

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

**Unit 3**

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

Practical rigid body problems

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

**TEXTBOOKS:**

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

**REFERENCE BOOKS:**

1. D. A. Walls, *Lagrangian Mechanics, Schaum Series, McGraw Hill, 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 its 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 its 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", Wiley, 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 Electrodynamics", 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. Silvest, 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:



**TEXTBOOK:**

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

**REFERENCES:**

1. Peter Würfel, "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) CO<sub>2</sub> 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 Siffvast, "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                      3 0 0 3**  
**AND NANOTECHNOLOGY**

**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 et al, *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: Cosmic 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 Nirnayasagar press

**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) Subhashitas, 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.thegrammarbook.com](http://www.thegrammarbook.com) - online teaching resources  
[www.englishpage.com](http://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.

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

**TEXTBOOKS:**

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quick Maths – Tyra.*
6. *Quicker Arithmetic – Ashish Aggarwal*
7. *Test of reasoning for 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](http://www.thegrammarbook.com) - online teaching resources  
[www.englishpage.com](http://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, personal 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. Aggarwal, 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.*

## 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](http://www.terapiacognitiva.eu/dwl/dsm5/DSM-IV.pdf)
2. American Psychiatric Association. (2000) [www.ccsa.ca/Eng/KnowledgeCentre/OurDatabases/Glossary/Pages/index.aspx](http://www.ccsa.ca/Eng/KnowledgeCentre/OurDatabases/Glossary/Pages/index.aspx).
3. Canadian Mental Health Association, Ontario "Workplace mental health promotion, A how to guide" [wmhp.cmhaontario.ca/](http://wmhp.cmhaontario.ca/)
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](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](http://www.tnhealth.org/mha.htm)
7. Persons with disabilities Act 1995 (India) [socialjustice.nic.in](http://socialjustice.nic.in)
8. The Factories Act 1948 (India) [www.caaa.in/Image/19ulabourlawshb.pdf](http://www.caaa.in/Image/19ulabourlawshb.pdf)

**Objectivs :** 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) – purāṇānūru (74,112,184,192 pāṭalkaḷ) – tirukkuraḷ (iṟaimāṭci, amaiccū)

### Unit 2

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

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

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

### Unit 3

Novel: Jeyakāntaṇ "kuru pīṭam"

Essay: Aṇṇā "ē tāḷnta tamiḷakamē"

### Unit4

Tirunāṇa campantar – tirunāvukkaracar – cuntarar – māṇikka vācakar – āṇṭāḷ – tirumūlar – kulacēkara āḷvār – cīttalaic cāttāṇār toṭarpāṇa ceytikal, mēṟkōḷkaḷ marṛum ciṟappup peyarkaḷ

### Unit 5

Tamil Grammar: Col vakaikaḷ - vēṟṟumai urupukaḷ - valliṇam mikumiṭam

mikāyiṭam - canti(puṇarcci) - ilakkaṇakkuṟippu.

Practical skills: Listening, speaking, writing and reading

### Textbooks:

- Aṇṇā "ē tāḷnta tamiḷakamē" nakkīraṇ papḷikēṣaṇs.
- Caktitācaṇ cupramaṇiyaṇ "nalla kuṟuntokai mūlamumuraiyum" mullai patippakam, 2008.
- <http://Www.Tamilvu.Org/libirary/libindex.Htm>.

