15AVP201 /   AMRITA VALUES PROGRAMME I /   1 0 0 1
15AVP211   AMRITA VALUES PROGRAMME II   1 0 0 1

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

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

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

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

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

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

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

Lessons from the Upanishads
Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The

Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, 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 Paramahamsa, 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 'Únity 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 - co-ordinate covalent compounds and their characteristics, molecular orbital theory for H_2, N_2, O_2 and CO, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 2
Thermodynamic Parameters

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

Kinetics

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

Unit 3
Electrochemistry

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

Photochemistry

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

REFERENCE BOOKS

Physical chemistry, Puri and Sharma
Inorganic chemistry, Puri and Sharma

15CHY181   **CHEMISTRY LAB.**   **0 0 2 1**

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

15CHY231   **ADVANCED POLYMER CHEMISTRY**   **3 0 0 3**

Unit 1
Newer Polymers and Polymerizations: Polymeric Liquid Crystals - Inorganic and Organometallic polymers - Synthesis and reactions of Phosphorus - Nitrogen polymers - Boron - Silicone polymers. Cyclisation versus Linear Polymerization - Molecular weight control in linear polymerization - Molecular weight distribution in linear polymerization - Molecular weight distributions in nonlinear polymerization - Multichain Polymerization - Metallocene Polymerization.

Unit 2
Solid-state irradiation polymerization - Atom transfer radical polymerization - Plasma Polymerization - Zwitterionic Polymerization - Isomerization polymerization - Polymer supported solid phase reactions - Merrifield method.
Polymer degradation and stabilization: Mechanism of different types of degradation - Commonly used antidegradants and the mechanism of their stabilization.

Unit 3
Polymer solutions: Criteria for solubility - Heat of Dissolution and Solubility parameters - Conformation of polymer chains in solutions - Nature of polymer molecules in solution - Size and shape of macromolecules in solution - Thermodynamics of polymer solutions - Phase equilibria - Entropy and heats of mixing of polymer solutions - Effect of molecular weight on solubility - Solubility of crystalline and amorphous polymers - Flory Huggins theory of polymer solution, Equation of state theory, Flory Krigbaum theory and cluster type theory - Viscosity of dilute polymer solutions.

TEXTBOOKS:
1. George Odian, "Principles of Polymerization", John Wiley & Sons Inc., New York, (1991).
2. Malcolm P. Stevens, "Polymer Chemistry", Oxford University Press, New York, (1999).
REFERENCES:
1. Harry R Allcock and Frederick W Lampe, "Contemporary Polymer Chemistry", 2nd edition, Prentice Hall, Inc., New Jersey, (1990).
2. Charles E Carraher, Jr., "Polymer Chemistry", 5th edition, Marcel Dekker Inc., New York, (2000).
3. Jayadev Sreedhar and Govariker, "Polymer Chemistry".

15CHY232   **BIOMATERIALS SCIENCE**   **3 0 0 3**

Unit 1
Introduction: Bulk properties, Surface properties and characterization - polymers, silicone biomaterials, medical fibres and biotextiles - Smart polymers - bioresorbable and bioerodible materials - natural materials, metals and ceramics - physicochemical surface modification.

Biocompatibility concepts: Introduction to biocompatibility - cell material interaction – types of materials - toxic, inert, bioactive - long term effects of materials within the body - cell response.

Unit 2
Chemical and biochemical degradation of polymers - degradation of metals and ceramics - calcification of biomaterials.

Host reactions and their evaluation: Inflammation and foreign body response - adaptive immunity - systemic toxicity and hypersensitivity - blood coagulation and blood materials interactions - device related infections.

Unit 3
Biological testing of biomaterials: Invitro and invivo assessment of tissue compatibility - evaluation of blood materials interaction - microscopy in biomaterials.

Practical aspects of biomaterials: Bioelectrodes, biomedical sensors and biosensors - sterilization of implants - implant failure - implant retrieval and evaluation - legal aspects, ethical issues and regulation aspects.

TEXTBOOK:
Buddy D Ratner, Allan S Hoffman, "Biomaterials Science - An introduction to materials in Medicine", Elsevier academic press, (2004).
REFERENCES:
1. Jonathan Black, "Biological Performance of Materials: Fundamentals of Biocompatibility", 4th edition, CRC Press, (2006).
2. John D. Enderle, Susan M. Blanchard, Joseph D. Bronzino, "Introduction to Biomedical Engineering", 2nd edition, Elsevier Academic Press, 2005.

15CHY233   **CATALYTIC CHEMISTRY**   **3 0 0 3**

Unit 1
Catalysis: Introduction, Industrial applications. Rates of reactions - equilibrium, energy of activation and the catalyst's role, Elementary reactions in catalytic transformations homogeneous and heterogeneous catalysis.

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

Unit 2
Catalysis by macromolecules, Phase transfer catalysis.

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

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

Unit 3
Catalysis in polymer gels, bifunctional and multifunctional catalysis, porous polymers, Applications of polymer catalysis.

Catalysis in Molecular scale cavities: Structures of crystalline solids, structure of Zeolites, catalysis by Zeolites, catalysis by Zeolites containing metal complexes and clusters. Catalysis on surfaces – surface catalysis, catalysis on metal surfaces.

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

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

15CHY234   CHEMISTRY OF ADVANCED MATERIALS   3 0 0 3

Unit 1
Chemistry of Engineering Plastics: Preparation, properties and applications of ABS, polycarbonates, epoxy resins - polyamides - Nylon and Kevlar.

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

Unit 2
Electron transfer studies in salt based conductors and magnets: Introduction - definitions and units - ferromagnets and ferrimagnets. One-dimensional conductors

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

Unit 3
Functional electro active polymers: Conjugated polymers - synthesis, processing and doping of conjugated polymers: polyacetylene, polyaniline, polythiophene, poly (p-phenylenevinylene) - ionically conducting polymers - applications of conjugated polymers. Semi-conducting, poly ferrocene - photo resist optical fibers and sensors, photo chromic & thermo chromic materials.

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

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

TEXTBOOKS:
1. *Van Vlack, Lawrence H, "Elements of Material Science and Engineering", 6th edition, New York Addison, Wesley, (1989).*
2. *Chawla S, "A Textbook of Engineering Chemistry", Dhanpat Rai & Co, Delhi, (2001).*
REFERENCES:
1. *Mark Ratner and Daniel Ratner, 'Nano technology - A gently introduction to the next big idea', Pearson Education, (2003).*
2. *Interrante L. V. and Hampden Smith M.J, 'Chemistry of Advanced Materials', Wiley-VCH, (1988).*

15CHY235   CHEMISTRY OF ENGINEERING MATERIALS   3 0 0 3

Unit 1
Chemical materials in Electronics and Electrical Engineering: Structural correlation to behavior of conducting polymers, Semi-conducting polymers - properties of organic polymers containing metal groups such as poly ferrocene - optical fibers - definition, principle and structure - characteristics of optical fibre - photo resist optical fibre - advantages of optical fibre - liquid crystalline - peizo and pyroelectric polymers - magnetic materials, hard and soft magnets – sensors (voltametric).

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

Unit 2

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

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

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

Unit 3

Florescence and Phosphorescence - chemiluminescence - photo sensitization.

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

TEXTBOOK:

1. 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:

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

15CHY236   CHEMISTRY OF NANOMATERIALS   3 0 0 3

Unit 1

Introduction: Introduction to Nanomaterials: Size dependence of properties - Surface to volume ratio and Quantum confinement. Microscopic techniques to study nano structures - SEM, AFM - TEM and STM - Raman spectroscopy.
Synthesis of Nanomaterials: Synthetic approaches: Colloidal Self-Assembly (Self-assembled monolayers - SAMs) and electrostatic self-assembly, electrochemical methods, sol-gel deposition.

Unit 2

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

Carbon nanostructures: Carbon Clusters: Fullerenes, structure, synthesis, alkali doped C60 - superconductivity in C60, applications of fullerenes. Carbon nanotubes: Classification, properties, synthesis, characterization, and potential applications, growth mechanism of carbon nanotubes.

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

Unit 3

Fabrication and applications of conducting polymer nanotubes, TiO_2 and metallic nanotubes.

Molecular Electronics and Machines: Molecular electronics: Working of Molecular and supramolecular switches, transistors and wires. Molecular machines: Working of Molecular motors, rotors, cars, elevators and valves.

TEXTBOOKS:

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

REFERENCES:

1. Rao C N R, Muller A, Cheetham A K (Eds.), "The Chemistry of Nanomaterials: Synthesis, Properties and Applications", WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, (2004).
2. Zhong Lin Wang, "Characterization of nanophase materials", Wiley VCH, (2000).
3. Massimiliano Di Ventra, Stephane Evoy, James R Heflin, "Introduction to nanoscale science and technology", Kluwer Academic Publishers, (2004).
4. William A Goddard, III, Donald W Brenner, Sergey Edward Lyshevski and Gerald J. 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", Marshell Dekker Inc. 2003

15CHY239   COMPUTATIONAL CHEMISTRY AND   3 0 0 3
MOLECULAR MODELLING

Unit 1

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

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

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

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

Unit 2
Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

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

Unit 3
Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

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

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

TEXTBOOKS:

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

2. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*

3. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

1. *James B Forseman and Aeleen Frisch-Gaussian, "Exploring Chemistry with Electronic Structure Method", Inc., Pittsburgh, PA, 2nd edition, (2006).*

2. *A C Philips, "Introduction to Quantum mechanics", Wiley, (2003).*

3. *Wolfram Koch, Max C. Holthausen, "A Chemist's guide to Density Functional Theory", Wiley, VCH, 2nd edition, (2001).*

15CHY241   ELECTROCHEMICAL ENERGY SYSTEMS   3 0 0 3
AND PROCESSES

Unit 1
Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2
Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

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

Unit 3
Reserve batteries and Fuel cells: Reserve batteries - water activated, electrolyte activated and thermally activated batteries - remote activation - pyrotechnic materials. Fuel Cells: Principle, chemistry and functioning - carbon, hydrogen-oxygen, proton exchange membrane (PEM), direct methanol (DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

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

TEXTBOOKS:

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

REFERENCES:

1. *Christopher M A, Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, (2004).*
2. *Watanabe T, "Nano-plating: microstructure control theory of plated film and data base of plated film microstructure", Elsevier, Oxford, UK (2004).*
3. *Kanani N, "Electroplating and electroless plating of copper and its alloy", ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Lindon David, "Handbook of Batteries", McGraw Hill, (2002).*
5. *Curtis, "Electroforming", London, (2004).*
6. *Rumyantsev E and Davydov A, "Electrochemical machining of metals", Mir, Moscow, (1989).*

15CHY242　　　ENVIRONMENTAL CHEMISTRY　　　3 0 0 3

Unit 1

Air and air pollution (earth's atmosphere): Regions - ozone - CFC and other chemicals - catalytic decomposition of ozone - 'ozone hole' formation - Air pollution due to gas emission from industries - Atmospheric aerosols – dust, combustion products, aerosol concentration and lifetimes - Automobile exhausts, smog and effects - Acid rain - chemistry of acid rain, roll of meteorology, greenhouse gases and global warming - air pollution due to jet engines.

Water and water pollution (hydrosphere): Physical and chemical properties of water - microbiological processes - carbon, nitrogen cycles - Water pollution - polluting agents - indices of pollution, heavy metal pollution and toxicity - BOD and COD determination - suspended solids - determination of other ions by photometric methods - Chemistry of anaerobic process, use of Effective Microorganisms.

Unit 2

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

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

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

Unit 3

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

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

TEXTBOOKS:

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

REFERENCES:

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

15CHY243   FUELS AND COMBUSTION   3 0 0 3

Unit 1

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

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

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

Unit 2

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

Flue gas analysis by chromatography and sensor techniques.

Unit 3

Combustion: Stochiometry, 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, theatrical air requirements, flue gas analysis, combustion kinetics – hydrogen - oxygen reaction and hydrocarbon - oxygen reactions.

Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

TEXTBOOK:

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

REFERENCES:

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

15CHY244   GREEN CHEMISTRY AND TECHNOLOGY   3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

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

REFERENCES:

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

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

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

TEXTBOOKS:

1. *Willard H W, Merritt 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 internationals (P) limited, (2005).*
2. *Thomas Nogrady and Donald F. Weaver, "Medicinal chemistry: A Molecular and Biochemical Approach", 3rd edition, Oxford university press, (2005).*

REFERENCES:

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

15CHY247   MODERN POLYMER COMPOSITES   3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

Composite precursors: SMCs, DMCs, BMCs prepreg materials and their choice in specific applications. Fabrication processes for FRP Composites: hand layup, spray up, vacuum bag moulding, compression moulding, filament winding, braiding, pultrusion, RTM, RIM, RRIM, RFI, autoclave moulding, injection moulding etc. Room temperature and hot curing of composites, Nanocomposites: Introduction; Nanoscale Fillers – Clay, POSS, CNT, nanoparticle fillers; Processing into nanocomposites;

Modification of interfaces; Properties. Applications. Joining composite elements and repairs, Recycling of polymer composites.

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

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

15CHY248   ORGANIC REACTION MECHANISMS   3 0 0 3

Unit 1

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

Reaction of nucleophiles and bases: Nucleophilic substitution - SN1 and SN2 reactions, nucleophilic substitution at aliphatic sp2 carbon and aromatic carbon - nucleophilic addition to carbonyl compounds - addition of grignard and organo lithium reagents - reactions of nitrogen containing nucleophiles with aldehyde and ketones - aldol condensation.

Unit 2

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

Reaction involving acids and other eletrophiles: Carbocations - formation and rearrangements - cationic rearrangement involving electron deficient nitrogen atom - Beckmann rearrangement - Curtius, Lossen and Schmidt rearrangement - electrophilic

additions - acid catalyzed reaction of carbonyl compounds - hydrolysis of carbocyclic acid derivatives - electrophilic aromatic substitution - carbenes and benzynes - Baeyer-Villeger reactions - Dienone-phenol rearrangement - pinacol rearrangement.

Unit 3

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

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

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

REFERENCES:
1. *Carey F and Sundberg R, "Advanced Organic Chemistry - Part A & B", Kluwer, (2000).*
2. *Peter Sykes, "Organic reaction mechanism", 6th edition, Pearson education (Singapore) Pte. Ltd., (2005).*
3. *Michael B. Smith, "Organic Synthesis", 2nd edition, 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 peizoelectric properties and the relationship between them. Dia, para, ferro, ferri, antiferro and antiferri magnetic types - selected magnetic materials such as spinels, garnets and perovskites, superconductors.

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

Unit 3

Neutron diffraction - principles, electron diffraction patterns, limitations - applications of electron diffraction - structural elucidation. Distinction between X-ray, Neutron and electron diffraction. Structure factor - definition, factors influencing structure factor. Uses of structure factor.

Fourier synthesis - definition, applications of fourier synthesis in crystal structure analysis of S-Tetrazine. Structure of Rutile, Fluorite, Antifluorite, Zinc blende, Wurtzite, diamond and graphite.

REFERENCES:

1. Cotton F. A, Wilkinson G and Gaus P, "Basic Inorganic Chemistry", 3rd edition, John Wiley and Sons, (2003).
2. Shriver D. F and Atkins P. W, "Inorganic Chemistry", 3rd edition, ELBS, Oxford University Press, Oxford, (2004).
3. Huheey J. E, Keiter E. A and Keiter R. L, "Inorganic Chemistry", 4th edition, Addison-Wesley Pub. London, (1993).
4. Cotton F. A, Wilkinson G, Murillo C. A and Bochmann M, "Advanced Inorganic Chemistry", 6th edition, John Wiley and Sons, New York, (2003).
5. Jolly W. L, "Modern Inorganic Chemistry", 2nd edition, McGraw-Hill, Inc., (1991).
6. Miessler G. L and Tarr D. A, "Inorganic Chemistry", 3rd edition, Pearson Education, Singapore, (2004).

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　　　3 0 2 4
　　　　　　　AND PROBLEM SOLVING

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.

15CSE313   SOFTWARE ENGINEERING   2 0 2 3

Unit 1
Software Engineering Concepts - A Generic view of Process - Categories of Software - Process Models - Perspective models - Waterfall model - Incremental models - Evolutionary models - Specialized models - Unified Process Models. Requirements Engineering: Tasks Initiation – Elicitation - Developing Use Cases - Building the analysis model – Negotiation - Validation - Building the Analysis Model.

Unit 2
Requirement Analysis – Approaches - Data modelling concepts - OO Analysis - Scenario Based modelling - Flow Oriented modelling - Class based modelling -

Behavioural Modelling. Design Engineering: Design Process and Quality - Design Concept – Model - Creating an Architectural Design - Software Architecture - Data Design - Architectural Styles and Patterns - Architectural Design - Mapping Data Flow into Software Architecture – Modelling Component level design – Component-Class based Components - Conducting component level design -Designing conventional components.

Unit 3
Performing user interface design - Golden Rules - User interface Analysis and Design - Interface Analysis - Interface design steps - Web Engineering - Attributes, Layers, Processes and best Practices - Initiating, Analysis, Design and Testing of Webapp projects, Testing Strategies: Testing Tactics - Testing fundamentals - Black-box and White-box Testing - Product Metrics. Case Study: SWEBOK.

TEXTBOOK:

Pressman R S, Bruce R.Maxim, "Software engineering - A Practitioner's Approach", Eighth Edition, Tata McGraw-Hill, 2014.

REFERENCES:
1. *Sommerville I, "Software Engineering", Sixth Edition, Addison Wesley, 2003.*
2. *Fairley R, "Software Engineering Concepts", Seventh Edition, Tata McGraw-Hill, 1999.*
3. *G J Myers, Corey S, Tom B and Todd M T, "The Art of Software Testing", Third Edition, Wiley, 2011.*
4. *Pankaj J, "An Integrated Approach to Software Engineering", Third Edition, Narosa Publishing House, 2005.*

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'sAstanga-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 Ranaganathananda published by Bharatiya Vidya Bhavan, Bombay.*

6. *Personality Development – Swami Vivekananda published by Advaitha Ashram, Kolkatta.*
7. *Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development- Swami Budhananda published by Advaitha Ashram, Kolkatta*
9. *Ultimate Success - Swami Ramakrishnananada Puri published by Mata Amritanandamayi Math, Kollam*
10. *Yoga In Daily Life - Swami Sivananda – published by Divine 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 Advaitha Ashram, Kolkatta*
14. *Krida Yoga - Vivekananda Kendra, Publication.*
15. *Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi*
16. *New perspectives in Stress Management - Dr H R Nagendra & Dr R Nagaratna published by Swami Vivekananda Yoga Prakashana, Bangalore.*
17. *Mind Sound Resonance Technique (MSRT) Published by Swami Vivekananda Yoga Prakashana, Bangalore.*
18. *Yoga & Memory - Dr H R Nagendra & Dr. Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.*

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 indispensible role of the intellect. How to achieve and apply clear thinking?

6 The quagmire of thought.The doctrine of Karma – Law of Deservance.

7 Increase Productivity, reduce stress.. work patterning.

Unit 3

8 The art of right contact with the world. assessment, expectations.

9 Myths and Realities on key issues like richness, wisdom, spirituality.

10 Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:

The Bhaja Govindam and the Bhagavad Gita.

15CUL232   EXPLORING SCIENCE AND TECHNOLOGY   2 0 0 2
IN ANCIENT INDIA

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

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

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

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

TEXTBOOK:
Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao
REFERENCE:
IFIH's interactive multimedia DVD on Science & Technology in Ancient India.

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 - Vikalpah – Unfolded belief - Smriti – Memory.

Unit 2
Patanjali Yoga Sutra – 3
Two formulae - Necessity of Abhyasah and Vairagyah - Foundation of Abhyasah - Foundation of Vairagyah.

Patanjali Yoga Sutra – 4
Introduction to Samadhi - Samprajnata-Samadhi - Reasoning in Samprajnata-Samadhi - Reflection in Samprajnata-Samadhi - Bliss in Samprajnata-Samadhi - Sense of Individuality in Samprajnata-Samadhi.

Patanjali Yoga Sutra – 5
Main obstacles in the path of Yoga - other obstructions - removal of obstacles by one – pointedness; by controlling Prana - by observing sense experience - by inner illumination - by detachment from matter - by knowledge of dream and sleep - by meditation as desired.

Patanjali Yoga Sutra – 6
How to make mind peaceful? - Cultivating opposite virtues: happiness – friendliness - misery – compassion - virtue – gladness - vice – indifference.
Patanjali Yoga Sutra – 7
Five causes of Pain - avidya – ignorance (Root Cause) - asmita – 'I-Feeling' - raga – attraction - dwesha – repulsion - abhinivesha – clinging to life.

Unit 3
Patanjali Yoga Sutra – 8

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

Patanjali Yoga Sutra – 9
Five Niyamas: Soucha – Santhosha – Tapas – Swadyah – Ishwara - Pranidhanam.

Patanjali Yoga Sutra – 10
Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery over the senses.

Report review

Conclusion

REFERENCES:

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

15ECE111   SOLID STATE DEVICES   3 0 0 3

Unit 1
Introduction to Semiconductor materials, Crystal Structure of Silicon and GaAs – Planes – directions - planes and planar atomic densities - Unit cell characteristics - Review of Quantum Mechanics – Dual Nature of Light and Electrons - Bohr model of atom, Uncertainty Principle - Time dependent and Time independent Schrodinger Wave equation - Infinite Potential well problem - Step Potential Function - Tunneling.

Unit 2
Molecular Orbital theory and formation of energy bands in semiconductors - Direct and Indirect band gap semiconductors - Charge carriers - Effective mass - Extrinsic and intrinsic semiconductors - Fermi Dirac Statistics and Fermi Level - Boltzman Statistics - Density of states - Equilibrium Carrier concentrations - Drift velocity and mobility - Temperature dependence of carrier concentration – mobility - and conductivity - Hall effect - Excess Carriers and photoconductivity - Diffusion of Carriers - Built in fields.

Unit 3
Direct and indirect recombination - excess carrier lifetime - Steady State Carrier generation - Quasi Fermi levels - Continuity Equation - Haynes Shockley experiment

- Equilibrium PN junctions - Band diagram - built in potential and electric field in space charge region - depletion width - Forward and Reverse Biased PN junction - Ideal Diode equation - Reverse bias breakdown - PN Junction diodes - MOSFET Physics - Threshold voltage - Fundamentals of BJT physics.

TEXTBOOKS:
1. *Ben G. Streetman and Sanjay Kumar Banerjee, "Solid State Electronic Devices", Prentice Hall India, Sixth Edition, 2009.*
2. *Donald A. Neamen, "Semiconductor Physics and Devices: Basic Principles", McGraw-Hill International, Third Edition, 2003.*

REFERENCES:
1. *S. M. Sze and Kwok K. NG, "Physics of Semiconductor Devices", John Wiley and Sons, Inc., Third Edition, 2007.*
2. *S. O. Kasap, "Principles of Electronic Materials and Devices", Tata McGraw Hill, Third Edition, 2007.*

15ECE112   FUNDAMENTALS OF ELECTRICAL TECHNOLOGY   3 1 0 4

Unit 1
Introduction to Electrical Power System - Ideal Independent Current and Voltage Sources - Reference Directions and Symbols – Resistance - Inductance - 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.

Unit 3
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.

TEXTBOOKS:

1. *Edward Hughes, "Electrical Technology", Pearson Education Asia, Seventh Edition 2011.*
2. *A. P. Malvino, "Electronic Principles", Tata McGraw Hill, Seventh Edition, 2007.*

REFERENCES:

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

15ECE201   APPLIED ELECTROMAGNETICS   3 1 0 4

Unit 1
Static Electric Fields: Co-ordinate systems – Review - Line integral - Surface integral – Gradient – Divergence - Curl-Stoke's theorem - Divergence theorem - Helmholtz theorem - Electrostatics - Postulates - Coulomb's law - Gauss law - Electric potential - Behaviour of conductors and dielectric in static fields - Dielectric constant - Poisson's and Laplace equation.

Unit 2
Steady currents and magnetic fields: Current density - Point form of Ohm's law – Continuity equation - Lorentz force - Magneto statics – Postulates - Magnetic vector potential – Biot-Savart law - Relative permeability - Hall effect.

Unit 3
Electromagnetic Fields: Faraday's law of Induction - Maxwell's equations - Differential and Integral Forms - Boundary Conditions for electromagnetic fields - Wave equation - Time harmonic electromagnetic fields.

TEXTBOOK:

David K. Cheng, "Field and Wave Electromagnetics", Pearson Education, Second Edition, 2002.

REFERENCES:

1. *Clayton R. Paul, Keith W. Whites, Syed A. Nasar, "Introduction to Electromagnetic Fields", Tata McGraw-Hill Education Private Limited, Third Edition (Fifth Reprint), 2009.*
2. *Kraus, Fleisch, "Electromagnetics with Applications", Tata McGraw Hill Education Private Limited, Fifth Edition, 2004.*

15ECE202   DIGITAL CIRCUITS AND SYSTEMS   3 1 0 4

Unit 1
Introduction to logic families: ECL – TTL - Tri state logic. Implementation technology: Transistor switches - NMOS logic gates - CMOS logic gates - Negative logic systems.

Introduction to logic circuits: Variables and functions, inversion - Truth tables - Logic gates and Networks - Boolean algebra - Synthesis using gates - Design examples - Optimized implementation of logic functions: Karnaugh map - Strategy for minimization - Minimization of product of sums forms - Incompletely specified functions - Multiple output circuits - 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. Sequential circuit building blocks: Basic latch - Gated SR latch - Gated D latch - Master slave and edge triggered - D flip-flops - T flip-flop - JK flip-flop - Registers - Counters - Reset synchronization - Other types of counters.

Unit 3
Synchronous sequential circuits: Basic design steps - State assignment problem - Mealy state model - Serial adders - State minimization. Asynchronous sequential circuits:Analysis of asynchronous circuits.

TEXTBOOK:

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

REFERENCES:

1. *Morris Mano, Michael D. Ciletti "Digital Design – with introduction to Verilog HDL", Pearson Education, Fifth Edition, 2011.*
2. *Charles H., Jr. Roth, LizyKurian John, Beyond Kill Lee, "Digital System Design Using Verilog", Cengage Learning, 2015.*
3. *Donald D Givone, "Digital Principles and Design", Tata McGraw Hill Publishing Company Limited, 2003.*

15ECE203   NETWORK THEORY   3 0 0 3

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'stheorems - Superposition theorem - maximum power transfertheorem - Tellegan'stheorem, Reciprocitytheorem. 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 theorem; Power factor – power factor correction. Self and mutual Inductance - Coupled circuits – dot convention.

Unit 3

Two-port Networks and Filters – Voltage and Current ratios of two port networks – Admittance – impedance- hybrid and transmission parameters of two port networks. Passive filters as two port networks - Transient response and reduction of overshoot, sensitivity. Active filters: poles and zeros, filter design. Attenuators: Image and scattering parameters, insertion loss. Various types of attenuators.

TEXTBOOKS:

1. *Charles K Alexander, Mathew N. O. Sadiku, "Fundamentals of Electric circuits", Tata McGraw-Hill, 2003.*
2. *John D. Ryder, Myril Baird Reed and W. L. Everitt, "Foundation for Electric Network Theory", Prentice Hall of India, Second Edition, 2013.*

REFERENCES:

1. *M. E. Van Valkenburg, "Network Analysis", Prentice Hall India Private Limited, Third Edition, 1999.*
2. *K. V. V. Murthy, M. S. Kamath, "Basic Circuit Analysis", Tata McGraw Hill Publishing Company Limited, 2006.*
3. *D. Roy Chaudhary, "Networks and Systems", New Age International Publisher, 2003*
4. *N. Balabanian, T. Bickart, "Linear Network Theory: Analysis, Properties, Design and Synthesis", Matrix Publishers Inc., 1981.*

15ECE204   SIGNAL PROCESSING I   3 1 0 4

Unit 1

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

Signals: Classification of signals, continuous – discrete time; even / odd signals, periodic / nonperiodic 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 systems. LTI system response of LTI system - convolution, properties (continuous / discrete) - LTI systems – differential / difference equation representation.

Unit 2

Fourier Series: Fourier series - Half range Expansions - Parseval's Identity - Transform integrals¬ - Fourier Integrals - Fourier integral theorem. Sine and Cosine Integrals. Fourier analysis of continuous time signals and systems: Fourier series for periodic signals - Sine and Cosine Transforms - Fourier transform – properties of continuous time FT - Sampling: Sampling theorem - reconstruction of signal – aliasing.

Unit 3

Laplace Transform analysis of systems: Laplace Transforms, Inverse Transforms, Linearity, Shifting, Transforms of Derivatives and Integrals – ROC - inverse LT - unilateral LT - Frequency response of continuous time LTI systems, response of electronic circuits with initial conditions using Lapalce transforms. Z-Transform: Definition – ROC - inverse z-transform – properties - transform analysis of LTI Systems - Frequency response of discrete time LTI systems. Inter relationship between different representations and transforms.

TEXTBOOKS:

1. *Alan V. Oppenheim, Alan S. Wilsky, S, Hamid Nawab, "Signals and Systems". Prentice Hall India private Limited, Second Edition, 1997.*
2. *E Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, Ninth Edition, 2012.*

REFERENCES:

1. *Simon Haykin, Barry Van Veen, "Signals and Systems", Second Edition, John Wiley and Sons, 2005.*
2. *Lathi B P, " Signal Processing & Linear Systems", Oxford University Press, 2006*
3. *Michael J. Roberts, "Fundamentals of Signals and systems", Tata McGraw Hill Publishing Company Limited, First Edition, 2007.*
4. *Rodger E. Ziemer, William H. Tranter D. Ronal Fannin, "Signals and Systems", Pearson Education, Fourth Edition, 2004.*

15ECE211   ELECTRONIC CIRCUITS   3 1 0 4
(Pre-requisite: 15ECE111 Solid State Devices)

Unit 1

Diode Fundamentals: Diode characteristics - Physics of diode operation and modeling of diodes.

Diode applications: Rectifiers - Clipper and clamper circuits - Voltage multipliers - Voltage regulator using zener diode.

Unit 2

Bipolar junction transistors: Introduction - Operation of BJT–I-V characteristics of BJT. BJT Applications: BJT biasing techniques - Analysis of BJT as a switch and as an amplifier - Small signal analysis - Single stage BJT amplifiers (CE, CB, CC) - BJT high frequency models and amplifier frequency analysis.

Unit 3

Field effect transistors: Introduction - Device structure and operation of JFET (Junction Field Effect Transistor) and MOSFETs - I-V characteristics of JFET and MOSFET - MOSFET applications - MOSFET biasing techniques - Analysis of MOS as a switch and as an amplifier - Small signal analysis - Single stage MOS amplifiers (CS, CD, CG) MOS capacitances - MOS high frequency and model and amplifier frequency analysis.

TEXTBOOK:

Sedra A and Smith K C, "Microelectronic circuits", Sixth Edition, Oxford University Press, 2010.

REFERENCES:

1. *Neamen D A, "Electronic circuit analysis and design", McGrawHill, 2001.*
2. *Boylestad R L and Nashelsky L, "Electronic devices and circuit theory", Upper Saddle River N.J., Pearson/Prentice Hall, Tenth Edition, 2009.*

15ECE212   SIGNAL PROCESSING II   3 1 0 4
(Pre-requisite: 15ECE204 Signal Processing I)

Unit 1

Discrete Fourier transforms: Fourier Transform, Fourier analysis of discrete time signals and systems: Discrete time Fourier series – Discrete Time Fourier Transform- properties of DTFT – Introduction to DFT - properties of DFT – linear filtering methods based on DFT – FFT– efficient computation of the DFT of a 2N- point real sequences – correlation – use of FFT in linear filtering and correlation.

Unit 2

Digital filters: Introduction, specifications of practical filters, Characteristics of commonly used analog filters – IIR filters: design by approximation of derivatives – impulse invariance and Bilinear transformation – frequency transformations for analog and digital filters.

FIR filters: symmetric and anti-symmetric FIR filters – design of linear phase FIR filter using Windows – FIR differentiators – Hilbert transforms – comparison of design methods for linear phase FIR filters.

Unit 3

Digital filters realizations: Structures for IIR systems – direct form structures, cascade form structures, parallel form structures, Structures for FIR systems – direct form structures, Linear phase and cascade form structures.

Applications of DSP - a few case studies.

TEXTBOOK:

John G Proakis, G. Manolakis, "Digital Signal Processing Principles, Algorithms, Applications", Prentice Hall India Private Limited, Fourth Edition, 2007.

REFERENCES:

1. *Sanjit K. Mitra, "Digital Signal Processing. A Practical approach", Tata McGraw Hill Publishing Company Limited, 2005.*
2. *Allen V. Oppenheim, Ronald W. Schafer, "Discrete time Signal Processing", Prentice Hall India Private Limited, Fifth Edition, 2000.*

15ECE213   TRANSMISSION LINES AND WAVEGUIDES   3 0 0 3
(Pre-requisite: 15ECE201 Applied Electromagnetics)

Unit 1

Plane Wave Theory: Plane waves in lossless and lossy media – Types of media – Skin effect – Poynting vector and group velocity – Normal incidence at conducting and dielectric boundary – Brief review of oblique incidence.

Unit 2

Transmission line theory: TEM wave along parallel plate line – Transmission line parameters – General equations – Infinite line concept – Transmission line parameters – Finite line properties – Input impedance – Smith chart calculations – Transmission line impedance matching techniques – Stub matching.

Unit 3

Wave Guiding Systems: Transverse Electric (TE) and Transverse Magnetic(TM) modes – Electromagnetic waves between parallel plates (TE and TM) – Properties – Rectangular waveguides – TE and TM waves in rectangular waveguides – Properties - Attenuation in waveguides.

TEXTBOOK:

1. *David K.Cheng, "Field and Wave Electromagnetics", Pearson Education, Second Edition, 2002.*

REFERENCES:

1. *Clayton R. Paul, Keith W. Whites, Syed A. Nasar, "Introduction to Electromagnetic Fields", Tata McGraw-Hill Education Private Limited, Third Edition (Fifth Reprint), 2009.*
2. *John Daniel Kraus , Daniel A. Fleisch, "Electromagnetics with Applications", Tata McGraw Hill Education Private Limited, Fifth Edition, 2004.*

15ECE281   DIGITAL CIRCUITS AND SYSTEMS LAB.   0 0 2 1

1. Familiarization of Digital trainer kit and study of logic gates.
2. Realization of Boolean expressions using logic gates
3. Realization of Boolean expressions using universal gates
4. Realization of code converters

5. Design of Adders/Subtractors
6. Design of Multiplexers/ De-Multiplexers
7. Design of Encoders/ Decoders
8. Study of flip-flops
9. Design of Synchronous counters
10. Design of Asynchronous counters

15ECE282 SIGNAL PROCESSING I LAB. 0 0 2 1

1. Introduction to Matlab
2. Generation of sequences
3. Basic operations on signals
4. Properties of system
5. Convolution
6. Interconnection of systems
7. Frequency response of LTI Systems
8. Frequency domain representation
9. Time shifting property - DTFS
10. LTI System - analysis

15ECE285 DIGITAL SIGNAL PROCESSING LAB. 0 0 2 1

1. Generation of signals
2. Sampling of analog signals and study of aliasing
3. Computation of DFT using direct / linear transformation method
4. Properties of DFT
5. Computation of 2-N point DFT of a real sequence by using an N point DFT just once.
6. Linear filtering using Overlap add /save method
7. Design of FIR filter (different windowing technique)
8. Design of IIR Butterworth filter
9. Applications of DSP - a few case studies

15ECE286 ELECTRONIC CIRCUITS LAB. 0 0 2 1

1. P-N junction Diode and Zener Diode Characterization.
2. Rectifier with and without filters
3. Clippers/ Clampers
4. Shunt regulator
5. BJT Characterization
6. Single stage CE amplifier

15ECE301 COMMUNICATION THEORY 3 1 0 4

Unit 1
Introduction to analog communication system - Amplitude Modulation (AM) - Double Sideband Suppressed Carrier (DSB-SC) - Single Sideband (SSB) - Quadrature AM (QAM) - Vestigial Sideband (VSB) – Generation and demodulation of AM signals.

Unit 2
Frequency Modulation (FM) - Phase Modulation (PM) - Bandwidth of FM signals - Generation and demodulation of FM signals - Frequency Division Multiplexing (FDM) - Superhetrodyne receiver.

Unit 3
Complex low pass representation of narrow band signals - Introduction to random processes - Characterization of noise - Noise analysis of analog modulation systems - Sampling theorem - Time division multiplexing.

TEXTBOOK:
Simon Haykin, "An Introduction to Analog and Digital Communications", Wiley, Second Edition, 2006,
REFERENCES:
1. *J. Proakis, M. Salehi, "Fundamentals of Communications systems", Pearson Education, Second Edition, 2005.*
2. *Herbert Taub, Donald Schilling, "Principles of Communications", Tata McGraw-Hill, 2008.*
3. *Bruce Carlson, "Communication Systems", McGraw-Hill, Fifth Edition, 2010.*

15ECE302 CONTROL SYSTEMS ENGINEERING 3 1 0 4
(Pre-requisite: 15CSE204 Signal Processing I)

Unit 1
Introduction - System Configurations - Analysis and design objectives - Design process - Computer-aided design - Laplace transform review - The transfer function: Electrical network Transfer functions - Translational mechanical system transfer functions - Electric circuit analogs – Nonlinearities – Linearization - Transfer function of a DC motor. Poles Zeros and system response - Time response analysis (1st, 2nd order) - System response with additional poles - System response with zeros. Reduction of multiple system - Block reduction techniques - Signal flow graph - Mason's gain formula. Stability: Routh-Hurwitz criterion - Steady-state error for unity feedback systems - Static error constants and system type - Steady-state error specifications.

Unit 2
The root locus, properties of the root locus - Sketching the root locus - Transient response Design via gain adjustment - Frequency response techniques. Asymptotic

approximations: Bode plots - Introduction to the Nyquist criterion – Stability - Gain margin and Phase margin via Nyquist diagram and Bode plots relation between closed loop transient and closed loop frequency responses - Relation between closed and open loop frequency responses - Relation between closed loop transient and open loop frequency responses - Steady-state error characteristics from frequency response - Systems with time delay - Obtaining transfer functions.

Unit 3

Design via frequency response - Transient response design via gain adjustment - Lag compensation - Lead compensation - The general state - Space representation - Applying the state-space representation - Converting a transfer function to state-space - Converting from state-space to a transfer function.

TEXTBOOK:

Norman Nise, "Control System Engineering", John Wiley & Sons, Inc., Sixth Edition, 2011.

REFERENCES:

1. *Dorf R. C. and Bishop R. H, "Modern control systems", Addison-Wesley Longman Inc., Eighth Edition, Indian reprint, 1999.*
2. *Katushiko Ogata, "Modern control engineering", Pearson education, Third Edition, 2004.*
3. *Benjamin C.Kuo, "Automatic Control Systems", Prentice Hall India Ltd, Sixth Edition, 2000.*

15ECE303   LINEAR INTEGRATED CIRCUITS   3 0 0 3
(Pre-requisite: 15ECE211 Electronic Circuits)

Unit 1

Amplifier parameters - Multistage amplifiers. Feedback: Introduction to the concept of feedback - positive and negative feedback - Properties of feedback - Feedback topologies - Non-ideal effects.

Unit 2

Differential Amplifier: The MOS differential pair - Common-mode and Differential signals. Small-signal operation - Differential gain and CMRR. Operational amplifiers: Ideal op-amp - parameters and characteristics - Inverting and non-inverting amplifiers.

Unit 3

Op-amp circuits: Difference Amplifiers - Instrumentation amplifiers – Adder – Subtractor – Integrator – Differentiator – Comparators - Schmitt trigger - Peak detector - Sample and hold circuits - Precision rectifiers - Dual-slope ADC – DVM - R-2R type DAC - Multivibrators - Monostable - Astable and Bistable - Oscillators: RC phase shift and Wein-bridge oscillators - 555 Timer.

TEXTBOOK:

Sedra A and Smith K C, "Microelectronic circuits", Oxford University Press, Sixth Edition, 2010.

REFERENCES:

1. *Neamen D A, "Electronic circuit analysis and design", McGraw-Hill, 2001.*
5. *Franco S., "Design with operational amplifiers and analog integrated circuits", New York, McGraw-Hill, Third Edition, 2002.*
6. *Ramakant A. Gayakwad, "Op-amps and linear integrated circuit technology" Prentice Hall, Fourth Edition, 2000.*
7. *Application Notes and Data Sheets of ICs from various manufacturers.*

15ECE304   MICROPROCESSOR AND MICROCONTROLLER   3 1 0 4
(Pre-requisite: 15ECE202 Digital Circuits and Systems)

Unit 1

8085 Microprocessor: Architecture – Functional block diagram - Registers, ALU, Bus Systems - Timing and Control Signals – Machine cycles and timing diagrams, memory interfacing.

Unit 2

ARM Architecture: Acron RISC Machine – Architectural Inheritance – Programmers Model. ARM Assembly Language Programming: Data Processing Instructions – Data Transfer Instructions – Control Flow Instructions. ARM Organization and Implementation: 3-stage Pipeline – 5-stage Pipeline – ARM Instruction Execution – ARM Implemenation – Coprocessor Interface. ARM Instruction Set – Architectural Support for High-Level Programming – Thumb Instruction Set.

Unit 3

Architectural Support for System Development: ARM memory Interface – AMBA Interface – The ARMulator – JTAG Boundary Scan Architecture – Embedded Trace. ARM Processor Cores: ARM7TDMI – ARM8 – ARM9TDMI – ARM10TDMI. Memory Hierarchy – Memory Size and Speed – ON-Chip Memory – Caches. Architecture Support for Operating System: ARM System Control Coprocessor – CP15 Protection Unit Registers – ARM MMU Architecture. ARM CPU Cores: ARM710T – ARM720T – ARM740T – ARM810 – Strong ARM SA-110.

TEXTBOOKS:

1. *Ramesh S Goankar, "Micropocessor Architecture: Programming and Applications with the 8085", Penram International, Fifth Edition, 2002.*
2. *Jochen Steve Furber, "ARM System-on-Chip Architecture", Addison Wesley Trade Computer Publications, Second Edition, 2000.*

REFERENCES:

1. *Douglas V Hall, "Microprocessor and Interfacing: Programming and Hardware", McGraw Hill Inc,. New Delhi 2002.*
2. *Kenneth L Short, "Microprocessors and Programming Logic", Prentice Hall of India, Second Edition.*

3. *Andrew Sloss, Dominic Symes and Chris Wright, "ARM System Developers Guide", Elsevier, Third Edition, 2004.*

15ECE311　　DATA COMMUNICATION AND NETWORKS　　3 0 0 3

Unit 1

Data Communication Concepts - Networks and open system standards - OSI reference model - Network layered architecture - Network topologies and the physical layer - Bus/Tree topology - ring topology, star topology - Transmission media and technologies.

Unit 2

Protocol concepts - MAC layer - LAN and standards – MAN - WAN - Network routing - Public data networks – Circuit-switched data network - Packet-switched data network - Internet protocol - ISDN.

Unit 3

Network Interconnections - LAN-to-LAN connections - LAN-to-Host connections – Repeaters - Bridges - Routers and Gateways - Interconnection utilities - Electronic mail – VoIP – DNS – HTTP - Networks management- WLAN.

TEXTBOOK:

James Kurose and Keith Ross, "Computer Networking: A Top-Down Approach", 5th/6th Edition, Addison Wesley, 2010.

REFERENCES:

1. *Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach", Morgan Kaufmann, Fifth edition, 2011.*
2. *Andrew. S. Tannenbaum, DavidJ.Whetheral, "Computer Networks", Prentice Hall, Fifth Edition, 2010.*

15ECE312　　DIGITAL COMMUNICATION　　3 1 0 4
(Pre-requisite: 15ECE301 Communication Theory)

Unit 1

Introduction - Waveform Coding – PCM – DPCM - DM - Geometric representation of signal waveforms - Binary pulse modulation - Optimum receiver for binary modulated signals in additive white Gaussian noise - M-ary binary and orthogonal pulse modulation - Probability of error for binary and M-ary pulse modulation.

Unit 2

Digital Transmission through band limited channels - Signal design for band limited channels - Probability of error for detection of digital PAM - System design in the presence of channel distortion.

Unit 3

Transmission of digital information via carrier modulation - Amplitude modulated signals - Phase modulated signals - Quadrature amplitude modulated signals - Frequency modulated signals.

TEXTBOOKS:

1. *John G. Proakis and Masoud Salehi, "Fundamentals of Communication Systems", Pearson Education, First Edition, 2007.*
2. *Simon Haykin, "Digital Communications", Wiley India Private Limited, First Edition, 2006*

REFERENCES:

1. *Ziemer and Peterson, "Introduction to Digital Communication", Pearson Education, 2000.*
2. *B. Sklar, "Digital Communications", Pearson Education, Second Edition, 2006.*
3. *Amitabha Bhattacharya, "Digital Communication", Tata McGraw Hill Publishing Company, First Edition, 2006.*

15ECE313　　VLSI DESIGN　　3 0 0 3
(Pre-requisite: 15ECE202 Digital Circuits and Systems)

Unit 1

MOSFETs as switches - NMOS and CMOS physical layouts and stick diagrams. Physical structure of integrated circuits: NMOS and CMOS layers - Designing FET arrays - FET sizing and unit transistor - Physical design of logic gates and design hierarchies.

Unit 2

Analysis of MOS logic gates: DC switching characteristics of NMOS and CMOS inverters - DC characteristics of NAND and NOR gates - Transient response - Gate design for transient performance - Transmission gates and pass transistors.

Unit 3

Designing high speed CMOS logic networks: Gate delays - Driving large capacitive loads - Logical effort - BiCMOS drivers - Clocking and data flow control - Advanced techniques in CMOS logic circuits: Mirror circuits - Pseudo-NMOS - Tristate circuits - Clocked CMOS, Dynamic CMOS logic circuits.

TEXTBOOKS:

1. *J. P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley and Sons, Second Edition, 2002.*
2. *David A Hodges, Horace Jackson, ResveSaleth, "Analysis and Design of Digital Integrated Circuits", McGraw Hill Publishing Company Limited, Third Edition, 2003.*

REFERENCES:

1. *Sung-Mo Kang, Yusuf Leblechi, "CMOS Digital Integrated Circuits - Analysis and Design", Tata McGraw Hill Publishing Company Limited, Third Edition, 2003.*

2. *Neil Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, Third Edition, 2005.*

15ECE314   COMPUTER SYSTEM ARCHITECTURE   3 0 0 3
(Pre-requisite: 15ECE202 Digital Circuits and Systems)

Unit 1

Introduction to computer system - Brief history of computer systems - Fixed point arithmetic – Addition – Subtraction - Multiplication and division - Booth's algorithm - Non-restoring division algorithm - Floating point arithmetic. Various addressing modes and designing of an Instruction set.

Unit 2

Data path and controller design - Introduction to CPU design - Processor organization - Execution of complete instruction - Design of control unit - Microprogrammed control unit.

Unit 3

Memory and system organization - Concepts of semiconductor memory - CPU-memory interaction - Organization of memory modules - Cache memory and related mapping and replacement policies - Virtual memory. Introduction to input/output processing: Programmed controlled I/O transfer - Interrupt controlled I/O transfer DMA - Secondary storage and type of storage devices - Introduction to buses - Introduction to RISC and CISC paradigm - Design issues of a RISC processor and example of an existing RISC processor - Introduction to pipelining.

TEXTBOOKS:

1. *John P. Hayes, "Computer architecture and Organisation", Tata McGraw-Hill, Third edition 1998.*
2. *V. Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, "Computer Organisation", Fifth edition, McGraw-Hill Inc, 1996.*

REFERENCES:

1. *Morris Mano, "Computer System Architecture", Prentice-Hall of India, 2000.*
2. *Behrooz Parhami, "Computer Architecture", Oxford Press.*
3. *P. Pal Chaudhuri, "Computer organization and design", 2nd Ed., Prentice Hall of India,2007.*
4. *G. Kane & J. Heinrich, "MIPS RISC Architecture", Englewood cliffs, New Jersey, Prentice Hall, 1992.*

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:

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

15ECE320   ACTIVE FILTER DESIGN   3 0 0 3
(Pre-requisite: 15ECE303 Linear Integrated Circuits)

Unit 1

Introduction to Active Filtering - Categories of Filters - LP, HP, BP, BE and All Pass Filters - Second Order s-domain equations in each case and their pole-zero plots. Filter approximations – Butterworth, Chebyshev, Elliptic and Bessel - Phase and group delay characteristics of approximation functions - Delay equaliser functions - Frequency transformations.

Unit 2

Review of opamp characteristics: Single opampbiquads - First order LP, HP, BP, All pass filters - Biquad topologies - Analysis and design of single opamp Biquads with finite gain. Analysis and design of LP, HP and BP filter with second order response. Use of bridged T network in active Filters - Sensitivity analysis of single opamp filters.

Unit 3

Multiple opamp Filters: KHN (Universal Active Filter) filter, Tom-Thomas biquad - Analysis and design for various categories of filters - Q enhancement and pole frequency error problem - Elementary ideas of compensation.

TEXTBOOK:

R Schaumann and M E Van Valkenburg, "Design of analog filters", First Edition, Oxford University Press, 2005.

REFERENCES:

1. *G Daryanani, "Principles of active network synthesis and design", New York, Wiley, 1976.*
2. *M Van Valkenburg, "Analog filter design", New York, Holt Rinehart and Winston, 1982.*
3. *Franco S., "Design with operational amplifiers and analog integrated circuits", 3rd ed. New York, McGraw-Hill, 2002.*
4. *Allan Waters, "Active filter design", New York, McGraw-Hill, 1991.*

15ECE321   ADAPTIVE SIGNAL PROCESSING   3 0 0 3

(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Adaptive Systems - Definition and characteristics – Properties - Applications and examples of an adaptive system. Stochastic Processes and Models: Characterization - Mean ergodic theorem - Correlation matrix - Stochastic models - Power spectral density - Properties of power spectral Density - Linear transformations - Power spectral estimation.

Unit 2

Wiener filters - Linear optimum filtering - Minimum mean-square error - Wiener-Hopf equations - Multiple linear regression model - Steepest-descent algorithm - Linear prediction - Forward linear prediction, Levinson-Durbin algorithm. Kalman filter - Extended kalman filter.

Unit 3

Least-Mean-Square (LMS) adaptive filters - LMS algorithm, LMS adaptation algorithm - applications. Method of Least Squares - Data windowing, Normal equations and linear least square filters, Recursive least squares algorithm.

TEXTBOOK:

Simon Haykins, "Adaptive Filter Theory", Pearson Education, Fifth Edition, 2013.

REFERENCES:

1. *Todd K. Moon, Wynn C. Stirling, "Mathematical Methods and Algorithms for Signal Processing" Prentice Hall, First edition, 1999.*
2. *John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, "Theory and Design of Adaptive Filters", Prentice Hall India Private Limited, 2004.*
3. *Bernard Widrow and Samuel. D. Stearns, "Adaptive Signal Processing", Pearson Education, 2001.*

15ECE322   ANALOG SIGNAL PROCESSING   3 0 0 3

Unit 1

Review of transistor characteristics- bias stability- compensation techniques - frequency response of cascaded amplifiers - theory of compensation - dominant pole and pole-zero compensation techniques - two-stage MOS amplifier compensation - bandwidth limitation of amplifiers - single transistor and differential mode wide-band video amplifiers - tuned amplifier design - stabilization and applications.

Unit 2

Universal Active filter - simulation of differential equations - inductor and negative simulations - double integrator and gyrator oscillators - Analog Multipliers - Log-Antilog Multipliers - AGC/AVC - Low-drift and Low-input-current specifications - origin of slew rate limitations - improving slew rate in MOS Op-amps.

Unit 3

Switched-Capacitor circuits - MOSFEs as switche s- Switched-Capacitor integrators - Switched-Capacitor amplifiers - Unity gain buffer - Non-inverting amplifier - Precision multiply-by-two circuit.

TEXTBOOKS:

1. *Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley Publishers, Fifth Edition, 2009.*
2. *Sedra and Smith,"Microelectronic Circuits", Oxford Press, 2004, Fifth Edition.*

15ECE323   AVIATION ELECTRONICS   3 0 0 3

Unit 1

Introduction to avionics - Systems design parameters and specifications - Traceability - Ilities - Avionics architecture - LRU/LRM - Backplane standards - Data bus – topologies - word formats - MIL-STD 1553B - ARINC 429 - ARINC 629 - CSDB – FCAD.

Unit 2

Fault diagnosis methodologies - FMEA - FTA - Fault tolerance and recovery - NOTAM - Practical exercises.

Unit 3

New avionics systems - Cockpit instruments - User interface - Navigation - Guidance and Flight Control - Stores management system - Data communications.

TEXTBOOKS:

1. *Albert Helfrick, "Principles of Avionics, Airline Avionics", Fourth edition, 2007*
2. *Keith W. Bose, "Aviation Electronics", Howard W. Sams& Company Inc., 1981.*

REFERENCES:

1. *Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, electrical, and avionics subsystems integration", Professional Engineering Publishing Limited, London and Bury St Edmunds, UK, 2001.*
2. *Cary R. Spitzer, "The Avionics Handbook", CRC Press, 2001 Qiping Chu et al., Advances In Aerospace Guidance, Navigation and Control, Springer, 2013.*

15ECE324   **BIOMEDICAL IMAGE PROCESSING**   **3 0 0 3**
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Objectives of biomedical image analysis - Computer aided diagnosis - Nature of medical images: X-ray imaging – Tomography - Nuclear medicine imaging - SPECT imaging - Positron imaging tomography – Ultrasonography - Magnetic resonance imaging. Removal of artifacts - Space domain filters - Frequency domain filters - Optimal filtering - Adaptive filters.

Unit 2

Image enhancement – Gray level transforms - Histogram transformation - Convolution mask operators - Contrast enhancement. Detection of regions of interest - Thresholding and binarization - Detection of isolated lines and points - Edge detection - Region growing.

Unit 3

Analysis of shape and texture - Representation of shapes and contours - Shape factors - Models for generation of texture - Statistical analysis of texture - Fractal analysis - Fourier domain analysis of texture - Segmentation and structural analysis of texture. Pattern classification and diagnostic decision - Measures of diagnostic accuracy - Applications: Contrast enhancement of mammograms - Detection of calcifications by region growing - Shape and texture analysis of tumours.

TEXTBOOKS:

1. *Sinha G. R, Patel, B. C., "Medical Image Processing: Concepts And Applications", Prentice Hall, 2014.*
2. *Gonzalez R C, Woods R E, "Digital Image Processing", Third Edition, Prentice Hall, 2007.*

REFERENCES:

1. *Rangayyan R M, "Biomedical Image Analysis", Fifth Edition, CRC Press, 2005.*

2. *KayvanNajarian, Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2014.*
3. *Deserno T M, "Biomedical Image Processing", Springer, 2011.*

15ECE325   **BIOMEDICAL SIGNAL PROCESSING**   **3 0 0 3**
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Signal processing: Review of Discrete time signals and systems - LTI systems - Response of LTI systems – Convolution - Difference equation representation of discrete systems Z transform - Transform analysis of LTI system – DFT. STFT - Introduction to wavelets - CWT and DWT with Haar wavelet. Introduction to biosignals: Computers in medicine. Human anatomy and physiology - Cell structure - Origin of bioelectric potentials - Biomedical signals - The Brain and its potentials. Electrophysiological origin of brain waves. EEG signal and its characteristic- ECG signal origin and characteristics.

Unit 2

Neurological signal processing: EEG analysis - Parametric modelling - Linear prediction theory; Autoregressive (AR) method; Recursive estimation of AR parameters. Cardiological signal processing: ECG parameters and their estimation - Arrhythmia analysis monitoring - ECG data reduction techniques.

Unit 3

Adaptive interference / Noise cancellation: Types of noise in biosignals; Digital filters - IIR and FIR - Notch filters - Optimal and adaptive filters. Weiner filters - steepest descent algorithm - LMS adaptive algorithm - Adaptive noise canceller - cancellation of 50 Hz signal in ECG - Cancellation of maternal ECG in foetal electrocardiography.

TEXTBOOKS:

1. *D. C Reddy, "Biomedical Signal Processing, Principles and Techniques", Tata McGraw Hill Publishing Company Limited, First Edition, 2005.*
2. *Willis J Tompkins, "Biomedical Digital Signal Processing", Prentice Hall India Private Limited, First Edition, 2006.*

REFERENCES:

1. *Rangaraj M Rangayyan "Biomedical Signal Analysis – A case study approach" IEEE press series in biomedical engineering, First Edition, 2002.*
2. *John G Proakis, Dimitris and G. Manolakis, "Digital Signal Processing Principles algorithms, applications" PHI Third Edition. 2006*

15ECE326   BIOMETRIC SYSTEMS   3 0 0 3

Unit 1

Introduction: Benefits of biometric versus traditional techniques – Key biometric terms and processes – Verification and identification - Enrollment and template creation - Biometric matching. Accuracy in biometric systems: False match rate - False non-match rate - Failure-to-enroll rate - Derived metrics - Equal error rate - Ability-to-verify rate.

Unit 2

Physiological biometrics: Finger scan – Facial scan – Iris scan – Components - Working principles - Competing technologies - Strengths and weaknesses – Automated fingerprint Identification systems. Behavioural biometrics signature scan – Keystroke scan – Components - Working principles - Strengths and weaknesses.

Unit 3

Biometric applications: Categorizing biometric applications - Criminal identification - Citizen identification – Surveillance – PC/network access – Physical access/time and attendance - Customer facing applications - E-commerce/telephony – Retail/ ATM/point of sale applications. Biometric markets: Law enforcement - government sector - Financial sector – Healthcare - travel and immigration - Biometric standards.

TEXTBOOK:

Samir Nanavati, Michael Thieme, Raj Nanavati, "Biometrics – Identity Verification in a Networked World", Wiley-dreamtech India Pvt Ltd, New Delhi, 2003.

REFERENCES:

1. *James Wayman, Anil Jain, David Maltoni, Dario Maio (Eds), "Biometric Systems", Springer International Edition, 2004.*
2. *Anil K Jain, Patrick Flynn, Arun A Ross, "Handbook of Biometrics", Springer, 2008.*
3. *John R Vacca, "Biometric Technologies and Verification Systems", Elsevier Inc, 2007.*
4. *Ruud M. Bolle, SharathPankanti, Nalini K. Ratha, Andrew W.Senior, Jonathan H. Connell, "Guide to Biometrics", Springer, 2009.*

15ECE327   DIGITAL SIGNAL PROCESSORS AND APPLICATIONS 3 0 0 3
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Programmable architecture: Review of digital signal processing concepts - Basic architectural features - DSP communicational building blocks - Bus architecture and memory data addressing capabilities - Address generation unit - Programmability and program execution - Speed issues - Features for external interfacing.

Unit 2

Programmable digital signal processors: Commercial digital signal processing devices - Data addressing modes of TMS320C54XX digital signal processors - Data addressing modes of TMS320C54XX processors - Memory space of TMS320C54XX processors - Memory space of TMS320C54XX processors - Program control - TMS320C54XX instruction & programming - On-chip peripherals - Pipeline operation of TMS320C54XX processors.

Unit 3

Implementation of basic DSP algorithms: The Q notation - FIR filters - IIR filters interpolation of filters. Decimation filters - Adaptive filters - 2-D signal processing - FFT algorithm for DFT computation - Butterfly computation overflow and scaling - Bit reversed index generation FFT implementation on the TMS320C54XX - Computation of signal spectrum. Advanced DSPs: Overview of TMS320C67X processor: Architecture - pipelining - Applications of programmable DSP devices to speech/image processing.

TEXTBOOK:

Avtar Singh, S. Srinivasan, "Digital Signal Processing Implementation", Thomson Learning Inc, First Edition, 2004.

REFERENCES:

1. *Emmanuel C. Fletcher, Jervis B. W. "Digital Signal Processing: A Practical Approach", Pearson education, Second Edition, 2002.*
2. *B. Venkataramani, M. Bhaskar, "Digital Signal Processors - Architecture, Programming and Applications", Tata McGraw Hill Publishing Company Limited, First Edition, 2007.*

15ECE328   HYPERSPECTRAL IMAGING ANALYSIS   3 0 0 3
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Introduction to Remote Sensing: Multi-Spectral Imagery (MSI) - Hyperspectral Imagery (HSI) - Scientific Principles: Physics of imaging spectroscopy - electromagnetic propagation - sensor physics - atmospheric Corrections - Hyperspectral Concepts and System Tradeoffs: Signal-to-Noise ratio (SNR) - spectral resolution– sampling – range.

Unit 2

Dispersion Techniques – data collection systems – current HIS systems: Ground – airborne – spaceborne – calibration techniques – HSI Data Processing Software – HSI Data Processing Techniques: Image Space – spectral space - feature space, spectral angle mapping - N-dimensional scatterplots - projection pursuit – spectral mixture analysis – Principal Component Analysis (PCA).

Unit 3

Spectral mapping – Pixel Purity Index (PPI) – Minimum Noise Fraction (MNF) – Mixture Tuned Matched Filtering (MTMF) – Classification Techniques: Supervised – Unsupervised – Hybrid - Detection, Classification, and Quantification in Hyperspectral Images Using Classical Least Squares Models.

TEXTBOOK:

Chein-I-Chang, "Hyperspectral Techniques for Spectral Detection and Classification Graphics and General-Purpose Computation," Kluwer Academic Publishers, 2003.

REFERENCES:

1. *James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", Guilford Press, Fifth Edition, 2011.*
2. *Hans F. Grahn and Paul Geladi, "Techniques and Applications of Hyperspectral Image Analysis, "John Wiley & Sons Ltd, 2007.*

15ECE329   IMAGE ANALYSIS   3 0 0 3
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Review of basics of image processing - Image restoration - Image segmentation: Thresholding – Edge-based segmentation – Region based segmentation - Matching - Evaluation issues in segmentation - Image morphology - Basic morphological concepts - Dilation and erosion - Skeletons and object marking - Granulometry - Morphological segmentation and watersheds.

Unit 2

Image representation and description - Chain Codes - Polygonal approximations using minimum perimeter polygons - Other polygonal approximation – Approaches – Signatures - Boundary descriptors - Regional descriptors - Use of principal components for description- Introduction to object recognition.

Unit 3

Applications: Medical image analysis. Medical imaging modalities: Planar X-Ray imaging - X-Ray computed tomography - Magnetic resonance imaging - Nuclear imaging - Ultrasonography. Document Image Analysis: Document Image binarization - Noise reduction - Document cleaning - Text segmentation - Optical character recognition.

TEXTBOOK:

Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education India, 2009.

REFERENCES:

1. *Geoff Dougherty,"Medical Image Processing Techniques and Applications", Springer, 2011.*
2. *L. O. Gorman and R. Kasturi, "Document Image Analysis", IEEE Computer Society Press, 1995.*

15ECE330   IMAGE PROCESSING   3 0 0 3
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Review of matrices - Vector spaces - Probability and random variables - Origin of digital image processing: Examples of fields that use digital image processing - Elements of visual perception brightness and contrast - Image sensing and acquisition - Image sampling and quantization - Some basic relationships between pixels. Image Enhancement in spatial domain: Some basic gray level transformations - Histogram processing - Enhancement using arithmetic/logic operations - Basics of spatial filtering - Smoothing and sharpening spatial filters.

Unit 2

Image enhancement in frequency domain: Review of sampling and discrete fourier transform - Image enhancement in the frequency domain. Frequency domain filtering: Smoothing – Sharpening - Homomorphic filtering. Color image processing fundamentals: Pseudo color image processing- Basics of full color image processing.

Unit 3

Image Compression: Image compression models – Error free compression- Lossy compression – Applications of image compression. Image transforms: Introduction to transformation used for image processing applications -Cosine – Hadamard – Haar – Sine - KL Transforms and their properties.

TEXTBOOK:

Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education India, 2009.

REFERENCE:

Anil K. Jain, "Fundamentals of digital image processing" Prentice Hall of India Private Limited, 1996.

15ECE331   PATTERN RECOGNITION TECHNIQUES   3 0 0 3
AND ALGORITHMS
(Pre-requisite:15MAT213 Probability and Random Processes)

Unit 1

Statistical decision making techniques: Bayes' theorem - Multiple features - Conditionally independent features - Decision boundaries - Unequal costs of error - Estimation of error rates - Leaving one out technique - Characteristic curves.

Unit 2

Non-parametric decision making techniques: Histograms - Kernel and window estimators - Nearest neighbor classification techniques - Adaptive decision boundaries - Adaptive discriminant functions - Minimum squared error discriminant functions - Choosing a decision making technique.

Unit 3

Artificial neural networks: nets without hidden layers - Nets with hidden layers - Back propagation algorithm - Hopfield nets.

TEXTBOOK:

Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", PHI Learning Private Ltd., New Delhi, 2009.

REFERENCES:

1. *Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers (Elsevier), 2011.*

2. *K. P Soman, Shyam Diwakar, V. Ajay, "Insight into Data Mining: Theory and Practice", PHI Learning Private Ltd., New Delhi, 2006.*

3. *Sergios Theodoridis, Konstantinos Koutroumbas,"Pattern Recognition", Fourth Edition, Academic Press (Elsevier), 2011.*

15ECE332   SPARSE SIGNAL AND IMAGE PROCESSING   3 0 0 3
(Pre-requisite:15ECE212 Signal Processing II)

Unit 1

Review of Mathematical Preliminaries, signals and systems course: Review of matrices - vector spaces and linear algebra - Linearly independent - Vector norms – Orthogonality - Eigen values - Eigen vectors - Covariance of matrices – Vector/function space - Basis function - Orthogonal basis by sampling sine and cosine functions - Singular value decomposition. Significance of time-frequency domains – convolution - Fourier series - Fourier transforms - Review of Fourier theory and properties of fourier transform – DFT-FFT.

Unit 2

Introduction to image processing and wavelet transform: The origins of digital image processing - Examples of fields that use digital image processing - Image digitization and sampling - Image sensing and acquisition - Image sampling and quantization - Image enhancement - Image compression. Continuous wavelet transform (CWT) - Discrete wavelet transform - Haar scaling function nested spaces - Signal decomposition and signal reconstruction using (DWT).

Unit 3

Compressed sensing and Sparse Signal Representation: Sparse signals - Single-pixel imaging - Compressible signals - over complete dictionaries - Coherence between bases - Compressed sensing and signal reconstruction - Restricted isometry property - Unconstrained and constrained optimization algorithms – Applications of compressed sensing in different fields.

TEXTBOOK:

K. P. Soman and R. Ramanathan, "Digital signal and Image Processing - The sparse way", Elsevier India. 2012.

REFERENCES:

1. *K. P. Soman, K. I. Ramachandran, "Insight into Wavelets: From Theory to Practice", PHI, 2004.*

3. *Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education India, 2009.*

4. *Yonina C. Eldar, Gitta Kutyniok, "Compressed Sensing: Theory and Applications", Cambridge university press, 2012.*

15ECE333   SPOKEN LANGUAGE PROCESSING   3 0 0 3
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Speech analysis: source filter modeling - Speech sounds - Lip radiation - Linear prediction - Lattice filters - Levisnon-Durbin recursion. Feature extraction for speech processing: Short term Fourier transform – Wavelets – cepstrum - Sinusoidal and harmonic representations - Mel frequency cepstral coefficients (MFCC) - Perceptual linear prediction (PLP) - Mel filter bank energies.

Unit 2

Principles of speech coding: Main characteristics of a speech coder - Key components of a speech coder - From predictive coding to CELP - Improved CELP coders - Wide band speech coding - Audio-visual speech coding. Speech synthesis: Linguistic processing - Acoustic processing - Training models automatically - Text pre-processing - Grapheme to phoneme conversion – Rule based and decision tree approaches - Syntactic prosodic analysis - Prosodic analysis - Speech signal modeling.

Unit 3

Principles of speech recognition: Hidden Markov models (HMM) for acoustic modeling, Observation probability and model parameters - HMM as probabilistic automata - Viterbi algorithm - Language models - n-gram language modeling and difficulties with the evaluation of higher order n-grams and solutions. Spoken keyword spotting approaches - Evaluation metric - Spoken language identification – Approaches – Acoustic – Phonotactic - LVCSR based.

TEXTBOOKS:

1. *Joseph Mariani (Ed), "Spoken Language Processing", John Wiley & Sons, 2009.*

2. *Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, "Spoken Language Processing, A guide to theory, algorithm and system development", Prentice Hall, Inc, New Joursey, USA, 2001.*

REFERENCE:

J Benesty, M MSondhi, Y. Huang (Eds.), "Springer Handbook on Speech Processing", Springer-Verlag Berlin, Heidenberg, 2008.

15ECE334   WAVELET - BASED SIGNAL PROCESSING   3 0 0 3
AND APPLICATIONS
(Pre-requisite: 15ECE212 Signal Processing II)

Unit 1

Review of mathematical preliminaries: Vector - Function space - Basis function - Review of fourier theory and properties of fourier transform - Short time fourier transform - Heisenberg's uncertainty principle - Continuous wavelet transform – CWT and its Properties – DWT - Time-frequency tiling.

Unit 2

Discrete Wavelet Transform - Haar scaling function - Nested spaces - Wavelet function. Designing orthogonal wavelet systems: Daubechies – Coiflet - Symlet wavelet system coefficients - Signal decomposition using DWT - Relation to filter banks and frequency response - Signal reconstruction using DWT – M band wavelets.

Unit 3

Introduction to bi-orthogonal wavelets - Introduction to lifting scheme- Applications ofwavelet transform: Image processing - Image compression - De-noising - audio coding - channel coding.

TEXTBOOK:

K. P. Soman, K. I. Ramachandran, "Insight into Wavelets: From Theory to Practice", Third Edition, PHI, 2004.

REFERENCES:

1. Gilbert Strang and Truong Nguyen, "Wavelets and Filter banks", Wellesley Cambridge Press, 1996.

2. R. M. Rao and Ajit S. Bopardikar, "Wavelet Transform, Introduction to theory and Applications", Addison-Wesley, 1998.

15ECE337   ANALOG AND MIXED CIRCUIT DESIGN   3 0 0 3

Unit 1

Overview of MOFSET basics – Second order effects – Measurement of parameters for a given technology with a simulation tool – Passive and active current mirrors – Single stage amplifier – Differential voltage and current amplifiers – Noise performance of elementary transistor stages – Systematic design of operational amplifiers.

Unit 2

Mixed Signal Circuits: Non-linear analog circuits - Open loop comparators – static and dynamic comparators, effect of positive feedback and stability issues – Switched capacitor circuits. Nonlinearity and Mismatch – capacitor nonlinearity, effect of feedback on nonlinearity, linearization techniques – offset cancellation techniques – reduction of noise by offset cancellation.

Unit 3

Data convertors: Fundamental of data converters - static characteristics – INL, DNL – Dynamic characteristics – SNR, SFDR, SINAD – DAC architectures: Resistive – Capacitive – Current steering. ADC Architectures: Flash – SAR – Pipeline ADC.

TEXTBOOKS:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2003.

2. Franco Maloberti, "Data Convertors", Springer, 2007.

REFERENCES:

1. Willy M. C Sansen, "Analog Design Essentials", Springer,2006.

2. Behzad Razavi, "Principles of Data Conversion System Design", IEEE Press,1995.

15ECE338   ANALOG IC DESIGN   3 0 0 3
(Pre-requisite: 15ECE211 Electronic Circuits)

Unit 1

Introduction to Analog Integrated Circuits: Analog Integrated Circuit design, Notation, Symbols and Terminology, Analog Signal processing, Example of Analog VLSI mixed signal Circuit Design. CMOS Technology: Basic MOS semiconductor fabrication process, PN junction, The MOS Transistor, Passive Components, Other Considerations of CMOS Technology, Integrated Circuit Layout - CMOS Device Modeling, Simple MOS Large Signal Model, Other MOS Large Signal Model Parameter, Small Signal Model for the MOS Transistor, Computer Simulation Model, Sub threshold MOS model, SPICE Simulation of MOS Circuit.

Unit 2

Analog CMOS Sub circuits: MOS Switch, MOS Diode /Active Resistor, Current sinks and sources, current mirror. Frequency response of MOS amplifiers. Large signal and small signal analysis of Differential amplifier.

Unit 3

CMOS Operational Amplifier: Introduction and analysis of Cascode Amplifier and Telescopic Cascode Amplifier. Design of CMOS op-amps, Compensation of op-amps, Design of Two stage op-amps, Cascode op-amps.

TEXTBOOK:

P. Allen and D. Holberg, "CMOS Analog Circuit Design", Oxford University Press, Second Edition, 2012.

REFERENCES:

1. B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2003.

2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley Publishers, Fifth Edition, 2009.

15ECE339   **APPLICATIONS OF**   **3 0 0 3**
LINEAR INTEGRATED CIRCUITS
(Pre-requisite: 15ECE303 Linear Integrated Circuits)

Unit 1

Current Sources and Operational Amplifiers: Current mirror - Wilson Current Mirror - Widlar Current Source - Current Sources in IC Form. Op-amp basics; ?A741 – Internal schematic - Parameters - Frequency compensation of voltage and current feedback amplifiers - Grounding and shielding.

Unit 2

Op-amp CircuitsI: Instrumentation amplifiers - Current Sources using opamps - Isolation Amplifiers - Operational transconductance amplifiers (OTA) - Log and anti-log amplifiers – Multipliers - Voltage to frequency and frequency to voltage converters - Phase sensitive detectors (PSD) - Phase locked loops (PLL) - Lock-in amplifiers;

Unit 3

Op-amp circuits II: Voltage references - Low noise current differencing and low power operational amplifiers - Power supply ripple - Voltage regulators - IC protection circuits - Analog to digital converters - $\Sigma-\Delta$ ADC.

TEXTBOOKS:

1. *Franco S., "Design with operational amplifiers and analog integrated circuits", Third Edition, New York McGraw-Hill, 2002.*
2. *Sedra A and Smith K C, "Microelectronic circuits", Sixth Edition, New York Oxford University Press, 2010.*

REFERENCES:

1. *Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2003.*
2. *Graeme J., Tobey G., and Huelsman L. P., "Operational amplifiers - Design and Applications", New York McGraw-Hill, 1971.*
3. *Soclof S, "Applications of analog integrated circuits", Englewood Cliffs, NJ: Prentice-Hall, 1985.*
4. *Relevant Datasheets from Texas Instruments, Maxim and Harris Semiconductors.*

15ECE340   **INTEGRATED CIRCUITS FOR**   **3 0 0 3**
BIOLOGICAL SYSTEMS
(Pre-requisites: 15ECE303 Linear Integrated Circuits;
15ECE302 Control Systems Engineering)

Unit 1

Introduction: Bio-signals, Bio-potentials: neural, cardiac, muscular, Chemical, optical signals. Role of amplifiers - Analog and digital signals – Frequency-response band and interfacing.The basic linear feedback loop, Connections between feedback

loops and circuits, Root-locus techniques, Eight root-locus rules, Thezeros of a closed-loop system.

Unit 2

Device physics (MOS), Operating regimes, Large signal model - Parasitics, Small signal model, Transconductance, Impedances, Common Source (CS) Amplifier-Gain, Biasing, Interfacing CS to Biology, Diff. Amp. for Noisy Electrodes – Common/ differential mode signals – Common-mode rejection ratio, Common drain (voltage in, current out) - Common gate (current in, voltage out), Current in, current out-Biasing circuits Op-amps-two stage, frequency compensation, sources of noises, Power spectral density,noise in op-amp, Minimum detectable signal.

Unit 3

Design and simulation of ECG Pre-amplifier, High CMRR OP-Amp design, instrumentation amplifier, design and simulation of CMOS filters for low frequency ranges. Advanced process design, fabrication and testing of transistors for analog integrated circuits.

TEXTBOOKS:

1. *Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2003.*
2. *Gary. S. May and S. M. Sze, "Fundamentalsof semiconductor fabrication", John Wiley, First Edition, 2003.*

REFERENCES:

1. *T. Chan Carusone, D. Johns, and K. Martin, "Analog Integrated Circuit Design", 2nd edition, J. Wiley & Sons, 2011.*
2. *P. Allen and D. Holberg, CMOS "Analog Circuit Design", 2nd edition, Oxford University Press, 2002.*
3. *P. Gray, P. Hurst, S. Lewis, and R. Meyer, "Analysis and Design of Analog Integrated circuits", John Wiley and Sons, Fifth Edition, 2009.*
4. *Rahul Sarpeshkar,"Ultra Low Power Bioelectronics Fundamentals, Biomedical Applications and Bio-inspired Systems", 1st edition Cambridge University Press 2010*
5. *Myer Kutz, The-Bio-Medical-Engineering and Handbook.*

15ECE344   **ANTENNA SYSTEMS AND DESIGN**   **3 0 0 3**

Unit 1

Introduction to radiation concept – Antenna parameters – Directivity – Gain – Radiation pattern – Impedance - Polarization – Beamwidth – Antenna temperature – Antenna measurements and Requirement for measurements.

Unit 2

Types of antennas – Point source – Dipole and slots – Loop antenna – Horn antenna – Helical Antenna – Patch – Reflector antennas –Parabolic reflector.

Unit 3

Array of two sources – Pattern multiplication – Linear arrays – Broadside array – Endfire array – Planar arrays.

TEXTBOOK:

Kraus, Marhefka, "Antennas for all Applications", Tata McGraw Hill, Third Edition, 2002.

REFERENCES:

1. *Vincent F. Fusco, "Foundations of Antenna Theory and Techniques", Pearson Education, First Impression, 2007.*
2. *C. A. Balanis, " Antenna Theory – Analysis and Design", Wiley India, 2000*

15ECE345   **CELLULAR AND MOBILE**   **3 0 0 3**
COMMUNICATION SYSTEM

Unit 1

Introduction to cellular mobile systems - Basic Cellular System - Cellular communication infrastructure: Cells – Clusters - Cell Splitting - Frequency reuse concept and reuse distance calculation - Cellular system components - Operations of cellular systems – Handoff/Handover - Channel assignment - Fixed and dynamic - Cellular interferences: Co-Channel and adjacent channel and sectorization.

Unit 2

Channel Models: Properties of mobile radio channels - Intersymbol interference - Multipath and fading effects - Interleaving and diversity - Multiple access schemes (TDMA, FDMA, CDMA, SDMA) - Interuser interference - Traffic issues and cell capacity - Power control strategies - Channel assignment - Handoff.

Unit 3

Introduction to modern cellular standards - 2G Architecture such as GSM and CDMA based - 2.5G - GPRS: GPRS and its features - GPRS network architecture - GPRS protocol architecture - GPRS backbone network - 3G standard details such as UMTS - Introduction to LTE.

TEXTBOOKS:

1. *Theodore S. Rappaport, "Wireless Communications Principles and Practice", Second Edition, 2002.*
2. *Gottapu Sasibhushana Rao, "Mobile Cellular Communication" Pearson Education, 2012.*

REFERENCES:

2. *Andrea Goldsmith, "Wireless Communications", Cambridge University Press, First Edition, 2005.*
3. *William Stallings, "Wireless Communication and Networking", PHI, 2003.*

15ECE346   **DIGITAL TELEPHONY**   **3 0 0 3**

Unit 1

Telephony Background: An overview of telephone networks - Transmission system - Basic switching system – Signaling - Echo cancellation - Working principles of telephone - DC (pulse) and DTMF (tone) – Signaling - Digital Switching Systems. Traffic Analysis: Traffic characterization - Loss systems - Network blocking probabilities - Delay systems (queuing system) - Queues in tandem.

Unit 2

Switching: Single stage – Grading - Progressive grading - Traffic capacity of grading – Applications - Link systems. Space/Time Division Switching: Space switch - Time switch and their design - Hybrid switches - Concentrator and switching components - PBX switches - Digital cross connect - Time division switching: Space and time division switching - General space switches - Time switches - Time division switching networks - Basic networks - Bidirectional pass - Complex switching networks – Concentrators - PBX switches - Digital cross connect units - Grades of services of time division switching networks.

Unit 3

Switching Control: Call processing - Signal exchanges - Signal operations - Common control – Reliability - Availability and security - Network synchronization - Network control network management. Digital Network and Signaling: Integrated service digital network (ISDN) - ISDN overview - ISDN interfaces and functions - User network interface - ISDN protocol architecture. Signaling System Number 7 (SS7): SS7 architecture signaling date link level - signaling link level - Network level - Signaling connection control part.

TEXTBOOKS:

1. *J E Flood, "Telecommunication Switching, Traffic and Networks", Pearson Education, 2003.*
2. *John C Bellamy, "Digital Telephony", Third Edition, John Wiley and Sons, 2002*

REFERENCES:

1. *William Stalling, "ISDN and Broadband ISDN with Frame Relay and ATM", Fourth Edition, Pearson education Asia publication.*
2. *Thiagarajan Viswanathan, "Telecommunication Switching and Networks", PHI Publication.*

15ECE347   **INTRODUCTION TO RADAR SYSTEMS**   **3 0 0 3**

Unit 1

Introduction to Radar: Radar block diagram - Radar frequencies - Applications of radar - Radar range equation - Minimum detectable signal - Receiver noise - Integration of radar pulses Radar cross section of targets - Pulse repetition frequencies and range ambiguities.

Unit 2

Radar Components: Radar antennas - Review of antenna parameters - Parabolic reflector antennas - Scanning feed reflector antennas - Lens antenna - Cosecant squared antenna pattern - Radomes. Radar receivers: Noise figure in receivers – Mixers – Displays - Duplexers.

Unit 3

Radar Types: CW and FM modulated radar: Doppler effect - CW radar - FM CW radar - multiple frequency CW radar. MTI and pulse Doppler radar: Delay line cancellers - Staggered PRF - Pulse Doppler radar - MTI from a moving platform. Tracking radar: tracking using a radar - Sequential lobing conical scan - Monopulse tracking radar - Target reflection and angular accuracy - Tracking in range - Acquisition.

TEXTBOOKS:
1. *Meril I Skolink,"Introduction to Radar Systems", Tata–McGraw Hill (Third Edition), 2003*
2. *C.A Balanis, "Antenna Theory: Analysis and design", John Willey & Sons,2000.*

REFERENCES:
1. *Mark A Richards, James A Scheer, William A Holm,"Principles of modern radar", Sci. Tech Publishing incorporated, 2010.   .*
2. *Jerzy M Kawecki, "Radar Essentials", IEEE Press 2000.*

15ECE348   MICROSTRIP DEVICES AND CIRCUITS   3 0 0 3
(Pre-requisite: 15ECE213 Transmission Lines and Waveguides)

Unit 1

Introduction to planar transmission lines: stripline – Microstrip line – Shielded microstripline – Impedance – Effect of thickness – Attenuation - Applications. Distributed and lumped elements - Capacitors – Inductors – Resistors – Terminations – Attenuators – Resonators. Directional couplers: Rring directional couplers - Branch-line directional couplers.

Unit 2

Power dividers, combiners and Y junctions: Power dividers – Combiners – Quarter wave length power dividers / combiners – N-way dividers / combiners – Ferrite devices – Circulators – Isolators - Non-ferrite nonreciprocal devices. Diode control devices: Pin diode parameters – Switches – Attenuators.

Unit 3

Microstrip circuits: Microwave integrated subassemblies – I band multifunctional transmit / receive module – Electrically tunable preselector – Switchable balanced amplifier - Design and fabrication technology – RF/microwave packages - Metal – Ceramic – Plastic – 3D design.

TEXTBOOK:
Leo G. Maloratsky, "Passive Rf& Microwave Integrated Circuits", Elsevier Inc, First Edition, 2006.
REFERENCES:
1. *David M. Pozar, "Microwave Engineering", Wiley India Limited, Third Edition, 2007.*
2. *G. P. Srivastava, V. L. Gupta, "Microwave Devices And Circuit Design", Prentice HallIndia Private Limited, First Edition, 2006.*

15ECE349   MICROWAVE SOLID STATE DEVICES   3 0 0 3
(Pre-requisite: 15ECE211 Electronic Circuits)

Unit 1

Introduction to radio frequency transistors and diodes: Transit time effects – Silicon and GaAs material properties – Applications. Bipolar Transistors (BJT): Physical structure – Configuration – Operation – Amplification phenomena. Hetero junction BJT: Operational mechanism – Applications: Tunnel effect: Tunnel diodes and operation.

Unit 2

Field effect transistors (FET): Junction FET: Structure – Operation – I-V characteristics. Metal Semiconductor FET (MESFET): Structure – Operation – Cutoff and maximum oscillation Frequency. High electron mobility Transistors (HEMT): Structure – Operation and electronic applications. Metal oxide semiconductor FET: Maximum operation frequency – CMOS, NMOS Memory devices.

Unit 3

Transferred electron devices: Gunn effect – GaAs diode – Ridley's Watkins Hilsum Theory – Negative resistance – Two valley model theory – High field domain – Modes of operation – Classification of modes – Limited space charge accumulation – LSA diodes – InP diodes. Avalanche transit time devices: Read diodes – IMPATT – TRAPATT – BARITT – Parametric devices. Monolithic microwave integrated circuits: Materials – Substrate: conductor, Dielectric – Resistive materials – MMIC fabrication techniques – MOSFET fabrication – Thin film formation – Hybrid integrated circuit fabrication.

TEXTBOOK:
Samuel. Y. Liao, "Microwave Devices and Circuits", Pearson Education, Third Edition, 2004.
REFERENCES:
1. *Matthew. M. Radmanesh, "Radio Frequency and Microwave Electronics Illustrated", Pearson Education, First Edition, 2006.*
2. *R. Ludwig and P. Bretchko, "RF Circuit Design-Theory and Applications", Pearson Education, First Edition, 2006.*

**15ECE350   MILLIMETER WAVE PERSONAL   3 0 0 3
                        COMMUNICATION SYSTEM**

Unit 1

Indoor propagation modeling: Introduction – Interference - Indoor propagation effects - ITU indoor path loss model - Long distance path loss model - link budget. Millimeter Wave (MMW) characteristics: MMW characteristics - 60 GHz MMW radio:Principle and technology - Channel performance at 60 GHz - Gigabit wireless communications - Development of MMW standards - Coexistence with wireless backhaul.

Unit 2

Review of modulations for MMW communications: PSK - OFDM. MMW transceivers: Transceiver architecture. MMW antennas: Path loss and antenna directivity - Antenna beamwidth – Beamsteering antenna.

Unit 3

MMW MIMO: Spatial diversity of antenna arrays - Multiple antennas - Multiple transceivers - Noise coupling in a MIMO system. Potential benefits of advanced diversity for MMW: Spatial and temporal diversity - Spatial and frequency diversity - Dynamic spatial, Frequency and modulation allocation. Advanced beamsteering and beamforming: The need for beamsteering / beamforming. MMW applications.

TEXTBOOK:

Kao-Cheng Huang, Zhoacheng Wang, *"Millimeter Wave Communication Systems"*, Wiley IEEE press, 2011.

REFERENCES:

1. *John S. Seybold "Introduction to RF propagation,"John Wiley and Sons, 2005.*
2. *Chia-Chin Chong, Kiyoshi Hamaguchi, Peter F. M. Smulders and Su-Khiong, "Millimeter - Wave Wireless Communication Systems: Theory and Applications," Hindawi Publishing Corporation, 2007.*

15ECE351   MIMO AND MULTICARRIER SYSTEMS   3 0 0 3
(Pre-requisite: 15ECE312 Digital Communication)

Unit 1

Introduction - Crowded spectrum - Need for high data rates – Multiple input multiple output systems – Multi antenna systems and concepts - Spatial multiplexing - MIMO system model- MIMO system capacity- Channel known to the transmitter - Channel unknown to the transmitter - Water-pouring principle – Capacity calculation – SIMO - MISO - Ergodic capacity - Outage capacity – Influence of fading Correlation on MIMO capacity - Influence of LOS on MIMO capacity.

Unit 2

Delay diversity scheme- Alamouti space - time code - Maximum likelihood decoding - Maximum ratio combining - Transmit diversity - Space-time block codes - STBC for real signal constellations - Decoding of STBC-OSTBC - Capacity of OSTBC channels - Space-time code Word design criteria – Multiplexing architecture - V-BLAST architecture.

Unit 3

Data transmission over multipath channels - Single carrier approach - Multicarrier approach - OFDM - OFDM generation - Cyclic prefix - Performance of space - Time coding on frequency-Selective fading channels- Capacity of MIMO - OFDM systems - Performance analysis of MIMO-OFDM systems.

TEXTBOOKS:

1. *MohinderJanakiram, "Space time Processing and MIMO systems",Artech House, First Edition, 2004.*
2. *ArogyaswamiPaulraj, RohitNabar, Dhananjay Gore, "Introduction to Space-Time Wireless Communications", Cambridge University Press, 2008.*

REFERENCES:

1. *Hamid Jafarkhani, "Space Time coding-Theory and Practice",Cambridge University Press, First Edition, 2005.*
2. *BrankaVucetic, Jinhong Yuan, "Space Time coding", John Wiley and Sons, First Edition, 2003.*
3. *Andrea Goldsmith, "Wireless Communication", Cambridge University Press, First Edition. 2005.*
4. *David Tse, PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.*

15ECE352   MULTIMEDIA COMMUNICATION STANDARDS   3 0 0 3

Unit 1

Introduction to multimedia communications - Multimedia representation – Digitizationprinciples – Text - Audio and video content representation. Text and image compression: Introduction - compression principles text compression - Image compression - Audio and Video compression.

Unit 2

Standards of multimedia communication-introduction - reference models - Interpersonal andinteractice standards - Standard entertainment applications. Internet – Introduction - IP diagram – Fragmentationand reassembly – HRP – RAR message format and transmission - Routing algorithm – ICMP - QOS support - PPP link layer protocol - IPv6 - IPv6/IPv4 interoperability.

Unit 3

Broadband ATM networks - Cell format and switching principles - Switch architecture and protocol architectures - ATM's LAN - MAN and WIDE area network.

Entertainment networks and high speed modem: Cable TV network - Satellite TV network and Terrestrial TV network. Internet applications - High speed PSTN access technologies. Internet applications and world wide web.

TEXTBOOK:

Fred Halsall, "Multimedia communications, Applications, Networks, Protocols and Standards" Pearson education, 2009 reprint.

REFERENCES:

1. *Morris Mano, "Introduction to Data Communications and networking", First Edition, Pearson Education, 2006.*
2. *S.Kesav, "An Engineering Approach to Computer Networking: ATM Networks, the Internet, and the Telephone Network", First edition, Pearson education   Indian print.*
3. *IEEE Transactions on Multimedia.*
4. *ACM transaction on multimedia computing.*

15ECE353   **OPTICAL COMMUNICATION**   **3 0 0 3**
(Pre-requisite: 15ECE301 Communication Theory)

Unit 1

Introduction - Ray theory transmission - Electromagnetic mode theory for optical propagation - Cylindrical fibers - Single-mode fibers – Attenuation - Material absorption losses in silica glass fibers - Linear and nonlinear scattering losses - Fiber bend losses - Chromatic and intermodal dispersion.

Unit 2

Optical detectors: Introduction - Device types - Optical detection principles – Absorption -Quantum efficiency – Responsivity - Long-wavelength cutoff - Semiconductor photodiodes with and without internal gain.

Unit 3

Link design - System degradation and power penalty - Measurements on fiber optic systems – SONET – EDFA - WDM components and networks.

TEXTBOOK:

John M Senior, "Optical Fiber Communication, Principles and Practice", Third Edition, Prentice Hall, 2009.

REFERENCES:

1. *Gerd Keiser, "Optical Fiber Communication", Fourth Edition, MGH, 2008.*
2. *Joseph C. Palais, "Fiber Optic Communications", Fourth Edition, Pearson Education, 2004.*
3. *C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts, Design,andAlgorithms"Prentice-Hall, 2002.*

15ECE354   **PRINCIPLES OF RFID DESIGN**   **3 0 0 3**

Unit 1

Introduction to RFID - Comparison with other identification systems - Operating and physical principles. Types of tags - Passive, active, semi-passive, security issues, memory capacity - Radio regulatory issues and frequency ranges. Challenges in deployment-cost comparison of tags and readers in India.

Unit 2

Communication principles, coding, modulation and demodulation - Data integrity multiple access procedures -Anti-collision procedures - Security issues and solutions. Hardware architecture of Tags and readers - Transponder design – memory- Sensors. Reader RF inrerface-control unit – Middleware - Near field communications. Comparison of successful RFID standards.

Unit 3

Case studies - Smart cards - Public transport - Payment systems - NFC Applications - Electronic passport - Ski Tickets - Access control - Online and offline Systems - Supply chain and transport systems - Container transport animal identification - Stock keeping - Industrial and medical applications.

TEXTBOOK:

Klaus Finkenzeller, "RFID Handbook - Fundamentals and applications in contactlesssmart cards, radio frequency identification and near-field communication", 3rd edition,Wiley 2010.

REFERENCES:

1. *Curty, Declercq, Dehollain and Joehl, "Design and Optimization of passive UHF RFID Systems", Springer, 2007.*
2. *V.D. Daniel, A. Puglia and M. Puglia, "RFID: A Guide to Radio Frequency Identification", Wiley, 2007.*

15ECE355   **RADIO FREQUENCY CIRCUIT DESIGN**   **3 0 0 3**
(Pre-requisite: 15ECE402 Radio Frequency Engineering)

Unit 1

Radio frequency concepts: Frequency spectrum and applications – Behavior of passive components at radio frequencies – Design parameters. RF Passive components: Transmission lines and equivalent circuits – Design of transmission lines and transmission lines based devices - Smith chart representation.

Unit 2

RF Network theory: Interconnection of networks – Scattering parameters and properties - RF measurements and principles. Active RF components and modeling: Diode – Transistor – measurements of parameters – scattering parameter characterization.

Unit 3

RF System Design: Impedance matching concepts – Microstrip matching – Transistor biasing networks – Amplifier design concepts and power relations – Design of portable systems.

TEXTBOOK:

R. Ludwig and P. Bretchko, "RF Circuit Design-Theory and Applications", Pearson Education, First Edition, 2006.

REFERENCES:

1. *Matthew.M.Radmanesh, "Radio Frequency and Microwave Electronics Illustrated", Pearson Education, First impression, 2006.*
2. *D.M.Pozar, "Microwave Engineering", Wiley India Limited, Third Edition, 2007.*

15ECE356   SATELLITE COMMUNICATION   3 0 0 3
(Pre-requisite: 15ECE301 Communication Theory)

Unit 1

Review of Microwave Communications - Overview of satellite communications - Satellite orbits - Orbital mechanics and effects - Kepler's laws - Configurations of various orbits - Orbital elements - Elevation and azimuth angles - Doppler effect - Effect of the sun and moon - Sun transit outage. Satellite link models and design - Satellite system parameters - Link budget design.

Unit 2

Satellite subsystems – AOCS - TTC&M - Power and communication subsystems - Computations and controlling by processors - Satellite multiple access schemes – FDMA - TDMA and CDMA - Spread spectrum concepts - Comparison of multiple access schemes.

Unit 3

Satellite applications – VSAT - DTH television principles - Direct broadcast radios - Principles of navigation – GPS - Satellites and launch vehicles – INSAT - IRS satellites – PSLVs - GSLVs.

TEXTBOOK:

T.Pratt, C.W.Bostain and J.E.Allnut, "Satellite Communications" John Wiley and Sons, Second Edition, 2003.

REFERENCE:

Dennis Roddy, "Satellite Communications" McGraw-Hill Publishing company, Fourth Edition, 2006.

15ECE357   SOFTWARE DEFINED RADIO   3 0 0 3
(Pre-requisite: 15ECE312 Digital Communication)

Unit 1

Convergence of signal processing and communication engineering - Introduction of Software Defined Radio (SDR) - re configurability - Advantages of SDR over conventional radio –SDR architecture - Implementation. RF Implementation and front ends – Flexible RF system.

Unit 2

Multirate signal processing: Sample rate conversion- principles - Decimation and interpolation – DDC – DUC –Polyphase – filters- CIC filters - Digital filter banks. Timing recovery – Digital generation of signals – Applications of direct digital synthesis.

Unit 3

Parameters of Data converters, ADC and DAC architectures- Digital hardware choices – Case studies - Demonstration of SDR coupled to GNU radio.

TEXTBOOK:

J. H. Reed, "Software Radio A modern approach to Radio Engineering", Prentice Hall 2002.

REFERENCES:

1. *Behrouz. F. Bourjney" Signal Processing for Software defined Radios", Lulu 2008.*
2. *P. B. Kennington "RF and baseband techniques for software defined radio" Artech house 2005.*
3. *P. Bums "Software defined radio for 3G" Artech house, 2003.*
4. *T. J. Rauphal "RF and Digital signal processing for software radios, A multi-standard multimode approach", Elsevier, 2008.*

15ECE358   SPREAD SPECTRUM COMMUNICATION   3 0 0 3
(Pre-requisite: 15ECE312 Digital Communication)

Unit 1

Introduction to spread spectrum - Direct sequence spread spectrum - Spreading sequences and Waveforms: - Pseudo-random sequence generation- Maximal sequences - Autocorrelations and Power spectrums of codes - Characteristic polynomials - Generation of gold codes – Interference rejection for DS/SS. Frequency hopping spread spectrum - Frequency synthesizers - Multitone jamming - Hybrid systems.

Unit 2

Synchronization issues for spread-spectrum - Phase lock loop - Delay lock loop - Acquisition of spreading sequences – Serial search acquisition - Introduction to code tracking.

Unit 3

Detection of spread spectrum signals - Performance of direct sequence spread spectrum - Performance of frequency hopped spread spectrum - Performance of spread spectrum system with forward error correction. Low probability of detection - Code division multiple access (CDMA).

TEXTBOOK:

Don Torrieri "Principles of Spread-Spectrum Communication Systems", Second Edition, Springer New York Dordrecht Heidelberg London.2011.

REFERENCES:

1. *Roger L Peterson, Rodger E Ziemer, David E Borth, "Introduction to Spread Spectrum Communication", Pearson Education, First Edition, 2013.*
2. *John. G. Proakis&MasoudSalehi, "Digital Communication", Tata McGraw Hill Publishing Company Limited, Fifth Edition, 2009.*
3. *Rappaport, T. S, "Wireless Communications", Pearson Education Asia,2003.*

15ECE359   WIRELESS COMMUNICATION   3 0 0 3
(Pre-requisite: 15ECE312 Digital Communication)

Unit 1

Introduction to wireless communications - Large scale path loss - Free space propagation model - Two ray model - Practical link budget design – Outdoor and indoor propagation models. Small scale multi path propagation - Impulse response model of a multi path channel - Parameters of mobile multi path channels - Types of small scale fading.

Unit 2

Rayleigh and Rician distributions – Statistical models for multipath fading channels – Theory of multipath shaping factors - Equalization - Linear - Decision feedback - Adaptive equalizers - Training and tracking. Diversity – Receiver diversity – Transmitter diversity.

Unit 3

Capacity of wireless channels – Capacity in AWGN – Flat fading channels – Frequency selective channels – Time invariant and variant channels - Performance of digital modulations over wireless channels – AWGN and Fading channels.

TEXTBOOKS:

1. *Andrea Goldmith, "Wireless Communication", Cambridge University Press, 2005.*
2. *T.S. Rappaport, "Wireless Communication, Principles and Practice", Pearson Education, Second Edition, 2002.*

REFERENCES:

1. *William C Y Lee, "Wireless and Cellular Communications", Tata McGraw Hill Publishing Company Limited, Third Edition, 2006.*
2. *KamiloFeher, "Wireless Digital Communications", Prentice Hall India Private Limited, 2004.*

15ECE363   DATA SECURITY   3 0 0 3

Unit 1

Introduction:History of Cryptography. Mathematical background: Probability theory -Information theory - Complexity theory, Number theory. Symmetric (Private) Key Cryptographic Systems: Caesar – Affine - Monoalphabetic Substitution – Transposition - Homophonic substitution – Vignere - Beauford and DES Family - Product ciphers - Lucifer and DES.

Unit 2

Asymmetric (Public) Key Cryptographic Systems: Concept of PKCS, RSA Cryptosystem- Variants of RSA - Primality testing - Security of RSA - Merkle – Hellamn - Security of Merkle – Hellaman, ElGamal. Elliptical Curve Cryptography. Stream ciphers and block ciphers: The one time pad - Synchronous stream ciphers - Self-synchronizing stream ciphers - Feedback shift registers - Linear Complexity – Non-linear feedback shift registers - Stream ciphers based LFSRs. Non-linear Combination generators - Non linear filter generators - Clock controlled generators - The alternating step generators - The shrinking generators.

Unit 3

Digital Signatures: Properties, Generic signature schemes - Rabin Lamport - Matyas-meyer, RSA - Multiple RSA and ElGamal Signatures - Digital signature standard - Blind Signatures- RSA Blind. Secret Sharing Algorithms: Threshold secret sharing - Shamir scheme, Blakley scheme and modular Scheme. Pseudo random number generators: Definition of randomness and pseudo-randomness - Statistical tests of randomness - Linear congruential generator - Modern PRNGs (a brief description).

TEXTBOOKS:

1. *Padmanabhan T R, Shyamala C and Harini N, "Cryptography and Security", Wiley Publications 2011.*
2. *Josef Pieprzyk, Thomas Hardjono and Jenifer Seberry, "Fundamentals of Computer Security", Springer 2010.*

REFERENCES:

1. *Douglas R Stinson, "Cryptography:Theory and Practice", CRC Press 2005.*
2. *Alfred J Menezes, Paul C Van Oorshot and Scott A. Vanstone, "Handbook of Applied Cryptography", CRC press 1996.*

15ECE364   DIGITAL IC DESIGN   3 0 0 3
(Pre-requisite: 15ECE202 Digital Circuits and Systems)

Unit 1

Fast Adders: Hybrid adders, Carry save adder, Kogge-stone and Brent-Kugg adders. Multiplier: Booth, Booth recoded and Wallace tree implementation; Data Representation: Decimal representation – Alphanumeric representation – Fixed point representation – Floating point representation; Fixed point Arithmetic: Hardware implementation and hardware algorithm for fixed point Addition – subtraction, Multiplication and division with signed magnitude data; Floating point arithmetic: Hardware implementation and hardware algorithm for floating point addition – subtraction, multiplication and division with signed magnitude data.

Unit 2

BDD: Binary decision diagram, ordered BDD; Hazards: Static hazard detection and elimination, LPDD; Timing Analysis: Definitions of Set-up, hold time, skew, jitter. Critical path delay analysis; Design of Network application: ATM switch Design, ATM packet generator and decoder. Mapping Algorithms; mixed logic and entered variable K-Map.

Unit 3

Asynchronous state machines: Fundamentals – Mode Model – Problem of Asynchronous circuit design – Asynchronous design examples; Programmable Logic Devices: PLD's - FPGA's – LUT, CLB - FPGA Design Flow - Xilinx Spartan &Virtex Family Devices; Fault Detection & Location: Boolean difference method and path sensitization method in combinational circuits.

TEXTBOOKS:

1. *M. Rafiquzzaman, "Digital Logic and Microcomputer Design", John Wiley & Sons Inc., Fifth edition, 2005.*
2. *Richard F. Tinder, "Engineering Digital Design", Academic Press, Second edition, 2000.*

REFERENCES:

1. *Morris Mano, "Digital Design", Pearson Education, Third Edition, 2002.*
2. *A. P. Godse and D. A. Godse, "Digital Electronics and Logic Design", Technical Publications, First Edition, 2009.*

15ECE365   ELECTRONIC SYSTEM LEVEL DESIGN   3 0 0 3
AND VERIFICATION
(Pre-requisite: 15ECE313 VLSI Design)

Unit 1

Electronic system level design: Languages (C++, Verilog and SystemC) - Flows and methodologies – Architecture exploration, Models for system level design and functional Simulation,

Unit 2

Electronic system level verification: Verification languages (Verilog and System Verilog) - Verification flows and methodologies (UVM) - HW-SW co-verification.

Unit 3

Open source tools – Bluespec and Accellera, case study.

TEXTBOOKS:

1. *Michael D. Ciletti, "Advance Digital Design with Verilog HDL", Pearson Higher Education, 2011.*
2. *Chris Spear and Greg Tumbush, "System Verilog for Verification: A Guide to Learning the Testbench Language Features" Third Edition, Springer, 2012.*

REFERENCES:

1. *Sandro Rigo, Rodolfo Azevedo and Luiz Santos, "Electronic System Level Design – An Open-Source Approach", Springer, 2011.*
2. *Brian Bailey and Grant Martin, "ESL Models and their Application for Electronic System Level Design and Verification in Practice", Springer, 2010.*
3. *David Black, Jack Donovan, Bill Bunton and Anna Keist, "System C from the ground up", Second Edition, Springer, 2010.*

15ECE366   EMBEDDED SYSTEMS   3 0 0 3
(Pre-requisite: 15ECE304 Microprocessor and Microcontroller)

Unit 1

Introduction to Embedded Systems: Introduction to embedded systems – Application areas – Compiling - Linking and locating – Downloading and debugging. Embedded processor architecture definitions: SIMD – MIMD – SISD – MISD – VLIW – Superscalar – Pipelining - RISC – CISC. DSP processor architecture: Modified harvard architecture - Barrel shifters – Multipliers - MAC unit - Manufacturers of DSP processors.

Unit 2

Real time operating system concepts: Tasks - Task states – Context switching - Message box - Message queue - Semaphores – Binary counting and mutex semaphores – Deadlock - Priority Inversion. Scheduling algorithms: Round robin - Rate monotonic - Earliest deadline first.

Unit 3

ARM cortex M3 processor: ARM processor - ARM cortex M3 architecture - NXP LPC214x On chip Peripherals: A/D converters, PWM, Timer/Counter, UART and its Interfacing- Application development using Keil IDE.

TEXTBOOKS:

1. *David E.Simon, "AnEmbedded Software Primer", Pearson Education, 2006.*
2. *Steve Furber, "ARM system On Chip Architecture", Addison Wesley, 2000.*

REFERENCES:
1. *Joseph Yiu, "The Definitive Guide to the ARM Cortex M3", Second Edition, Elsevier Inc., 2010.*
2. *Jean J. Labrosse, "Micro /OS-II, The real time kernel", Second Edition, CMP books1998.*
3. *Arnold S. Berger, "Embedded System Design", CMP Books, USA 2002.*
4. *Michael Barr, "Programming Embedded Systems with C and GNU", O Reilly, 2003.*

15ECE367   HARDWARE SECURITY AND TRUST   3 0 0 3
(Pre-requisite: 15ECE202 Digital Circuits and Systems)

Unit 1
Background on VLSI testing – Test generation - Structured DFT techniques overview – Scan design - Boundary scan method – BIST schemes - Hardware trojan – Trojan taxonomy - Case study - Trojan detection – Classification of trojan detection - Challenges in trojan detection.

Unit 2
Design for hardware trust – Delay based methods – Shadow registers – Ring oscillators - Dummy scan Flip-Flop insertion - Trojan activation time analysis - Layout-aware scan cell reordering - Trojan detection and isolation flow.

Unit 3
Security and testing – Scan-based testing – Scan-based attacks and counter measures - System-on-chip test infrastructure - Emerging areas of test security. Trojan prevention: Built-in self authentication - BISA structure and insertion flow - Analyzing BISA structure - Trusted design in FPGAs.

TEXTBOOK:
Mohammad Tehranipoor and Cliff Wang (Eds.), "Introduction to Hardware Security and Trust", Springer, New York, 2012.

REFERENCE:
1. *Mohammad Tehranipoor, Hassan Salmani and Xuehui Zhang, "Integrated Circuit Authentication - Hardware Trojans and Counterfeit Detection", Springer International Publishing, Switzerland 2014.*

15ECE368   INTRODUCTION TO SOFT COMPUTING   3 0 0 3

Unit 1
Overview of Artificial Neural Networks (ANN) - Models of a neuron - Network architectures - Bayes theorem - Naïve Bayes classifier - Rosenblatt's Perceptron - Perceptron convergence theorem - Multilayer Perceptrons - Back propagation - Application of ANN in Classification and Regression - Classifier performance measures - Validation techniques.

Unit 2
Fundamentals of Genetic Algorithms - Creation of offspring – Encoding - Fitness function - Reproduction - Inheritance operators – Crossover - Inversion and deletion – Mutation - Generational cycle - Convergence of GA - Applications.

Unit 3
Introduction to basic Particle Swarm Optimization (PSO) algorithm – Swarm size – Information links – Initialization – Equations of motion – Interval confinement – Proximity distributions – Applications.

TEXTBOOKS:
1. *Simon Haykin, "Neural Networks & Learning Machines", PHI Learning Pvt. Ltd - New Delhi, Third Edition, 2010.*
2. *Clerc, Maurice, "Particle swarm optimization", John Wiley & Sons, 2010.*

REFERENCES:
1. *Rajasekaran Pai S, G. A Vijayalakshmi, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis And Applications", PHI Learning Pvt. Ltd - New Delhi, First Edition, 2003.*
2. *Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers (Elsevier), 2011.*

15ECE369   PRINCIPLES OF VLSI TESTING   3 0 0 3
(Pre-requisite: 15ECE313 VLSI Design)

Unit 1
Introduction - Need for testing - Role of testing - Elementary testing concepts - Fault and fault model – Defects - Errors and faults - Glossary of fault models - Single stuck-at fault - Fault equivalence - Equivalence of single stuck-at faults - Fault collapsing - Fault dominance - Checkpoint theorem.

Unit 2
Logic and fault simulation - Modeling circuits for simulation - Algorithms for true value simulation and fault simulation - Binary Decision Diagrams - Introduction and construction - Reduction rules and algorithms - ROBDDs - Operation on BDDs and its algorithms - Representation of digital circuits.

Unit 3
Combinational circuit test generation - Algebraic algorithms - Boolean difference method - Fault-table method – Path sensitizing method - ENF method - Structural algorithms - D-Algorithm - PODEM – Advanced algorithms - Fault detection - Two level circuit fault detection - Multilevel circuit fault detection. Sequential circuit test generation: Time frame expansion.

TEXTBOOK:

Vishwani D. Agrawal and Michael L. Bushnell, "Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuit," Springer, 2000.

REFERENCES:

1. *Samuel. C.Lee, "Digital Circuits and Logic Design," Prentice Hall India Ltd., 2000.*
2. *Parag K. Lala, "An Introduction to Logic Circuit Testing," Morgan Claypool Publishers, 2009.*
3. *Parag K. Lala, "Digital Circuit Testing and Testability," Academic Press, 1997.*

15ECE370   RISC PROCESSOR DESIGN USING HDL   3 0 0 3

Unit 1

Fundamental techniques of computer design: RISC and CISC architectures - Computer arithmetic - Comparison of RISC and CISC architectures. Verilog: Introduction and review of basic designs using verilog. MIPS processor: Introduction to MIPS features - MIPS instruction set - Logical design of MIPS data path - Control unit and instruction decoder.

Unit 2

Design of single cycle - Multicycle and pipelined architectures of MIPS. Introduction to superscalar - Super pipelined architectures - Performance evaluation of super scalar processors. Verilog design of a pipelined MIPS processor.

Unit 3

Introduction to memory hierarchy: Cache memory fundamentals - Memory systems for superscalar processors. Static timing analysis: Introduction - Setup and hold time constraints - Processor timing issues - Design examples.

TEXTBOOK / REFERENCES:

1. *V.Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, "Computer Organisation", Fifth edition, McGraw-Hill Inc, 1996.*
2. *Hennessy, John L. and David A. "Pattreson, Computer architecture: a quantitative approach", Elsevier, 2012.*
3. *Bhaskar J and Rakesh Chadha, "Static timing analysis for Nanometer designs", Springer 2009.*
4. *Dandamudi, Sivarama P, "Guide to RISC processor for programmers and engineers", Springer, 2005.*
5. *Hayes, John P, "Introduction to digital logic design, Addison", Wesley Longman publishing co., Inc, 1993.*
6. *Bhasker, Jayaram, "A verilog HDL Primer", Star galaxy publishing, 1999.*

15ECE371   VLSI FABRICATION TECHNOLOGY   3 0 0 3

Unit 1

Brief History of Semiconductor technology, Scaling Trends and Scaling Methodologies, Scaling Challenges, ITRS Roadmap; Starting material, silicon structure and properties,

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Czochralski and Float Zone crystal growth, GaAs growth; Silicon oxidation methods and properties, Deal Grove Model, Photolithography – masks, pattern transfer techniques, minimum resolvable feature sizes, UV sources, photoresists.

Unit 2

Diffusion and ion implantation, Types of diffusion, Ficks laws, junction depth, Stopping mechanisms, Gaussian implantation profile, variations to predicted distribution, implantation damage and annealing; Deposition requirements and techniques – Physical and Chemical Vapor deposition, Epitaxial growth techniques; Wet and dry etching techniques, Etch requirements, Chemical Mechanical Polishing;

Unit 3

Interconnect Technology – Copper and Aluminum interconnects, Silicodes, Isolation, CMOS and BJT Process flow; CMOS process for sub-100nm era - dielectrics and gate electrodes, Low K Dielectrics with Cu, Strained silicon, Silicon Germanium, Process Techniques to overcome Short Channel Effects, Nanolithography techniques, SOI Technology, Ultra Shallow Junction. Multiple Gate MOSFETs.

TEXTBOOK:

Peter Van Zant, "Microchip Fabrication: A Practical Guide to Semiconductor Processing", McGraw-Hill Professional, Sixth Edition, 2014.

REFERENCES:

1. *Gary. S. May and S. M. Sze, "Fundamentals of semiconductor fabrication", John Wiley, First Edition, 2003.*
2. *Marc J. Madou, "Fundamentals of Microfabrication and Nanotechnology - Volume II", CRC Press, Third Edition, 2011.*
3. *Stephen Campbell, "Science of Microelectronic Fabrication", Oxford University Press, 2001.*
4. *James D. Plummer, Michael D. Deal, Peter B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Prentice Hall India Private Limited, 2000.*

15ECE372 VLSI DIGITAL SIGNAL PROCESSING SYSTEMS   3 0 0 3
(Pre-requisites: 15ECE313 VLSI Design;15ECE212 Signal Processing II)

Unit 1

Introduction to Digital Signal Processing Systems – Iteration bound – Pipelining and Parallel Processing – Retiming – Unfolding – Folding.

Unit 2

Systolic Architecture Design – Fast Convolution – Algorithmic Strength Reduction in Filters and Transforms – Pipelined and Parallel Recursive and Adaptive Filters.

Unit 3

Scaling and Round off Noise – Digital Lattice Filter Structures – Bit-Level Arithmetic Architectures – Redundant Arithmetic – Numerical Strength Reduction – Low-Power Design.

TEXT BOOKS / REFERENCES:

1. *Keshab K. Parhi, "VLSI Digital Signal Processing Systems, Design and Implementation", Wiley, 1999.*
2. *Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Fifth Edition 2013.*

15ECE373   VLSI SYSTEM DESIGN   3 0 0 3
(Pre-requisite: 15ECE313 VLSI Design)

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:

1. *Wayne Wolf, "FPGA-Based System Design", First Edition, Prentice Hall India Private Limited, 2004.*
2. *Samir Palnitkar, "Verilog HDL", First Edition, Prentice Hall India Private Limited, 2003.*
REFERENCES:
2. *Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with Verilog Design", First Edition, Tata McGraw Hill Publishing Company Limited, 2002.*
3. *Stephen M.Trimberger, "Field-Programmable Gate Array Technology", Springer, 1994.*
4. *Clive Maxfield, "The Design Warrior's Guide to FPGAs", Elsevier, 2000.*

15ECE376   AGENT - BASED MODELING   3 0 0 3

Unit 1

Introduction to Agents – Features - Classification of agents. Multi Agent Systems (MAS) and properties. Agent communication ontology - Agent communication languages: FIPA-ACL, KIF, KQML. Internal structure of MAS: Shell - Reasoning engine. MAS development methodology: Agent behavior - Agent action. Knowledge diffusion in MAS: Application level, behavior level and evolutionary agent communities.

Unit 2

Data mining techniques for intelligent Agents: Association rule mining – Clustering - Classification and evolutionary algorithms.

Unit 3

Applying data mining to agents - Study of available agent based modeling software. Case studies - Application level, behavior level and evolutionary agent communities.

TEXTBOOK:

A. L. Symeonidis, P. A. Mitkas, "Agent Intelligence through DataMining", Springer, 2005.
REFERENCES:
1. *M. Mohammadian, "Intelligent Agents for Data Mining and Information Retrieval", Idea Group Publishing, 2003.*
2. *D. L. Poole, A. K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.*

15ECE377   ECONOMETRICS   3 0 0 3

Unit 1

Review of statistics - Random variables – moments – Distributions – least squares – Hypothesis testing - Hetroskedacity – ACF. Index Models – Mean variance analysis – Estimating beta – Multi-index models – CAPM and multifactor models – Market model – Fama – Macbeth – Event studies – Basic structure of event studies – Normal and abnormal returns – Quantitative events.

Unit 2

Time series analysis - ARMA (p,q) – Var(p) – Non-stationary processes – Predicting asset returns – Random walk – Efficient market hypothesis – Predictor methods – Security and technical analysis – Empirical evidence – Maximum likelihood estimation – Test principles – QMLE. ARCH and GARCH – Non-linear extensions – multivariate GARCH.

Unit 3

Option pricing – BS model – Estimation of volatility of a random walk model – Kernel density estimation and regression – Examples of non-parametric estimation. Risk measures – Symmetric dispersion measures – Down side risk.

TEXTBOOK:

D. C. Porter, D. N. Gujarati, S. Gunasekar, "Basic Econometrics", 5th Edition, McGraw Hill Education (India) Pvt. Ltd., 2011.

REFERENCES:

1. *J. M. Wooldridge "Introductory Econometrics: A modern Approach", Second Edition South western college publishing, Thomson learning. 2003.*
2. *Philip Hans Franses "A concise introduction to Econometrics," Cambridge University Press 2002.*
3. *Paul Soderlid. "Lecture notes in Financial Econometrics", University of St. Gallen, Switzerland 2009.*

15ECE378   FINANCIAL ENGINEERING   3 0 0 3

Unit 1

Cash Flows and Fixed income securities: Investments and markets - Principal and interest - Present and future values of streams - IRR. Fixed income securities - Market value for future cash - Bond value - Bond details – Yields – Convexity – Duration - Immunization. Bond portfolio management - Level of market interest rates, Term structure of interest-rate theories.

Unit 2

Stocks and Derivatives: Common stock valuation - Present value of cash dividends - Earnings approach - Value versus price - Efficient markets theory - Technical analysis. Analysis of financial statements. Derivatives - futures and options - Black Scholes formula - Utility functions - Applications in financial decision making.

Unit 3

Portfolio analysis and capital market theory: Covariance of returns – Correlation - Portfolio return - Portfolio standard deviation - Two asset case - Efficient frontier - Optimum portfolio. Capital market theory- Capital market line - Sample diversifications to reduce risk - Characteristic line - Capital asset pricing model. Arbitrage price theory - Stock performance evaluation.

TEXTBOOKS:

1. *David Luenberger, "Investment Science", Oxford University Press, 1998.*
2. *Jack Clark Francis, Richard W. Taylor, "Investments", Schaum's Outlines, Tata McGraw Hill, 2006.*

REFERENCES:

1. *Yuh – DauhLyuu, "Financial Engineering and Computation", Cambridge University Press, 2002.*
2. *Perry H. Beaumont, "Financial Engineering Principles", John Wiley and Sons Inc, New Jersey, 2004.*

15ECE379   SIGNAL PROCESSING FOR   3 0 0 3
                    BUSINESS APPLICATIONS

Unit 1

Introduction - Fourier Vs Wavelets - Seasonality filtering - Signal denoising - Identification of structural breaks – Scaling - Aggregate heterogeneity and time scales - Multiscale Cross Correlation. Review of linear filters – The EWMA and volatility estimation - The Hodrick – Prescott filter - Baxter – King filter - Filters in technical analysis of financial markets. Optimum linear estimation - Weiner filer - Recursive filtering and Kalman filter - Prediction with Kalmanfilter - Vector Kalman filter estimation - Applications.

Unit 2

Discrete Wavelet transforms – properties - DWT filters - The maximal overlap DWT - Multi resolution analysis – ANOVA - practical issues - Filtering FX intraday seasonalities - Causality and co-integration in economics - Money growth and inflation - Long memory processes -Fractional difference processes (FDP) - The DWT of FDP - Simulation of FDP - OLS estimation of FDP - Approximate Maximum likelihood estimation of FDP - Application to stock prices - Generalization of DWT and MODWT - Applications to money supply - Wavelets and seasonal long memory – Applications to money supply – GNP - Seasonality and trends - Unemployment - Consumer price index - Tourism revenues.

Unit 3

Market modes - Moving averages - Momentum functions - Hilbert transforms - Measuring cycle periods - Signal to noise ratio - Sine wave indicator - Instantaneous trend line - Identifying market modes - Designing profitable trading system - Transform arithmetic - FIR, IIR, Removing lag - Adaptive moving averages - Ehlers filters - Measuring market spectra - optimum predictive filters - Adapting standard indicators.

TEXTBOOKS:

1. *Ramazan Gencay, FarukSelcuk& Brandon Whitdly "An Introduction to Wavelets and other filtering methods in Finance and Economics," Academic Press 2002.*
2. *John F Ehlers "Rocket Science for Traders: Digital Signal Processing Applications", John Wiley 2001.*

REFERENCE:

Jack Clark Francis, Richard W. Taylor, "Investments", Schaum's Outlines, Tata McGraw Hill, 2006

15ECE380   TELECOMMUNICATION MANAGEMENT   3 0 0 3

Unit 1

Telecom Technology Fundamentals: Signal transmission and channels – Network media – Data compression – Protocols and topology – Connectivity in networks –

Ethernet principles – Wireless communication principles – Broadcasting versus link - TCP/IP model – OSI model Telecom network management: LAN – WAN – Repeaters – Bridges – Routers – Gateways – Hubs. Electronic commerce: Internet and intranet – Role of government in data communication quality of service in telecommunication. Telecommunication Standards and Regulations: International telecommunication union (ITU) and its role – Frequency management – Cost computations – Mobile and DTH operations – Role of wireless planning commission (WPC) for telecommunications in India - Service providers.

Unit 2

Telecom business management: Automated teller machines – Teleconferencing – Telecommuting – Enterprise applications – Customer oriented communication aspects – Wireless LAN - Telecom billing - Revenue assurance & fraud management. Business on bandwidth: Concepts of data rate and bandwidth requirements – Digital subscriber line – Broadband technologies – Digital home – Telecommuting – Voice enabled DSL - Bandwidth brokerage.

Unit 3

Telecommunication project management: Telecommunication design and implementation – Network analysis and design – Sources of projects – Methodology for designing, developing and implementing telecommunication capabilities – Network modeling – Phases of project management.

TEXTBOOK:

Houston H.Carr and Charles A. Snyder, "The Management of Telecommunications" McGraw-Hill companies Inc, Second Edition, 2003.

REFERENCES:

1. Willium C.Y. Lee, "Wireless & Cellular Telecommunications", McGraw-Hill Companies Inc, Third Edition, 2006.

2. T. S. Rappaport, "Wireless Communication, Principles and Practice", Pearson Education, Second Edition, 2002.

15ECE381   CIRCUITS AND COMMUNICATION LAB.   0 0 2 1

Electronic circuits
1. Current mirror
2. Amplifier using current biasing
3. Op-Amp characterization
4. Inverting and Non-inverting Amplifier
5. Integrator, Differentiators
6. Schmitt trigger
7. Astablemultivibrator using 555 Timer

Communication
1. Standard Amplitude Modulation and Demodulation
2. Generation of Double Side Band – Suppressed Carrier using Balanced Ring Modulator
3. Synchronous Detector
4. Generation of Single Side Band wave
5. Transistor Mixer
6. Intermediate Frequency Amplifier
7. Frequency Modulation
8. Pre-emphasis and De-emphasis

15ECE382   MICROCONTROLLER LAB.   0 0 2 1

1. ARM Assembly program for Arithmetic and Logical Operations
2. ARM Assembly program for Multi-byte Operations
3. ARM Assembly program for Control Manipulation
4. ARM Assembly program for String Manipulation
5. ARM Assembly program for Thumb Instructions
6. Embedded C Programming using Keil Simulator
a. Simple C Programs
b. Port Programming
c. Peripheral Interfacing – Keypad, Motor, LED etc.

15ECE385   DIGITAL COMMUNICATION LAB.   0 0 2 1

1. Pulse Amplitude Modulation and Demodulation
2. Pulse Position Modulation
3. Pulse Width Modulation
4. Amplitude Shift Keying Modulation and Demodulation
5. Frequency Shift Keying
6. Phase Shift Keying
7. Time Division Multiplexing.
8. Sampling and Quantization Using Matlab.
9. Gram Schmidt orthogonalization for vectors Using Matlab
10. Probability of Error for BPSK using Matlab.

15ECE386   VLSI DESIGN LAB.   0 0 2 1

1. Transfer and Output Characteristics of PMOS and NMOS: Measurement of Threshold voltage, ß,?, and ?.
2. Pass transistor and transmission logic based AND and OR gates: checking "strong" and "weak" ones and zeros.
3. Inverter output response for a given input: Measurement of rise time, fall time, propagation delay, short circuit power and switching power for zero load and a finite capacitance load.

4. Voltage transfer characteristics (VTC) of Inverter: Measurement of mid-point voltage (switching threshold) and noise margin.
5. Realization of CMOS NAND and NOR gates: VTC characteristics and measurement of switching thresholds.
6. Realization of Boolean function: sizing for equal rise time and fall time.
7. Mirror logic based XOR and XNOR gates.
8. Pseudo NMOS based Boolean expression realization: Checking the output swing, input capacitance and short circuit power.
9. Dynamic and Domino logic based Boolean expression realization: Checking charge sharing and monotonicity.
10. Transistor level realization of D Flip-flop with set and reset.

15ECE387   OPEN LAB.   0 1 2 2

The objective of this lab.course is to provide opportunities for hands-on experience in the hardware domain to design, develop and realize prototype electronic systems.

15ECE390 / 15ECE490   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.

15ECE401   INFORMATION THEORY AND   3 1 0 4
CODING TECHNIQUES
(Pre-requisite: 15ECE301 Communication Theory)

Unit 1
Introduction to Information Theory: Modeling of information sources - source coding theorem - source coding algorithms - modeling of communication channels - channel capacity - bounds on communication.

Unit 2
Linear block codes: structure - matrix description - Hamming codes. Standard array arithmetic of Galois fields: Integer ring - finite fields based on integer ring - polynomial rings - finite fields based on polynomial rings - primitive elements. structure of finite fields cyclic codes: Structure of cyclic codes - encoding and decoding of cyclic codes.

Unit 3
BCH codes: Generator polynomials in terms of minimal polynomial - Decoding of BCH codes - Reed-Solomon codes - Peterson-Gorenstein - Zierler decoder. Convolutional Codes: Introduction to Convolutional Codes - Basics of Convolutional Code encoding and decoding - Sequential decoding - Viterbi decoding.

TEXTBOOKS:
1. *Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, Second Edition, 2002.*
2. *P. S. Satyanarayana, "Concepts of Information Theory and Coding", Dynaram Publication, 2005.*

REFERENCES:
1. *Richard B. Wells, "Applied Coding and Information Theory for Engineers", Pearson Education, LPE, First Indian Reprint, 2004.*
2. *Richard E. Blahut, "Algebraic Codes for Data Transmission", Cambridge University Press, 2003.*
3. *Shu Lin and Daniel J.Costello, "Error Control Coding – Fundamentals and Applications", Second Edition, 2004.*
4. *Thomas M Cover and Joy A Thomas, "Elements of Information Theory" MGH 2006.*

15ECE402   RADIO FREQUENCY ENGINEERING   3 1 0 4
(Pre-requisite: 15ECE201 Applied Electromagnetics)

Unit 1
Radio Frequency network Analysis: EM Spectrum and Applications – Electrical Length - Physical Length – Significance of Microwave Spectrum – Applications – Scattering Matrix Parameters and Properties - Insertion Loss, Return loss – Transmission matrix (ABCD) – Signal Flow Graph.

Unit 2
Waveguide Based Devices: Rectangular Waveguide Cavity – Cavity Resonator - Resonant Frequency and Quality Factor – Directional Coupler – Power Dividers and Tee's – Introduction to Ferrites – Ferrite based Isolator and Circulator.

Unit 3
Radio Frequency Systems: Noise in RF Systems – Dynamic Range – Noise Equivalent Temperature – Noise Figure – Noise Figure of Cascaded System – Antenna Parameters – gain – Directivity – Efficiency – Bandwidth – Beam width – Polarization – Dipole - Loops – Horn – Parabolic Dish – Friis Formula - Radio links.

TEXTBOOK:
David M Pozar,"Microwave Engineering", Wiley India Pvt. Limited, Third Edition, Second Reprint, 2007.

REFERENCES:
1. *Samuel Y. Liao, "Microwave Devices and Circuits", Pearson Edition, Third Edition, 2003.*

2. Kraus, Fleisch, "Electromagnetics with Applications", Tata McGraw Hill Education Private Limited, Fifth Edition, 2004.

15ECE481   MICROWAVE ENGINEERING LAB.   0 0 2 1

Experiments using Klystron, Gunn diode oscillators and study of various microwave components.

Antennas: Measurement and analysis of RF antennas.

15ECE495   PROJECT PHASE I   2 cr

• Design development and realization of selected problems and solutions based on ECE domain.
• Review and analysis of state of the arttechnology based research and development.
• Publication oriented academic research.
• Industry oriented problems and its solutions.
• Demonstration of working prototype model.
• Preparation of project report in prescribed format.

15ECE499   PROJECT PHASE II   10 cr

• Design development and realization of selected problems and solutions based on ECE domain.
• Review and analysis of state of the arttechnology based research and development.
• Publication oriented academic research.
• Industry oriented problems and its solutions.
• Demonstration of working prototype model.
• Preparation of project report in prescribed format.
• Publications in conference/journal approved by the department as the outcome of the project.

15EEE180   WORKSHOP B   0 0 2 1

Part A - Electronics
Identification of electronic components (Passive and Active)
Study of measuring instruments (Voltmeter, Ammeter and Multimeter)
Measurement and theoretical Verification of series and parallel combination of resistors and capacitors
Calibration of CRO and measurements of signal parameters (RMS, maximum value, peak value, time and frequency)
Calibration of function generator using CRO
Soldering practice

Part B - Electrical
1. Study on power supply and protective devices
2. Study on tools and electrical accessories
3. Study on sources of light
4. Study on energy efficiency
5. Study on water pump
6. Study on house hold appliances:
   a. Iron box
   b. Fan
   c. Refrigerator
   d. Air conditioner
7. House wiring I – Glow an incandescent lamp using SPST switch
8. House wiring II – Glow a fluorescent lamp using SPST switch
9. House wiring III – Operate a fan and an incandescent lamp using two independent SPST switch
10. House wiring IV – Operate a fluorescent lamp and a 3 pin socket using two independent SPST switch
11. House wiring V – Staircase wiring
12. House wiring VI – Godown wiring

15ENG111   COMMUNICATIVE ENGLISH   2 0 2 3

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

Unit 1
Reading: Different styles of communication – Reading Comprehension - critical thinking and analysis – Note-making – Any two pieces from the text.

Unit 2
Writing: Prewriting techniques - Kinds of paragraphs - basics of continuous writing.

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

Unit 3
Practical sessions (Listening & Speaking): Introduction to English pronunciation including minimal pairs and word stress – differences between British and American English – Listening comprehension and Note-taking - Any two pieces from the text.

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

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

Poems:
i. The Poplar Field by William Cowper
ii. Telephone Conversation by Wole Soyinka
Prose:
i. Higher Mathematics by R. K. Narayan
ii. Wings of Fire by Abdul Kalam (Part III.11)
Short Stories:
i. Best Investment I Ever Made by A. J. Cronin
ii. Death of an Indian by Krishna Charan Das

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   1 0 2 2
ENGLISH LITERATURE

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 LittleBlack 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. Alliyan & 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 Black Swan, 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, Juloos.

BOOKS:

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

15HIN111   HINDI II   1 0 2 2

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

Unit 1

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

Unit 2

Communicative Hindi - Moukhik Abhivyakthi

Unit 3

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

Unit 4

Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis

Unit 5

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

BOOKS:

1. *Kavay Tarang: Dr. Niranjan, 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 paramountcy – Kautilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2
India's contribution to the world: spirituality, philosophy and sciences

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

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

Unit 3
Women in Indian society
The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadarnyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kautilya's Arthasastra and Mrichchhakatikam of Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

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

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

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

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

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 varnashramadharma – socio-political structure of the various institutions based on the four purusarthas; The structure of ancient

Indian polity – Rajamandala and Cakravartins – Prajamandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King (Sri Rama) and the ideal state (Ramarajya) – Yudhisthira's ramarajya; Sarasvati - Sindhu civilization and India's trade links with other ancient civilizations; Towards chiefdoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of the Indo-Gangetic plain.

Unit 2

Classical India: 600B.C. – 1200 A.D.

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

Medieval India: 1200 A.D. – 1720 A.D.

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

Unit 3

Modern India: 1720 - 1947

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

Independent India – from 1947

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

Conclusion

REFERENCES:

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

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.*
2. *WHO Report on Adolescent Health: 2010*

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

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads.

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

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

REFERENCE:
The Bhagavad Gita, Commentary by Swami Chinmayananda

15HUM236   **INTRODUCTION TO INDIA STUDIES**   **2 0 0 2**

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

Unit 1
A brief outline of Indian history from prehistoric times to the present times.

Contributions of India to world culture and civilization: Indian Philosophy and Religion; Art and Literature; Physical and Social Sciences.

Unit 2
Modern India: Challenges and Possibilities.

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

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

TEXTBOOK:
Material given by the Faculty

BACKGROUND LITERATURE:
1 *Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture (Kolkata) publication.*
2 *Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.*
3 *Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.*
4 *Outlines of Indian Philosophy, M. Hiriyanna, MLBD.*
5 *An Advanced History of India, R. C. Majumdar et al, Macmillan.*
6 *India Since 1526, V. D. Mahajan, S. Chand & Company*
7 *The Indian Renaissance, Sri Aurobindo.*
8 *India's Rebirth, Sri Aurobindo.*
9 *On Nationalism, Sri Aurobindo.*

10 *The Story of Civilization, Volume I: Our Oriental Heritage, Will Durant, Simonand Schuster, New York.*

11 *Eternal Values for a Changing Society, Swami Ranganathananda, Bharatiya Vidya Bhavan.*

12 *Universal Message of the Bhagavad Gita, Swami Ranganathananda, Advaita Ashrama.*

13 *Awaken Children: Conversations with Mata Amritanandamayi*

14 *Indian Aesthetics, V. S. Seturaman, Macmillan.*

15 *Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.*

16 *Web of Indian Thought, Sister Nivedita*

17 *Essays on Indian Nationalism, Anand Kumaraswamy*

18 *Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi*

19 *The Invasion That Never Was, Michel Danino*

20 *Samskara, U. R. Ananthamurthy, OUP.*

21 *Hayavadana, Girish Karnard, OUP.*

22 *Naga-Mandala, Girish Karnard, OUP.*

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

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 – SarvaNamas: First Person, Second Person, Third Person – Tenses: Past, Present and Future - Words for Communication – Selected Slokas – Moral Stories – Subhashithas – Riddles.

Unit 2
Language Studies - Role of Sanskrit in Indian & World Languages.

Unit 3
Introduction to Sanskrit Classical Literature – KavyaTradition – Drama Tradition - Stotra Tradition – Panchatantra Stories.

Unit 4
Introduction to Sanskrit Technical Literature – Astronomy – Physics – Chemistry – Botany – Engineering – Aeronautics – Ayurveda – Mathematics – Medicine – Architecture - Tradition of Indian Art – Administration – Agriculture.

Unit 5
Indology Studies – Perspectives and Innovations.

TEXTBOOKS AND REFERENCE BOOKS:

1. *Vakya Vyavahara- Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi*

2. *The Wonder that is Sanskrit - Dr.Sampadananda Mishra, New Delhi*

3. *Science in Sanskrit – Samskritha Bharathi, NewDelhi*

15HUM238   NATIONAL SERVICE SCHEME   2 0 0 2

Unit 1
Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.

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

Unit 2
Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

Unit 3
Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.

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

Unit 4
Youth Development Programmes in India: National Youth Policy, Youth development programmes at the national level, state level and voluntary sector, youth-focused and youth-led organizations.

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

Unit 5

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

Project Work / Practical

15HUM239   PSYCHOLOGY FOR EFFECTIVE LIVING   2 0 0 2

Unit 1 Self-Awareness & Self-Motivation

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

Unit 2 The Nature and Coping of Stress

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

Unit 3 Application of Health Psychology

Health compromising behaviours, substance abuse and addiction.

TEXTBOOKS:

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

REFERENCE BOOKS:

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

15HUM240   PSYCHOLOGY FOR ENGINEERS   2 0 0 2

Unit 1

Psychology of Adolescents: Adolescence and its characteristics.

Unit 2

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

Unit 3

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

TEXTBOOKS:

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

REFERENCE BOOKS:

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

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

Unit 1

Introduction

Western and Indian views of science and technology

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

Unit 2

Indian sciences

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

Science and technology under the British rule

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

Unit 3

Science and technology in Independent India

Introduction; An assessment of traditional and modern energy resources; Green revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition

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

Conclusion

REFERENCES:

1. *Joseph, George Gheverghese. The Crest of the Peacock: Non-European Roots of Mathematics. London: Penguin (UK), 2003.*
2. *Iyengar, C. N. Srinivasa. History of Hindu Mathematics. Lahore: 1935, 1938 (2 Parts).*
3. *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, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.

18. The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.

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

15HUM242   THE MESSAGE OF BHAGAVAD GITA   2 0 0 2

Unit 1
Introduction: Relevance of Bhagavad Gita today – Background of Mahabharatha.

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

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

Unit 2
Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Concept of Swadharma.

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

Unit 3
Bhakti Yoga: Yoga of Devotion – Form and Formless Aspects of the Divine – Inner Qualities of a True Devotee.

GunatrayaVibhaga 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, Mylapore.*
6. *Eternal stories of the Upanishads by Thomas Egenes and Kumuda Reddy*
7. *Upanishad Ganga series – Chinmaya Creations*

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

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 foodsvalue 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, swaroopa, 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 Iyangar – 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 - Prasaranga, 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 Iyangar – Adalitha Kannada – Chetan Publication, Mysuru
2. Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana
3. Shrikanth - Mankuthimmana Kagga – 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 mother0-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.*

Unit 1
Ancient poet trio: Adhyatmaramayanam,
Lakshmana Swanthanam (valsa soumitre… mungikidakayal), Ezhuthachan - Medieval period classics – Jnanappana (kalaminnu… vilasangalingane), Poonthanam

Unit 2
Modern Poet trio: Ente Gurunathan, Vallathol Narayana Menon - Critical analysis of the poem.

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

Unit 4
Literary Criticism: Ithihasa studies - Bharatha Paryadanam - Vyasante Chiri - Kuttikrishna Mararu - Outline of literary Criticism in Malayalam Literature - Introduction to Kutti Krishna Mararu & his outlook towards literature & life.

Unit 5

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

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

REFERENCES:

1. *P. K. Balakrishnanan, Thunjan padhanangal, D. C. Books, 2007.*
2. *G. Balakrishnan Nair, Jnanappanayum Harinama Keerthanavum, N. B. S, 2005.*
3. *M. N. Karasseri, Basheerinte Poonkavanam, D. C. Books, 2008.*
4. *M. N. Vijayan, Marubhoomikal Pookkumbol, D. C. Books, 2010.*
5. *M. Thomas Mathew, Lavanyanubhavathinte Yukthisasthram, National Book Stall, 2009.*
6. *M. Leelavathy, Kavitha Sahityacharitram, 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 (Translated 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   3 1 0 4
DIFFERENTIAL EQUATIONS

Unit 1

Vector Differentiation: Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field. (Sections: 9.4, 9.5, 9.6, 9.9, 9.10, 9.11)

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

Unit 2

Surface Integral: Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem. (Sections: 10.5, 10.6, 10.7, 10.9)

First Order Differential Equations: First Order ODE, Exact Differential Equations and Integrating Factors (Sections 1.1and 1.4).

Unit 3

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

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

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

TEXTBOOK:

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

REFERENCE BOOKS:

1. *'Advanced Engineering Mathematics', Dennis G. Zill and Michael R. Cullen, second edition, CBS Publishers, 2012.*

2. *'Calculus', G. B. Thomas Pearson Education, 2009, Eleventh Edition.*
3. *'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.*

15MAT202   LINEAR ALGEBRA   2 1 0 3

Unit 1

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

Unit 2

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

Unit 3

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

TEXTBOOK:

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

REFERENCES:

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

15MAT213   PROBABILITY AND RANDOM PROCESSES   3 1 0 4

Unit 1

Review of probability concepts - conditional probability - Bayes theorem.

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

Unit 2

Random processes: General concepts and definitions - stationarity in random processes - strict sense and wide sense stationary processes - autocorrelation and properties - special processes – Poisson points, Poisson and Gaussian processes and properties.

Unit 3

Systems with stochastic inputs - power spectrum- spectrum estimation, ergodicity –Markov process and Markov chain, transition probabilities, Chapman Kolmogrov theorem, limiting distributions classification of states.

TEXTBOOKS:

1. *Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, (2005) John Wiley and Sons Inc.*
2. *A. Papoulis, and Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", Fourth Edition, McGraw Hill, 2002.*

REFERENCE BOOKS:

1. *J. Ravichandran, "Probability and Random Processes for Engineers", First Edition, IK International, 2015.*
2. *Scott L. Miller, Donald G. Childers, "Probability and Random Processes", Academic press, 2012.*

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*

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

15MEC332   ENTERPRISE MANAGEMENT   3 0 0 3

Unit 1
Engineering Economics: cost concepts - types of costs - cost functions. Cost controls: reduction – tools & applications. Pricing policies – methods – problems.

Process design and improvement – process capacity – process layout – process reengineering – job design. Work standards – work measurement – work sampling – problems.

Unit 2
Supply Chain Management – Basic Concepts, SC dynamics, push-pull boundary, integrated supply chain, logistics, customer relationship, supplier relationship – selection, rating and development, procurement, SC metrics and performance measurement - problems. Lean Manufacturing – concepts, wastes – tools viz., pull system, standardized work, takt time, kanban system, JIT, kaizen, SMED, 5S, value stream mapping, benefits of lean and implementation issues. Introduction to Six Sigma. Plant Location – globalization, factors affecting location decisions, facility location - Break-even method, rectilinear, factor-rating and centre of gravity – problems. Plant Layout – types, process layout, product layout, Systematic layout planning (SLP), Line Balancing problems.Capacity Planning – Aggregate Planning – importance, planning process, methods – problems.

Unit 3
Role of IT in business performance improvement – e-commerce – e-purchasing – Master Production Schedule, inventory lot sizing strategies, MRP basics – MRP

explosion, Available to Promise (ATP) inventory – MRP calculations – MRP II – Scheduling – Gantt chart – Introduction to ERP – ERP software – ERP modules – ERP implementation.

TEXTBOOKS:
1. *L. J. Krajewski and L. P. Ritzman - 'Operations Management: Processes and Value Chain' - PHI Pvt. Limited - 2010*
2. *R. L. Varshney & K. L. Maheshwari, 'Managerial Economics' - S Chand & Sons - 1997 - 13th Edition*

REFERENCES:
1. *W. J. Hopp and M. L. Spearman - 'Factory Physics' - McGraw-Hill - 2000 - 2nd Edition*
2. *E. S. Buffa and R. K. Sariss - 'Modern Production/Operations Management' - John Wiley - 1994 - 8th Edition*
3. *B. Harrison, C. Smith and B. Davis - 'Introductory Economics' – Macmillan - 1992*

15MEC333   FINANCIAL MANAGEMENT   3 0 0 3

Unit 1
Introduction: Financial Management an overview – Financial Decisions in a firm – Goal of FM – Function of the financial system.

Fundamental Valuation Concepts: Time value of money – Risk and Return.

Unit 2
Capital Budgeting: Techniques of capital budgeting investment criteria – NPV – Benefit Cost Ratio – IRR – Payback Period – ARR – Investment appraisal in Practice – Estimation of Project cost flows.

Unit 3
Working Capital Management: Current Assets – Financing Ruling – Profit Criterion. Cash and Liquidity Management. Working Capital Financing.

Financial Analysis and Planning: Analyzing Financial Performance – Break – even analysis and Leverages – Financial Planning and Budgeting.

Mergers and Takeovers - International trade.

TEXTBOOK:
Chandra P. - 'Financial Management: Theory and Practice' - TMH - 2001 - 5th Edition
REFERENCES:
1. *Denzi Watson & Antony Head - 'Corporate Finance- Principles and Practice' - Pearson Education Asia, - 2002 - 2nd Edition*

2. *Terry S. Maness - 'Introduction to Corporate Finance' - McGraw Hill Book Company - 1988*
3. *Eugene F. Brigham & Louis C. Gapenski, 'Financial Management: Theory and Practice' - 2010 12th Edition*

15MEC411   OPERATIONS RESEARCH   3 0 0 3

Unit 1
Linear programming: Formulations - graphical solutions, simplex method, duality, Transportation model, Assignment model - travelling salesman problem.

Unit 2
Decision theory: Decision trees. Game theory - two persons zero sum, mixed strategies; 2xn and mx2. Network models - project networks - CPM/PERT, project scheduling, crashing networks and cost considerations, resource levelling and smoothing, shortest route problem, minimal spanning tree problem, maximal flow problem.

Unit 3
Sequencing model - 2 machines n jobs, m machines n jobs - n jobs 2 machines. Inventor models - deterministic and probabilistic models, Queuing models - poison arrival and exponential service times, single server, multi-server. Simulation: Monte Carlo simulation - simple problems.

TEXTBOOK:

Wagner, H. M. - 'Principles of Operations Research - Prentice Hall, New Delhi - 1998
REFERENCES:
1. *J. K. Sharma. - 'Operations Research Theory and Applications' - Macmillan India Ltd, New Delhi - 2013 - 5th Edition*
2. *Taha H. A. - 'Operations Research: An Introduction'- Prentice Hall, New Delhi - 2010 - 9th Edition*
3. *Ravindra A., Phillips, D.J. and Solberg, J. J. - 'Operations Research - Principles and Practice' - John Wiley & Sons - 2005.*
4. *Hardly H. M. 'Linear Programming' - Narosa Book Distributors Private Ltd. - 2006*

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 or 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 – intraoccular materials – materials for drug delivery.

TEXTBOOKS AND REFERENCES:

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

15PHY234   INTRODUCTION TO COMPUTATIONAL PHYSICS   3 0 0 3

Unit 1
Differentiation: Numerical methods, forward difference and central difference methods, Lagrange's interpolation method.

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:
Rubin H Landau & Manuel Jose Paez Mejia, "Computational Physics", John Wiley & Sons
REFERENCES:
Suresh Chandra, "Computer Applications in Physics", Narosa Publishing House, New Delhi
M Hijroth Jensen, Department of Physics, University of Oslo, 2003 (Available in the Web)

15PHY238   ELECTRICAL ENGINEERING MATERIALS   3 0 0 3

Unit 1

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

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

Unit 2

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

Unit 3

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

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

TEXTBOOK:
A J Decker, "Electrical Engineering materials", PHI, New Delhi, 1957.
REFERENCES:
1. *A J Decker, "Solid State Physics", Prentice Hall, Englewood Cliffs, N J 1957.*
2. *C Kittel, "Introduction to solid state Physics", Wieley, New York, 1956 (2nd edition).*
3. *Allison, Electronic Engineering materials and Devices, Tata McGraw Hill*
4. *F K Richtmyer E H Kennard, John N Copper, "Modern Physics", Tata McGraw 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 McGraw Hill, New Delhi, 2002 (5th edition).

REFRENCES:

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

15PHY240   ELECTRONIC MATERIAL SCIENCES   3 0 0 3

Unit 1

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

Unit 2

Useof 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, Birefringerence; Dielectric Properties of Materials: Polarization and Permittivity, Mechanisms of polarization, dielectric properties - dielectric constant, dielectric loss, dielectric strength and breakdown, Piezoelectricity, Ferreoelectricity, and Pyroelectricity, Dielectric Materials

TEXTBOOK:

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

REFERENCE:

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

15PHY241   LASERS IN MATERIAL PROCESSING   3 0 0 3

Unit 1

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

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

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

Unit 2

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

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

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

Unit 3

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

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

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

REFERENCES:

1. *Steen, W M, Laser Material Processing (3rd Edition), Springer Verlag, 2003, ISBN 1852336986.*
2. *Silvast, W T, Laser Fundamentals, Cambridge University Press, 1998, ISBN 0521556171.*
3. *J. F. Ready, D. F. Farson. LIA Handbook of Laser Materials Processing Laser Institute of America, 2001.*

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

15PHY243   MICROELECTRONIC FABRICATION   3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

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

TEXTBOOK:

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

REFERENCE:

1. *S K Gandhi, VLSI Fabrication Principles, John Wiley & Sons, 1994*

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

15PHY245   NUCLEAR ENERGY: 3 0 0 3
PRINCIPLES AND APPLICATIONS

Unit 1

Basics: Atomic theory, nuclear composition, sizes and masses of nuclei, binding energy, radioactive decay, radioactive chains. Nuclear reactions, transmutation of elements, conservation laws, neutron cross sections, interaction of charged particles and gamma radiation with matter.

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

Unit 2

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

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

15PHY247   **PHOTOVOLTAICS**   3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

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

15PHY248   **PHYSICS OF LASERS AND APPLICATIONS**   3 0 0 3

Unit 1

Review of some basic concepts and principle of laser.

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

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

Unit 2

Properties of LASERS

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

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

Unit 3

Types of LASERS

Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS. gas LASER: (i) He-Ne LASER - principle, construction, working and application. (i) CO2 LASER - principle, construction, working and application.

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

Applications in Communication field:

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

Applications of LASERS in other fields:

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

REFERENCES:

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

15PHY250   QUANTUM PHYSICS AND APPLICATIONS   3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:

A Beiser, Perspectives in Modern Physics, McGraw Hill

REFERENCES;

1. *Arthur Beiser, Concepts of Modern Physics, 6th Edition Tata McGraw Hill*
2. *S H Patil, Elements of Modern Physics, Tata McGraw Hill, 1989*
3. *K Krane, Modern Physics, John Wiley, 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 - donar acceptor levels, trap and recombination centers, excitons, phonons.

Unit 2

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

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

Unit 3

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

Mechanical behaviors: stress, adhesion, hardness, stiffness.

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

TEXTBOOK:

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

REFERENCES:

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

15PHY331   **ASTRONOMY**   **3 0 0 3**

Unit 1

Astronomy, an Observational Science: Introduction - Indian and Western Astronomy – Aryabhatta - 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. RoyInstitute 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 nanotransition – 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 - Aryabhatta, Tycho Brahe, Copernicus, Galileo - Olbers paradox - solar system – satellites, planets, comets, meteorites, asteroids.

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

Celestial mechanics - Kepler's laws - and derivations from Newton's laws.
Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2

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

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

Unit 3

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

Relativity: Special theory of relativity - super-luminal velocity - Minkowski space - introduction to general theory of relativity – space - time metric, geodesics, space-time curvature. Advance of perihelion of Mercury, gravitational lens.

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

REFERENCES:

1. *"Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.*
2. *William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977*
3. *Bradley W. Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.*
4. *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   NONLINEAR 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 bharati, 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 bharati, 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; Cryptogrithms.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*

4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quantitative Aptitude by R. S. Aggarwal, S. Chand*
6. *Quantitative Aptitude – Abijith Guha, TMH.*
7. *Quantitative Aptitude for Cat - Arun Sharma. TMH.*

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

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.the grammarbook.com - online teaching resources

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

15SSK331   SOFT SKILLS III   1 0 2 2

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

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

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

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

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

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

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

TEXTBOOKS:

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

REFERENCES:

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

www.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

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support for employees - Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations. Case Study, Activity.

REFERENCES:

1. *American Psychiatric Association. "Diagnostic and statistical manual of mental disorders: DSM-IV 4th ed." www.terapiacognitiva.eu/dwl/dsm5/DSM-IV.pdf*
2. *American Psychiatric Association. (2000) www.ccsa.ca/Eng/KnowledgeCentre/OurDatabases/ Glossary/Pages/index.aspx.*
3. *Canadian Mental Health Association, Ontario "Workplace mental health promotion, A how to guide"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*
6. *Mental Health Act 1987 (India) www.tnhealth.org/mha.htm*
7. *Persons with disabilities Act 1995 (India) socialjustice.nic.in*
8. *The Factories Act 1948 (India) www.caaa.in/Image/19ulabourlawshb.pdf*

15TAM101   TAMIL I   1 0 2 2

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 : Kuṟuntokai; (2, 6,8,40 pāṭalkaḷ) – puṟanāṉūṟu (74,112,184,192 pāṭalkaḷ) – tirukkuṟaḷ (iṟaimāṭci, amaiccu)

Unit 2

Epic literature: cilappatikāram maturaik kāṇṭam (vaḻakkuṟaikkātai 50-55)
Spiritual Literature: tiruppāvai(3,4) – tēvāram (mācilvīṇaiyum)
Medieval Literature: bāratiyar kaṇṇaṉ pāṭṭu (eṉ viḷaiyāṭṭu piḷḷai) – bāratitacaṉ kuṭumpaviḷakku (tāyiṉ tālāṭṭu).

Unit 3

Novel: Jeyakāntaṉ "kuru pīṭam"

Essay: Aṇṇā "ē tāḻnta tamiḻakamē"

Unit4

Tiruñāṉa campantar – tirunāvukkaracar – cuntarar – māṇikka vācakar – āṇṭāḷ – tirumūlar – kulaccēkara āḻvār – cīttalaic cāttaṉār toṭarpāṉa ccytikaḷ, mērkōḷkaḷ marrum ciṟappup peyarkaḷ

Unit 5

Tamil Grammar: Col vakaikaḷ - vērrumai urupukaḷ - valliṉam mikumiṭam mikāyiṭam - canti(puṇarcci) - ilakkaṇakkurippu.

Practical skills: Listening, speaking, writing and reading

Textbooks:

➢ *Aṇṇā "ē tāḻnta tamiḻakamē" nakkīraṉ papḷikēṣaṉs.*

➢ *Caktitācaṉ cupramaṇiyaṉ "nalla kuṟuntokai mūlamumuraiyum"*
  mullai patippakam, 2008.

➢ *http:/Www.Tamilvu.Org/libirary/libindex.IItm.*

➢ *jeyakāntaṉ "kuru pīṭam" mīṉāṭci puttaka nilaiyam, 1971.*

➢ *Nā.Pārttacārati "puṟanāṉūṟuc ciṟukataikaḷ" tamiḻp puttakālayam, 1978, 2001*

➢ *Poṉ maṇimāṟaṉ "aṭōṉ tamiḻ ilakkaṇam "aṭōṉ papḷiṣiṉ kurūp, vañciyūr,*
  tiruvaṉantapuram, 2007.

➢ *puliyūrk kēcikaṉ "kuṟuntokai mūlamum uraiyum" cārāta patippakam, 2010.*

➢ *Puliyūrk kēcikaṉ "puṟanāṉūṟu" srīceṉpakā patippakam, 2010*

| 15TAM111 | TAMIL I I | î 0 2 2 |

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

Unit 1

The history of Tamil literature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḻamoḻikaḷ - ciṟukataikaḷ tōrramum vaḷarcciyum,

cirrilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭar paḷḷu 35.

Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu –1,4,6,7,8), marrum akappēy cittar pāṭalkaḷ(1-5).

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piraviṉai – nērkkūrru ayaṟkūrru

Unit 4

tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimār kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5

tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu. - Karuttu parimārram - viḷampara moḻiyamaippu – pēccu - nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

Textbooks:

➢ *http:/Www.tamilvu.trg/libirary/libindex.htm.*

➢ *http:/Www.tunathamizh.tom/2013/07/blog0post_24.html*

➢ *Mu.Varatarācaṉ "tamiḻ ilakkiya varalāṟu" cāhitya akaṭemi papḷikēṣaṉs, 2012*

➢ *nā.Vāṉamāmalai "palaṅkataikaḷum, paḻamoḻikaḷum" niyū ceñcuri*
  puttaka veḷiyīṭṭakam, 1980,2008

➢ *nā.Vāṉamāmalai, "tamiḻar nāṭṭuppāṭalkaḷ" niyū ceñcuri puttaka veḷiyīṭṭakam*
  1964,2006

➢ *poṉ maṇimāṟaṉ "aṭōṉ tamiḻ ilakkaṇam "aṭōṉ papḷiṣiṉ kurūp, vañciyūr,*
  tiruvaṉantapuram, 2007.