SYLLABI

CHY100   **CHEMISTRY**   **3 0 0 3**

Unit 1

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

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

Unit 2

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

Chemistry of corrosion and its control: Chemical and electro chemical corrosion – Pilling Bed worth ratio – forms of corrosion.

Unit 3

Electrochemical series - galvanic series - corrosion potential – corrosion current – rate of corrosion – units of corrosion - rate determination – weight loss method. Corrosion control - cathodic and anodic protection.

Advanced Engineering Materials: Introduction to Nanoscience and Technology – significance of nano materials – methods of synthesis – Carbon Nanotubes - synthesis – properties and applications. Conducting polymers - mechanism of conduction - applications. Organic LEDs - their functioning - advantages and disadvantages over conventional LEDs - their commercial uses. Liquid crystals – positional and orientation order - classification of liquid crystals - requirement for substance to exhibit liquid crystalline state - chemical constitution - identification of liquid crystals - electro-optic effect in liquid crystals, application of liquid crystals.

TEXTBOOKS:

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

REFERENCES:

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

CHY181   **CHEMISTRY LAB.**   **0 0 3 1**

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

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

CHY250   **CATALYTIC CHEMISTRY**   **3 0 0 3**

Unit 1

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

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

Unit 2

Catalysis by macromolecules, Phase transfer catalysis.
Catalysis by Enzymes: Introduction - kinetics of enzyme catalyzed reaction,

catalysis through enzyme, organic catalysis, metalloenzyme catalysis, supported enzymes. Industrial applications of enzyme catalyst.

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

Unit 3

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

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

TEXTBOOKS:

1. Bruce C Gates, "Catalytic Chemistry", John Wiley & Sons, Inc. USA, (1992).

2. Viswanathan B, Sivasankar S, Ramaswamy A V, "Catalysis, Principles and Applications", CRC Press, (2006).

REFERENCES:

1. James E House, "Principles of Chemical Kinetics", Academic Press, (2007).

2. Kuriacose J C, "Catalysis", Macmillan India Limited, New Delhi, (1991).

CHY251   CHEMISTRY OF ENGINEERING MATERIALS   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Photochemistry in Electronics: Photochemical reactions - laws of absorption

(Grothers - Draper law - Stark - Einstein's law) - Quantum efficiency - photochemical decomposition of HI and HBr - and Quantum yield.

Unit 3

Florescence and Phosphorescence - chemiluminescence - photo sensitization.

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

TEXTBOOK:

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

REFERENCE:

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

CHY252   CHEMISTRY OF ADVANCED MATERIALS   3 0 0 3

Unit 1

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

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

Unit 2

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

Unit 3

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

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

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

TEXTBOOKS:

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

REFERENCES:

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

CHY253   ADVANCED POLYMER CHEMISTRY   3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

TEXTBOOKS:

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

REFERENCES:

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

CHY254   POLYMERS FOR ELECTRONICS   3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCE:

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

CHY255   CHEMISTRY OF TOXICOLOGY   3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

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

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

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

TEXTBOOK:

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

REFERENCES:

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

CHY256   CHEMISTRY OF NANOMATERIALS   3 0 0 3

Unit 1

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

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

Unit 2

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

Carbon nanostructures: Carbon Clusters: Fullerenes, structure, synthesis, alkali doped C_{60} - superconductivity in C_{60}, applications of fullerenes. Carbon nanotubes: Classification, properties, synthesis, characterization, and potential applications, growth mechanism of carbon nanotubes.

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

Unit 3

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

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

TEXTBOOKS:

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

REFERENCES:

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

5. *Balzani V, Credi A, Venturi M, "Molecular devices and machines- A journey in to the Nanoworld" Wiley VCH (2003).*
6. *Bharat Bhushan, "Hand book of Nanotechnology", Springer, (2004).*

CHY257   BIOMATERIALS SCIENCE   3 0 0 3

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

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

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

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

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

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

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

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

CHY258   ENVIRONMENTAL CHEMISTRY   3 0 0 3

Unit 1
Air and air pollution (earth's atmosphere): Regions - ozone - CFC and other chemicals - catalytic decomposition of ozone - 'ozone hole' formation - Air pollution due to gas emission from industries - Atmospheric aerosols – dust, combustion products, aerosol concentration and lifetimes - Automobile exhausts, smog and effects - Acid rain - chemistry of acid rain, roll of meteorology, greenhouse gases and global warming - air pollution due to jet engines.

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

Unit 2
Aerobic processes - wastewater treatment systems (brief description only) - anaerobic and aerobic - sewage treatment, primary, secondary and tertiary processes - water reuse and recycle. Eutrophication of lakes, nitrogen and phosphorus in effluents - Drinking water standards - sources - fluoride and arsenic in water, purification, sterilization - chemistry of chlorination - water purification for domestic use - reverse osmosis -nano filters and membranes.

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

Unit 3
Other types of pollution: Soil pollution - agricultural pollution - use of chemical fertilizers - Organic chemicals and environment, dioxins and furans - chemistry of some of the pesticides, insecticides and herbicides, ill effects due to uncontrolled use - Bulk storage of hazardous chemicals and disasters, Radioactive pollution, radiation units, sources - exposure and damage - safety standards - radioactive wastes and their disposal - Toxicological substances, testing of toxic substance, enzyme inhibition and biochemical effects of toxic chemicals on humans.

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

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

REFERENCES:

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

CHY259   INSTRUMENTAL METHODS OF ANALYSIS   3 0 0 3

Unit 1

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

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

Unit 2

Gas chromatography - principle and applications – gel chromatography.

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

Unit 3

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

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

TEXTBOOKS:

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

REFERENCES:

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

CHY260   ORGANIC SYNTHESIS AND STEREOCHEMISTRY   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

TEXT BOOKS:

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

REFERENCES:

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

CHY261   UNIT PROCESSES IN ORGANIC SYNTHESIS   3 0 0 3

Unit 1

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

dioxide, chromium trioxide, lead tetraacetate, sodium borohydride, lithium borohydride, sulphur carbanions.

Unit 2

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

Unit 3

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

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

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

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

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

CHY262   MEDICINAL ORGANIC CHEMISTRY   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

TEXTBOOKS:
1. *Rama Rao Nadendla, "Principles of Organic Medicinal Chemistry", 1st edition, New age internationals (P) limited, (2005).*
2. *Thomas Nogrady and Donald F. Weaver, "Medicinal chemistry: A Molecular and Biochemical Approach", 3rd edition, Oxford university press, (2005).*

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

CHY263   ORGANIC REACTION MECHANISMS   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

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

CHY264   GREEN CHEMISTRY AND TECHNOLOGY   3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

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

REFERENCES:

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

CHY270   CORROSION SCIENCE   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Corrosion Inhibitors: Passivators - Vapour phase inhibitor.

Unit 3

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

Corrosion protection: Automobile bodies – engines – building construction.

TEXTBOOKS:

1. *Fontana and Mars G, "Corrosion Engineering", 3rd edition, Mc Graw-Hill, (1987).*

2. *Uhlig H H and Reviees R W, "Corrosion and its Control", Wiley, (1985).*

REFERENCES:

1. *ASM Metals Handbook, "Surface Engineering", Vol 5, ASM Metals Park, Ohio, USA, (1994).*

2. *ASM Metals Handbook, "Corrosion", Vol 13, ASM Metals Park, Ohio, USA, (1994).*

3. *Brain Ralph, "Material Science and Technology", CRC Series, Boston, New York.*

CHY271 ELECTROCHEMICAL ENERGY SYSTEMS AND PROCESSES 3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless

plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

TEXTBOOKS:

1. *Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, (1993).*

2. *Dell, Ronald M Rand, David AJ, "Understanding Batteries", Royal Society of Chemistry, (2001).*

REFERENCES:

1. *Christopher M A, Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, (2004).*

2. *Watanabe T, "Nano-plating: microstructure control theory of plated film and data base of plated film microstructure", Elsevier, Oxford, UK (2004).*

3. *Kanani N, "Electroplating and electroless plating of copper and its alloy", ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*

4. *Lindon David, "Handbook of Batteries", McGraw Hill, (2002).*

5. *Curtis, "Electroforming", London, (2004).*

6. *Rumyantsev E and Davydov A, "Electrochemical machining of metals", Mir, Moscow, (1989).*

CHY272   COMPUTATIONAL CHEMISTRY   3 0 0 3
AND 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. *Namboori P.K., Deepa Gopakumar and K.I. Ramachandran (In press) "Computational Chemistry and Molecular Modeling", Krishnan.*
2. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*
3. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

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

CHY273   FUEL CELLS - PRINCIPLES AND APPLICATIONS   3 0 0 3

Unit 1

Introduction: relevance, importance and classification of fuel cells.

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

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

CHY274   SOLID STATE CHEMISTRY   3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

REFERENCES:

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

CSE100   COMPUTER PROGRAMMING   3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

Structures - declaration, initialization, bitfields, operations on structures. Arrays, pointers and structures as members of structure. Array of structures, structures and functions, pointers to structures. Files - file operations for binary and text

files, file I/O statements - fscanf, fprintf, fread, fwrite. Random file access - rewind, ftell, fseek. Command line arguments. Preprocessor - macros.

TEXTBOOK:

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

REFERENCES:

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

CSE180   COMPUTER PROGRAMMING LAB.   0 0 3 1

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

CSE380   INFORMATION TECNOLOGY 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 though 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 commands, embedded SQL concepts, OLTP concepts.

Unit 3

System development methodology: software engineering and software 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 to web architecture: basic architecture of a web application, security, performance of web based applications, architecture documents.

REFERENCES:

1. Tanenbaum A. S, "Structured Computer Organisation", Fourth Edition, PHI, 1999.
2. Silberschatz A, Korth H F, S. Sudharshan, "Database System Concepts", Fourth Edition, Tata McGraw, 1997
3. Pressman R.S, "Software Engineering – A practitioner's approach", Sixth Edition, McGraw Hill Publishers, 2004

CUL101   CULTURAL EDUCATION I   2 0 0 2

Unit 1

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

Unit 2

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

Unit 3

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

TEXTBOOKS:

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

CUL102   CULTURAL EDUCATION II   2 0 0 2

Unit 1

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

Unit 2

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

Unit 3

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

TEXTBOOKS:

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

CUL151   ACHIEVING EXCELLENCE IN LIFE -   1 0 2 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 – PanchaKosas (Physical/ Energy/Mental/ Intellectual/ Bliss); Stress Management &Personality; Self Control & personality; Fundamental Indian Values & Personality;

Learning Skills (Teachings of Amma)

Art of Relaxed Learning; Art of Listening; Developing 'Sraddha' – a basic qualification for obtaining Knowledge;

Communication Skills - An Indian Perspective;

Unit 3

Developing Positive Attitude & Friendliness- (Vedic Perspective);

Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma);

Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);

REFERENCE BOOKS:

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

CUL152   EXPLORING SCIENCE AND TECHNOLOGY IN   1 0 2 2
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.

CUL153   EXCELLENCE IN DAILY LIFE   1 0 2 2

Unit 1

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

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

Unit 2

4 The play of the mind. Emotions – convert weakness into strength.

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

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

7 Increase Productivity, reduce stress.. work patterning.

Unit 3

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

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

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

REFERENCES:

The Bhaja Govindam and the Bhagavad Gita.

CUL154   **YOGA PSYCHOLOGY**   **1 0 2 2**

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

Unit 1

Introduction

Introduction to Modern Psychology

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

Introduction to Indian Psychology

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

Patanjali Yoga Sutra – 1

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

Patanjali Yoga Sutra – 2

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

Unit 2

Patanjali Yoga Sutra – 3

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

Patanjali Yoga Sutra – 4

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

Patanjali Yoga Sutra – 5

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

Patanjali Yoga Sutra – 6

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

Patanjali Yoga Sutra – 7

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

Unit 3

Patanjali Yoga Sutra – 8

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

Patanjali Yoga Sutra – 9

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

Patanjali Yoga Sutra – 10

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

Report review

Conclusion

REFERENCES:

· *The course book will be "The four chapters of Freedom" written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.*

· *"The message of Upanishads" written by Swami Ranganathananda. Published by Bharathiya Vidya Bhavan.*

· *Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttaranjal.*

· *'Hatha Yoga Pradipika' Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India*

ECE100   **ELECTRONICS ENGINEERING**   **3 0 0 3**

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

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

Unit 1

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

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

Unit 2

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

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

ECE210   DIGITAL SYSTEMS   3 1 0 4
(Pre-requisite: ECE100)

Unit 1

Introduction to logic circuits, logic families: Variables and functions, inversion, truth tables, logic gates and networks, Boolean algebra, synthesis using AND, OR, NOT, NAND and NOR gates. Design examples. Introduction to logic families such as ECL, TTL.

Implementation technology: Transistor switches, NMOS logic gates, CMOS logic gates, Negative logic system, tri-state logic.

Optimized implementation of logic functions: Karnaugh map, strategy for minimization, minimization of product of sums forms, incompletely specified functions, multiple–output circuits multilevel synthesis, analysis of multilevel circuits, cubical representation, a tabular method for minimization.

Number representation and arithmetic circuits: Addition of unsigned numbers, signed numbers, fast adders.

Unit 2

Combinational circuit building blocks: Multiplexers, decoders, encoders, code converters, arithmetic comparison circuits.

Flip flops, registers, counters: Basic latch, gated SR latch, gated latch, master slave and edge triggered D flip-flops, T flip-flop, JK flip-flop, registers, counters, reset synchronization, other types of counters.

Synchronous sequential circuits: Basic design steps, state assignment problem, mealy state model, serial adders example, state minimization.

Unit 3

Asynchronous sequential circuits: Asynchronous behavior, analysis of asynchronous circuits, synthesis of asynchronous circuits, state reduction, state assignment, hazards.

TEXTBOOK:

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

REFERENCES:

1. *Morris Mano, "Digital Design", Third Edition, Pearson Education, 2006.*
2. *Donald D Givone, "Digital Principles and Design", Tata McGraw Hill Publishing Company Limited, 2003.*
3. *Allen Dewey, "Analysis and Design of Digital Systems with VHDL", PWS Publishing Company, 1999.*
4. *John F. Wakerly, "Digital Design Principles and Practices", Third Edition, Pearson Education, 2001.*

ECE220   SIGNALS AND SYSTEMS   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 system. LTI system – response of LTI system, convolution, properties (continuous/ discrete); LTI systems – differential/difference equation representation and solution.

Unit 2

Fourier analysis of continuous time signals and systems: Fourier series for periodic signals; Fourier transform - properties of continuous time FT; Frequency response of continuous time LTI systems.

Fourier analysis of discrete time signals and systems: Discrete time Fourier series - discrete time Fourier transform - properties of DTFT; Frequency response of discrete time LTI systems.

Laplace transform analysis of systems: ROC, inverse LT, unilateral LT, solving differential equation with initial conditions.

Unit 3

Sampling: Sampling theorem, reconstruction of signal, aliasing, sampling of discrete time signals; Introduction to DFT.

z-Transform: Definition, ROC, inverse z-transform, properties, transform analysis of LTI Systems.

Interrelationship amongst different representation and transforms.

TEXTBOOK:

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

REFERENCES:

1. Simon Haykin, Barry Van Veen, "Signals and Systems", Second Edition, John Wiley and Sons, 2005.

2. Michael J. Roberts, "Fundamentals of Signals and Systems", First Edition, Tata McGraw Hill Publishing Company Limited, 2007.

3. Rodger E. Ziemer, William H. Tranter D. Ronald Fannin, "Signals and Systems", Fourth Edition, Pearson Education, 2004.

ECE221   DIGITAL SIGNAL PROCESSING   3 1 0 4
(Pre-requisite: ECE220)

Unit 1

The Discrete Fourier transforms: Review of main concepts form signals and systems course - frequency domain sampling and reconstruction of discrete time signals - the DFT as a linear transformation - relationship of the DFT to other transforms - properties of DFT - linear filtering methods based on DFT- efficient computation of the DFT-FFT algorithms. Efficient computation of DFT of two real sequences - efficient computation of the DFT of a 2N- point real sequences - use of FFT in linear filtering and correlation - introduction to DCT.

Unit 2

Digital filters: Introduction, specifications of practical filters.
a) FIR filters: symmetric and anti-symmetric FIR filters, design of linear phase FIR filter using Windows/optimization techniques. Design of linear phase FIR filters. FIR differentiators, Hilbert transforms, comparison of design methods for linear phase FIR filters.
b) IIR filters: Design from analog filters - design by approximation of derivatives, impulse invariance and Bilinear transformation. Characteristics of commonly used analog filters, frequency transformations for analog and digital filters.

Unit 3

Digital filters realizations: Structures for the realization of discrete time system - structures for FIR systems - direct form structures, cascade form structures, frequency sampling structures, lattice structures. Structures for IIR systems - direct form structures, cascade form structures, parallel form structures and lattice and lattice-ladder structures, analysis of finite word length effect and limit cycle oscillations in recursive systems.

Applications of DSP: Multirate digital signal processing, sampling rate conversion, decimation and interpolation, sub-band coding of speech signals, introduction to QMFs. Linear predictive coding, forward linear prediction, Levinson-Durbin algorithm, signal synthesis, application in digital transmission of speech signals.

TEXTBOOK:

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

REFERENCES:

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

2. Allen V. Oppenheim, Ronald W. Schafer, "Discrete time Signal Processing", Fifth Edition, Prentice Hall India Private Limited, 2000.

ECE310   INTRODUCTION TO MICROCONTROLLERS   3 1 0 4
AND APPLICATIONS
(Pre-requisite: ECE210)

Unit 1

Introduction to 8085 microprocessor-architecture and programming.

Registers: File registers - memory organisation tristate logic – buses - memory address register - memory addressing - read and write operations – ROM – RAM – PROM – EPROM - E^2PROM.

Introduction to elementary processor: Organization - Data Transfer Unit (DTU) - operation - Enhanced Data Transfer Unit (EDTU) – Opcode - machine language - assembly language - pipeline scheme and system clock.

Unit 2

Introduction to microcontrollers: PIC16FXXXarchitecture – operation - data and program memory organization - special function registers - addressing modes - instruction set. MPLAB IDE simulator – assembler - assembler directives - simple programs - conditional branching – subroutines - nested subroutines – interrupts - interrupt service routines – priority.

Unit 3

PIC peripherals: Application of each peripherals and its use: ports - IO ports - port configuration - parallel slave port - LED, LCD and keyboard interface -timers and counters - watchdog timer - analog to digital converter specification - operation. EEPROM data memory - serial communication – USART -CCP module.
Introduction to 8051 microcontrollers: architecture - instruction set – interrupts – ports – timers.

TEXTBOOK:

T.R.Padmanabahan, "Introduction to microcontrollers and their applications", First edition, Narosa publishing house private limited, 2007.

REFERENCES:

1. *Kenneth J Ayala, 'The 8051 Microcontroller", Thomas Delman Learning, 2004.*
2. *PIC Micro mid Range MCU Family Reference Manual, Micro Chip Technology Inc.*

ECE480   FINANCIAL ENGINEERING   3 0 0 3

Unit 1

Cash flows and fixed income securities: Investments & markets, principal and interest, present & future values of streams, IRR - pixed 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.

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, simple diversification reduces 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*

REFERENCE:

Yuh – Dauh Lyuu, "Financial Engineering and Computation", Cambridge University Press, 2002.

EEE100   ELECTRICAL ENGINEERING   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

Transformers; construction and principle of operation of transformers, Emf equation. Three phase Induction motor: Types, construction, rotating magnetic field, principle of operation, slip, rotor induced emf.

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

EEE180   WORKSHOP B   1 0 2 2

Electrical workshop:

Study of safety devices such as fuse, MCB, ELCB & earthing – electrical power distribution in domestic installations, study of tools and accessories used in electrical wiring – wiring practice for staircase circuit, fluorescent lamp, hospital wiring and godown lighting – study of domestic appliances like Mixie, fan, Electric iron, Air conditioner, Refrigerator – study of different types of electric lamps like Incandescent lamp, Fluorescent, CFL, Metal halide, Mercury vapour, Sodium vapour and halogen lamp.

Personal computer hardware workshop:

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

Electronics and basic microprocessor workshop:

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

PIC microcontroller workshop:

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

EEE212   ELECTRIC CIRCUITS   3 1 0 4
(Pre-requisite: EEE100)

Unit 1

Introduction**:** Brief idea about transition from field model to circuit model, electrical components, reference directions, brief review of mesh and nodal analysis for DC circuits with dependent and independent sources.

Network theorems (dc): Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Tellegan's theorem, Reciprocity theorem.

Transient analysis: Transient analysis of first order and second order circuits for dc and ac excitations using time domain equations, series and parallel circuits, RLC circuits, resonance, representation of circuit in the Laplace domain - transform impedance and admittance, application of Laplace transform in solving circuit equations.

Unit 2

Sinusoidal steady state analysis: Concept of phasor domain, representation of circuits in phasor domain and solution of circuits using mesh and nodal analysis, magnetically coupled circuit analysis with dot convention.

Network theorems (ac): Superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem.

Graph theoretic approach for circuit analysis: Introductory definitions: tree, twigs, co-tree, links, loops, cutsets. Graph matrices: Incidence matrix (A), cut-set matrix (Q), loop matrix (B), orthogonality, $AB^T = 0$ and $QB^T = 0$; relations between sub-matrices of A, B and Q. KCL and KVL in terms of A, B, Q matrices. Formulation of equations for different methods of circuit analysis. Development of algorithms for computer aided analysis.

Unit 3

Three phase circuit. Complex power, power factor correction, power measurement, three phase circuit, power measurements in balanced and unbalanced systems, symmetrical components for solving unbalanced circuits.

Network functions: Driving point and transfer functions. Two-port networks: Different sets of two-port parameters and relationship amongst them. Interconnection of two-ports, brief introduction to general multi-terminal and multi-port networks. Indefinite admittance Matrix, transmission lines, filters, and amplifiers.

TEXTBOOK:

Alexander, Mathew N.D. Sadiku, "Fundamentals of Electric circuits", Tata Mc Graw-Hill, 2003.

REFERENCE:

1. *M. E. Van Valkenburg, "Network Analysis", Third Edition, Prentice Hall India Private Limited, 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.*

EEE213 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION 3 1 0 4

Unit 1

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

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

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

Unit 2

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

Measurement of power and energy: EDM type wattmeter and power factor meters, LPF wattmeter, errors in wattmeters. Induction type energy meter, errors in energy meter, calibration of meters.

Oscilloscope: Basic principle, CRT features, block diagram of oscilloscope, vertical and horizontal amplifier, triggering pulse circuit, dual beam and dual trace CRO, sampling, storage oscilloscopes, Digital storage oscilloscope, applications of CRO.

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

Unit 3

Digital voltmeters: Ramp and dual slope integrating type DVM, successive approximation type analog to digital conversion techniques, resolution and sensitivity of digital meters, digital frequency, time and phase measurements**.**

Instrumentation systems: Block diagram, signal conditioning systems, instrumentation amplifier.

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

TEXTBOOKS:

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

REFERENCES:

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

EEE221   **ELECTRICAL MACHINES I**   **3 1 0 4**
                           (Pre-requisite: EEE212)

Unit 1

Definition of magnetic quantities, theory of magnetism, magnetization curves of ferromagnetic materials, magnetic circuit, concept and analogies, units for magnetic circuit calculations, magnetic circuit computation, Hysterisis and Eddy current losses in ferromagnetic materials, self and mutual inductances.

Principles of electromechanical energy conversion, basic concepts of rotating machines, dynamic equation of electromechanical systems.

Unit 2

DC Machines: EMF and torque, circuit model, armature reaction, compensating winding, commutation, methods of excitation, magnetization characteristic, self-excitation, types – shunt, series, compound generators and characteristics of DC generators, types and characteristics of DC Motors, starting of DC motors, speed control of DC motors, braking of DC motors, efficiency and testing, permanent magnet DC machine applications.

Unit 3

Transformer: Construction and practical considerations, transformer on no-load, ideal transformer, real transformer and equivalent circuit, transformer losses, transformer testing, efficiency and voltage regulation, excitation phenomenon in transformers, autotransformers, three-phase transformers, star-star, star-delta, zig-zag connection. Methods of cooling, parallel operation of transformers, three-winding transformers.

TEXTBOOK:

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

REFERENCES:

1. *M. G. Say, "Performance and Design of Direct Current Machines", CBS publishers, New Delhi, 1993.*
2. *Fitzgerald A.E., Charles Kingsley, Jr. and Stephen D. Umans, "Electric Machinery", Tata McGraw-Hill Publishing Company Limited 2002*
3. *Albert E. Clayton, "The performance and design of direct current machines", Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1992,.*

EEE222   **ELECTROMAGNETIC THEORY**   **3 1 0 4**
                           (Pre-requisite: EEE100)

Unit 1

Vectors and co-ordinate systems: Cartesian, cylindrical and spherical co-ordinate

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

Unit 2

Maxwell's equations: gradient, curl and divergence Maxwell's equation in integral form - Law of conservation of charge - Maxwell's equation in differential form - continuity equation - boundary condition for electromagnetic fields.
Electric potential - Poisson's and Laplace's equations – capacitance - energy stored - magnetic scalar and vector potentials - magnetic circuits – inductance - energy stored - conductance.

Unit 3

Uniform plane waves and sinusoidaly varying waves in time domain and in free space – polarization - power flow and Poynting vector - wave parameters - plane waves in material media - skin effect - reflection and transmission of uniform plane waves - normal and oblique incidence in conductor and dielectric interfaces.

TEXTBOOK:

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

REFERENCE:

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

EEE291   SIMULATION LAB. AND ELECTRICAL WORKSHOP   1 0 3 2

Experiments in electrical workshop and familiarization with simulation software. In theory classes, simulation of electric and electronics circuits using ORCAD, Matlab will be covered. Students are encouraged to come with their own laptop in simulation classes.

EEE292   ELECTRIC CIRCUITS LAB.   0 0 3 1

Familiarization of electrical measuring Instruments, verification of network theorems, series – parallel circuits, resonance circuits, separation of resistance and reactance, power factor improvement, three phase power measurement in balanced and unbalanced circuits. Characteristics of semiconductor devices, half wave and full wave rectifiers.

EEE293   ELECTRICAL MACHINES LAB. I   0 0 3 1

DC MACHINES:
Performance characteristics, dc shunt, series and compound generators, study of starters, predetermination of efficiency of dc machines, load test, speed control of dc shunt and series motors.
TRANSFORMERS: No load and load test on single phase and three phase transformers, predetermination of efficiency and regulation, three phase transformer connections, phase conversion, parallel operation of transformers.

EEE294   MEASUREMENTS AND DIGITAL CIRCUITS LAB.   0 0 3 1

Electrical measurements, calibration of voltmeter, ammeter, wattmeter and energy meter. Extension of instrument range using instrument transformers. AC and DC bridges, study of transducer, application of transducer.
Logic gates, verification of truth tables, adder, subtractor, flip flop, multiplexer, demultiplexer, assembly of shift registers, counters, ring counter.

EEE311   ELECTRONIC CIRCUITS   3 1 0 4
(Pre-requisite: ECE100)

Unit 1

Diodes and its applications: Review of diode characteristics, design of clipper, clamper circuit and nonlinear wave shaping circuits.
BJT and FET: Structures, operation, V-I characteristics of BJT and MOSFET. Biasing circuits, small signal operation and models of BJT and MOSFET, analysis of BJT and MOSFET amplifiers, frequency response of CE and CS amplifiers, BJT and MOSFET differential amplifier, Darlington pair, emitter follower.

Unit 2

Operational amplifiers: *Review - Ideal and practical op amp - inverting and non inverting configuration, differential configuration, practical op amp parameters, open loop and closed loop frequency response, gain - bandwidth product, slew rate, CMRR.
Operational amplifiers applications: adder, integrators, differentiators, voltage comparators, Schmitt trigger, peak detector, instrumentation amplifier, zero crossing detector, sample and hold circuit, precision rectifier, RC waveform shaping circuits, data converter circuits - D/A converters: Binary weighted type, R-2R ladder type, A/D converters: feedback type converter, flash converter. Phase-Locked Loops.

Unit 3

Feedback: Introduction, properties of negative feedback, basic topologies, analysis of ideal and practical voltage shunt and voltage-series configuration.

Oscillators and filters: Principle, op-amp RC oscillators. Filters: Filter transmission, types and specifications, transfer function, passive and active filters,
Design of first and second order low-pass and high-pass Butterworth filters. Introduction to band–pass and band reject filters, all-pass filter.
Power amplifier: Analysis of power amplifiers.
Voltage references and regulators: Characteristics of voltage regulators, analysis of series and shunt regulator. Shunt regulators.
*Only review - need not spend much time as this portion will be covered in EC-100 Electronics Engineering

TEXTBOOKS:
1. *Adel S. Sedra, Kenneth. C. Smith, " Microelectronic Circuits", Oxford University Press, Fifth Edition, 2005*
2. *Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Prentice-Hall of India Private Limited, 2003*

REFERENCES:
1. *John D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 2002*
2. *Millman and Halkias, "Integrated Electronics", Mc Graw-Hill, ISE, 1990.*
3. *David A. Bell, "Electronic Devices and Circuits", Prentice-Hall of India Private Limited, 1999.*
4. *S. Salivahanan, N. Suresh Kumar, A Vallavaraj, "Electronic Devices and Circuits", Tata McGraw-Hill Publishing Company Limited , 2002.*

EEE321   ELECTRICAL MACHINES II   3 1 0 4
(Pre-requisite: EEE221)

Unit 1
Induction machines - construction, time and space harmonics, starting and speed control, testing, circle diagram, equivalent circuit, performance curves, torque speed characteristics, slip ring induction motors.

Unit 2
Synchronous machines - construction, generators and motors, salient pole and non-salient pole synchronous machines, characteristics, regulation, parallel operation, operation on infinite bus, real and reactive power control, power angle curve, stability analysis, transient and sub transient reactance.

Unit 3
The fractional horse power motors, types, single phase Induction motor, construction, starting, equivalent circuit, performance curves, shaded pole motors, hysterisis motors etc.

TEXTBOOK:
Kothari D. P. and Nagrath I. J., "Electric Machines", Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.
REFERENCES:
1. *M. G. Say, "Performance and Design of Alternating Current Machines", CBS publishers, New Delhi, 1993.*
2. *Fitzgerald A.E., Charles Kingsley, Jr. and Stephen D. Umans, "Electric Machinery", Tata McGraw-Hill Publishing Company Limited, 2002.*
3. *Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India Private Ltd, 2002.*

EEE331   ELECTRICAL ENERGY SYSTEMS I   3 1 0 4

Unit 1
Structure of electric power system - methods of electric power generation - hydro, thermal, nuclear power generations, grid systems advantages - necessity of EHV transmission - EHV AC and HVDC transmission - variable load on power stations - load curve and load duration curve - three phase systems - balanced and unbalanced systems - power factor improvement – tariff - transmission line parameters - skin effect and proximity effect - inductance of single phase transmission line.

Unit 2
Inductance of three phase transmission line - single circuit and double circuit lines - symmetrical and unsymmetrical spacing - bundled conductors – self GMD and mutual GMD - capacitance of single phase, three phase single circuit and double circuit transmission lines - symmetrical and unsymmetrical spacing - performance of transmission lines - efficiency and regulation - short, medium and long lines - ABCD constants - ferranti effect - surge impedance - real and reactive power flow in transmission lines - shunt and series compensation - corona loss.

Unit 3
Cables - construction and characteristics of single core and three core cables - insulation resistance and capacitance of a single core cable, dielectric stress and most economical conductor size - grading of cables - capacitance and inter sheath grading - insulators - types - voltage distribution in suspension type insulators - string efficiency - grading of insulators - mechanical design of transmission lines - sag and span - supports at same level and different levels - sag template and stringing chart – substations - neutral grounding - circuit breakers - principle of operation and types - circuit breaker ratings.

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

REFERENCES:

1. *Wadhwa C L, "Electrical Power System", Wiley Eastern Limited, India, 2007.*
2. *Hadi Saadat, "Power System Analysis" McGraw Hill Publishing Company, 2003.*
3. *B. R. Gupta, "Power System Analysis and Design", Third Edition, S. Chand & Company Ltd., 2004.*
4. *Grigsby L. L, "Electrical Power Engineering Handbook", IEEE Press, 2001.*

EEE332   ELECTRICAL ENERGY SYSTEMS II   3 1 0 4
(Pre-requisite: EEE331)

Unit 1
Single line diagram and per unit representation of power system. Power system modeling - bus admittance matrix and bus impedance matrix - load flow analysis - Gauss siedel, Newton Raphson and fast decoupled load flow methods - comparison of methods - control of voltage profile.

Unit 2
Fault analysis - symmetrical faults - study behavior of short circuit transients - transient on a transmission line - performance of short circuited synchronous generator on no load as well as on load - selection of circuit breakers - symmetrical components - symmetrical component transformation, phase shift in Star-delta transformers - positive sequence, negative sequence and zero sequence impedances of synchronous machine, transformer and transmission line - sequence networks - construction of sequence networks of a power system - unsymmetrical faults - open conductor faults - L-G fault, L-L fault and L-L-G fault.

Unit 3
Power system stability - dynamics of a synchronous machine, power angle equation, node elimination technique, simple systems, steady state stability, transient stability, critical clearing time - equal area criterion - swing equation - multi machines stability - some factors affecting transient stability.

TEXTBOOK:

D. P. Kothari and I. J. Nagrath,"Power system engineering", Third Edition, Tata McGraw Hill publishing company Limited, 2003.

REFERENCES:

1. *Nagrat I. J. and Kothari. D. P., "Modern power system analysis", Third Edition, Tata McGraw hill publishing company,1998.*
2. *Hadi Saadat, "Power system analysis", McGraw Hill Publishing Company,2003.*
3. *Wadhwa C. L, "Electrical Power System", Wiley Eastern Limited, India ,2007.*
4. *John J. Grainger and Stevenson Jr. W. D, "Power system analysis", McGraw Hill International edition, 1996.*

EEE341   POWER ELECTRONCS   3 1 0 4

Unit 1
Characteristics of power semiconductor switches - power diodes, power transistors and thyristors, two transistor model of SCR, diode rectifiers, gating and protection circuit. Turn on circuits for SCR – triggering with single pulse and train of pulses – synchronizing with supply – triggering with microprocessor – forced commutation – different techniques.

Unit 2
Phase controlled converters: Single phase semi and full converters, three phase semi and full converters, power factor improvement by PWM control, effects of source inductance. Dual converter.
AC and DC choppers – DC to DC converters – buck, boost and buck – boost.

Unit 3
Inverters: Voltage and current source inverters, resonant, series inverter, PWM inverter.

TEXTBOOK:

Muhammad. H. Rashid, "Power Electronics-Circuits, Devices and Applications", Third Edition, Pearson Education Inc. 2004.

REFERENCES:

1. *Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics, Converters, Applications and Design", Third edition, John Wiley & Sons, 2003.*
2. *Joseph Vithayathil, "Power Electronics", McGraw-Hill, 1995.*
3. *Daniel W Hart, "Introduction to Power Electronics", Prentice Hall, 1997.*
4. *M.D Singh, K.B Khanchandani, "Power Electronics", Tata McGraw-Hill Publishing Company Limited, 1998.*

EEE342   CONTROL ENGINEERING   3 1 0 4
(Pre-requisite: ECE220)

Unit 1
Introduction to control systems, mathematical models of physical systems, block diagram, signal flow graph, feedback control system characteristics, reduction of parameter variations, control over system dynamics and disturbance signals, use of software tools to analyze and design of control system, performance of feedback control systems, test input signals, transient and steady state response of second and higher order systems, performance indices.

Unit 2
Concept of stability, Routh-Hurwitz stability criterion, root locus method, concept,

procedure, frequency response analysis, bode plots, polar plots, stability in the frequency domain, Nyquist criterion, Nichol's chart.

Unit 3

Introduction to design of feedback systems, lead-lag compensation networks, PID controllers, introduction to state variable approach, design of state variable feedback systems, controllability, observability. Control system design case studies - cruise missile altitude controller, turbine governor, robotic hand design, ship steering control system.**   (**)   *Self study topics.*

TEXTBOOK:

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

REFERENCES:

1. *Nagrath I. J, Gopal M, "Control Systems Engineering", Fifth Edition,, New Age Publishers 2004*
2. *Katushiko Ogata "Modern control engineering" Third Edition, Pearson education, 2004.*
3. *Benjamin C. Kuo "Automatic Control Systems", Sixth Edition, Prentice Hall India Ltd, 2000*
4. *G. F. Franklin, J.D. Powell and A. Emami-Naeini, "Feedback control of dynamic systems", Pearson Education Asia, Fourth Edition, Indian reprint 2002.*
5. *Morris Driels, "Linear control systems Engineering", International edition, McGraw-Hill Inc., 1995.*

EEE351   DESIGN OF ELECTRICAL APPARATUS   3 0 0 3
(Pre-requisite: EEE321)

Unit 1

Introduction: Design factors, limitations in design, thermal design aspects, standard specification.
DC machines: Specific loadings, output equation, design of main dimensions. Design of armature windings, design of field system, design of interpole and commutator. Transformers: Output equation - volt per turn, main dimensions for three phase and single phase transformers, window dimensions & yoke design and coil design. Design of tank with tubes.

Unit 2

Induction motor: Specific loadings, output equation, main dimensions, stator design, number of slots, shape and area of slots, rotor design for squirrel cage and slip ring types.
Synchronous machines: Output equation, main dimensions for salient pole and cylindrical rotor alternators, stator design, rotor, pole design for salient pole generators, pole winding calculations, design of cylindrical rotor.

Unit 3

Recent developments in core and insulation materials used in electrical machines; optimization techniques as applied to design of electrical machines; study of cooling systems. Computer aided design**: Advantage of computer aided design, flow chart for computer aided design. Standard specifications **: Indian standard specifications for copper conductor, power transformers and induction motor. (** *Self study)*

TEXTBOOK:

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

REFERENCES:

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

EEE352   DESIGN OF ELECTRICAL SYSTEMS   3 0 0 3

Unit 1

General introduction, gathering specific data, adoption of design-parameters for the particular project, selection of basic design philosophies, detailing the electrical system, preparation of as-erected drawings and design - manuals.
Maximum-demand-estimation, demand factors for HV motors, calculation of MD on the MCCs, MD, estimation for an entire load-centre substation and MSS, statutory inspector's approach to MD-estimation.

Unit 2

Sizing of transformer capacity on basis of md-calculations, consideration and constraints in the sizing of transformers CB ratings, split bus arrangements, sizing of power-transformer capacity, sizing of distribution transformer, capacity at ICSS, techno-economic studies on selection of transformer sizes, sizing the transformer to meet HV motor, starts and voltage dips.
Short-circuit calculations, SC analysis, standards for the SC analysis, passive and dynamic reactance to be considered for SC analysis, reactance multipliers for first cycle diagram for SC analysis of 415V system, the computation of AC components of fault currents, determination of DC component of the fault current and the total fault current, IEC equations, the impact of CB status on fault levels.

Unit 3

Selection of cable sizes, continuous rating of cables (standard rating and net-

rating), thermal ampacity of cables, short time short circuit rating of cables, Mechanical withstand of short circuit forces, techno economic consideration in selection of cables, SC-withstand capacity of 1.1 kV cable, voltage drops in 415V motor, feeders and voltage drop based ampacity, The use of copper cables for motors of rating less than 7.5 kW.

TEXTBOOK:

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

REFERENCES:

1. *TNEB Hand book*
2. *IEEE Hand book*

EEE353   ILLUMINATION ENGINEERING   3 0 0 3

Unit 1
Radiant energy and visible spectrum, energy conversion to light, colour, eye and vision; different entities of illuminating systems.
Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers; Energy efficient lamps; Luminaries, wiring, switching and control circuits.

Unit 2
Laws of illumination; illumination from point, line and surface sources. Photometry and spectrophotometry; photocells. Environment and glare. General illumination design. Illumination levels, loss factors, lamp selection and maintenance.
Interior lighting – industrial, residential, office departmental stores, indoor stadium, theater and hospitals.

Unit 3
Exterior lighting - flood, street, aviation and transport lighting, lighting for displays and signaling - neon signs, LED-LCD displays beacons and lighting for surveillance.
Energy conservation codes for lighting; lighting controls – daylight sensors and occupancy sensors; controller design.

TEXTBOOK:

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

REFERENCES:

1. *Kao Chen, "Energy Management in Illuminating Systems", Carlsons Consulting Engineers, San Diego, California, USA, CRC Press, 1999*
2. *Mark Stanley Rea, "IESNA Lighting Handbook", Illuminating Engineering Society of North America, 2000*

3. *Soni, Gupta and Bhatnagar, "A Course in Electrical Power", Fourth Edition, Dhanpat Rai & Sons, 1996.*

EEE354   ELECTROMAGNETIC COMPATIBILITY   3 0 0 3

Unit 1
Introduction to finite element method, introduction to electromagnetic compatibility, sources of EMI, transient EMI, basic definitions of EMC.

Unit 2
EMI coupling principles, conducted, radiated and transient coupling, common impedance ground coupling, radiated common mode and ground loop coupling, EMI specifications, units, civilian & military standards.

Unit 3
EMI test instruments, various test methods and calibration procedures, EMI control techniques, shielding, grounding, bonding, isolation transformer, transient suppressors, cable routing, signal control, component selection and mounting.

TEXTBOOK:

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

REFERENCES:

1. *Berhard Keiser, "Principles of Electromagnetic Compatibility", Artech House, 3rd Edition, 1986*
2. *V. P. Kodali, " Engineering EMC Principles , Measurements and Technologies," IEEE Press,1996*
3. *Course Material on electromagnetic Compatibility, Rajeev Thottappillil, Professor, Division for Electricity and Lightning Research, Angström Laboratory, Uppsala University*

EEE355   INDUSTRIAL ELECTRONICS   3 0 0 3
(Pre-requisite: EEE311)

Unit 1
Input transducers and sensors: Position, displacement, velocity, acceleration, force, flow pressure, level temperature, humidity. Telemetry 0-10V and 4-20mA systems. Thermocouples, RTD, LVDT, servo-pots, strain gauges, P, PI, PID converters, average to rms converters.
Actuators, DC and AC stepper motors, dosing equipment weigh feeders, dosing pumps, extrusion – bulk and film electronic components. Medical equipments.

Unit 2
Programmable controllers and PLCs. rotory encoders, digipots.
Automation: Transfer machines, robotics basics, application of PLCs, Industrial heating:

Arc furnace, high frequency heating, high frequency source for induction heating, dielectric heating and microwave heating, ultrasonic - generation and applications.

Unit 3

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

TEXTBOOK:

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

REFERENCES:

1. S. K. Bhattacharya and S. Chatterjee, "Industrial Electronics &Control", Tata Mc Graw Hill, 2003.

2. Terry. L. M. Bartell, "Industrial Electronics", Delmer Publishers, 1997

3. Thomas. E. Kissell, " Industrial Electronics", 2002

EEE361   POWER PLANT INSTRUMENTATION   3 0 0 3

Unit 1

Introduction to unit operation and unit process: Material and energy balance. Significance of Instrumentation and layout of thermal, hydroelectric, nuclear, gas turbine, solar, wind power plants.
Instrumentation and equipments of various unit operations: Evaporation, distillation, leaching, gas absorption, heat exchangers, humidification and dehumidification, drying, size reduction, crystallization, mixing.

Unit 2

Boiler instrumentation and optimization: Combustion control, 3 element drum level control, steam pressure, oxygen/CO/CO_2 – flue gases control, furnace draft, boiler interlocks, SCADA controls - boiler inspection and safety procedures.
Turbine instrumentation and control: Valve actuation, auto-start up, start up and shut down, thermal stress control, condition monitoring and power distribution instrumentation. Auxiliary control of water treatment plant, electrostatic precipitator and oil automation system.

Unit 3

Automation: Thermal power plant, boiler automation – diagnostic functions and protection – digital electro–hydraulic governor, man-machine interface - graphic display of automated power plant.

TEXTBOOKS:

1. McCabe W. L, Smith J, Peter Harriot, "Unit operation of chemical Engineering", Seventh rev Edition, Tata McGraw Hill Publishing Company, , 2005.

2. Popovic and Bhatkar, "Distributed Computer control in Industrial automation", Second Edition, CRC Press, 1990.

REFERENCE:

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

EEE371   ADVANCED MICROCONTROLLERS   3 0 0 3
(Pre-requisite: ECE310)

Unit 1

dsPIC 30F series: Introduction to 16 bit microcontrollers - dsPIC 30F – CPU, data memory, program memory - instruction set - programming in assembly and C-Interrupt structure.

Unit 2

Peripherals of dsPIC 30F: I/O ports, timers, input capture, output compare, motor control PWM, QEI,10 bit A/D converter, UART, CAN module, application development.

Unit 3

MSP430 and peripherals: MSP430f2274 - MSP430X22X2 device pin out, DA package, functional block diagram description, inputs, outputs, timers, ADC. application development.

TEXTBOOKS:

1. dsPIC 30F, Reference Manual, Microchip.

2. Chris Nagy, " Embedded System Design using the TI MSP 430 Series", First Edition, Newnes,2003

REFERENCES:

MSP430f2274, Reference manual, Texas Instruments.

www.microchip.com

www.ti.com

EEE372   COMMUNICATION ENGINEERING   3 0 0 3

Unit 1

Introduction: Communication, communication systems - block diagram description of analog and digital systems; Review of fourier representation, waveform spectra, bandwidth; Noise - sources of noise and their manifestations into communication systems, noise figure, significance of SNR considerations in communication systems. Modulation: Necessity, introduction to analog and digital modulation.

Unit 2

Amplitude modulation: Theory, modulation index, spectral representation of modulated waves, power and bandwidth considerations, carrier and side bands, modulation schemes: DSBFC, suppressed carrier, SSB techniques – filter systems, phase shift method, carrier reinsertion system, VSB, applications.

Frequency modulation: Introduction, theory of FM and phase modulation, frequency spectrum of FM wave, applications.

Pulse communication: Introduction, PWM, PPM, PCM.

Unit 3

Introduction to digital communications: Fundamentals of data communication systems, FSK, PSK and QAM.

Applications in power systems: Power line carrier, elements of carrier channel, transmitter, line traps, carrier communication, carrier relaying, power system communication, telemetry, tele control.

TEXTBOOKS:

1. *George Kennedy, Bernard Davis, "Electronic Communication Systems", Fifth Edition, Tata McGraw Hill Publishing Company Limited, 2006.*
2. *Wayne Tomasi, "Electronic Communication Systems, Fundamentals through Advanced", Fourth Edition, Pearson Education2002.*
3. *Donald G. Fink, H. Wayne Beaty, "Standard Hand Book for Electrical Engineers" Fourteenth Edition, McGraw Hill Publishing Company Limited, 2001*

REFERENCES:

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

EEE373   INTRODUCTION TO COMPUTER NETWORKS   3 0 0 3

Unit 1

Introduction to computer networks

Uses of computer networks, network hardware, network software, network reference models, example networks - the internet, connection-oriented networks: X.25, frame relay, ATM, ethernet,

Physical layer

Guided transmission media, wireless transmission, public switched telephone network - structure of the telephone system, local loop: Modems, ADSL, multiplexing, switching.

Data link layer (Logical link layer)

Data link layer design issues: Framing, error control, flow control.

Error detection and correction, error-correcting codes, error-detecting codes, data link protocols: Stop-and-wait protocol, sliding window protocols.

Unit 2

Data link layer (MAC Layer)

Multiple access control) protocols – Aloha, carrier sense multiple access protocols, collision-free protocols, limited-contention protocols, ethernet, repeaters, hubs, bridges, switches, routers, and gateways.

Network layer - network layer design issues, IP addressing, routing algorithms, ARP, RARP.

Unit 3

Transport layer

Transport service, elements of transport protocols, internet transport protocols - TCP, UDP, application layer: DNS, electronic mail.

Security in computer networks

Principles of cryptography, Symmetric-Key Algorithms, Public-Key Algorithms

TEXTBOOKS:

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

REFERENCES:

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

EEE391   ELECTRICAL MACHINES LAB. II   0 0 3 1

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

EEE392   MEASUREMENTS AND ANALOG CIRCUIT LAB.   0 0 3 1

Computer based measurements. Design and testing of common emitter amplifier, differential amplifier, common collector amplifier, common source amplifier, Schmitt trigger, linear voltage regulator.

EEE393   ELECTRONIC CIRCUITS LAB.   0 0 3 1

Linear power supply, A/D converter, D/A converter, operational amplifier circuits, 555 timer, wave form generation using op- amp. Instrumentation amplifier, IC power amplifier, high power amplifier, phase locked loop applications. Precision rectifier. Familiarization with simulation software.

EEE394 MICROPROCESSOR AND MICROCONTROLLER LAB.   0 0 3 1

Programming 8085 using simulator - *Programming using kit.   *(*Optional)*
Programming exercises which includes interfacing, using PIC micro controller.

TEXTBOOKS:
1. *Douglas V. Hall, "Microprocessors and Interfacing", Second edition, Tata McGraw Hill Publishing Company Limited, 2006.*
2. *T.R. Padmanabhan, "Introduction to Microcontrollers and their Applications", First Edition, Narosa Publishing House Private Limited, 2007.*

REFERENCE:
Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", Fifth Edition, Penram International Publishing (India) Private Limited, 2002.

EEE397   SEMINAR   0 0 2 1

Each student is to prepare a seminar paper related to Electrical Engineering in an approved format and present it at the end of the semester. No weekly slot to be allotted for presentation.

EEE431   POWER SYSTEM PROTECTION AND SWITCHGEAR   3 0 0 3

Unit 1
Nature, causes and consequences of faults - fault statistics - need for protection - essential qualities of protection - types of protection – primary and back up protection - basics of switchgear - fuses, isolators, earthing switches, circuit breakers - operating principle - arc phenomenon, principle and methods of arc extinction - arc interruption theories - arc voltage, restriking voltage, recovery voltage.

Unit 2
Types of circuit breaker - low voltage circuit breaker - miniature circuit breaker, earth leakage circuit breaker - high voltage circuit breaker - oil, air, SF6, vacuum circuit breakers - problems of circuit interruption - resistance switching - circuit breaker ratings - HVDC circuit breaker - auto reclosing - development of protective relays - recent developments - operating principle - classification of relays based

on construction - electromechanical relays, thermal relays, static relays, microprocessor-based relays, based on functions - current, voltage, power, differential, distance, pilot, and phase sequence relays.

Unit 3
Apparatus protection - generator, motor, transformer, busbar, feeder protection - overvoltage protection - lightning arresters - insulation co-ordination.

TEXTBOOK:
Ravindra P. Singh,"Switchgear and power system protection", Prentice Hall of India,2009
REFERENCES:
1. *A. S. Ingole, "Switchgear and protection" Umesh publication,2006*
2. *B. Ravindranath and M. Chander, "Power system protection and switchgear", New age International(P) Ltd.,2003*
3. *C. Christopoulos and A. Wright, "Electrical power system protection", Springer International edition,2010.*

EEE441   ELECTRIC DRIVES AND CONTROL   3 1 0 4
(Pre-requisite: EEE341)

Unit 1
Introduction**:** Concepts and classification of electric drives. Dynamics of electric drives: Types of loads, multi quadrant operations, motor dynamics steady state stability and transient stability. Rating and heating of motors: Heating effects, heating and cooling curves, classes of duty, load equalization, environmental factors.
DC motor drives: Basic characteristics, operating modes, Ward-Leornard system, single phase and three phase controlled rectifier fed DC drives, dual converters drives, chopper drives, rheostatic and regenerative braking, effects of changes in supply voltage and load torque, closed loop control schemes.

Unit 2
AC motor drives: Induction motor drives, stator voltage control, stator impedance control, rotor voltage control - slip power recovery, static Kramer drives and static Scherbius drive, V/f control, current control method. Closed loop control. Introduction to vector control scheme.

Unit 3
Synchronous motors: Speed torque characteristics and torque angle characteristics. Fixed and variable frequency operation modes, self control modes.
Special machines: Brushless DC motor, switched reluctance motor, introduction to the relevant converter circuits.

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

REFERENCES:
1. *Pillay. S.K, A First Course on Electric Drives, Wiley Eastern Limited, Bombay, 1987*
2. *B.K Bose, 'Power Electronics and AC Drives', Prentice Hall, New Jersey, 1986.*
3. *V. Subrahmanyam,' Thyristor Control of Electric Drives', Tata McGraw Hill , New Delhi, 1988.*
4. *R. Krishnan, 'Electric Motor Drives, Modeling, Analysis and Control', Prentice Hall, NJ, 2001.*
5. *Muhammad H. Rashid, Power Electronics, Circuits, Devices and Applications, Third Edition, Pearson Education Press, 2004.*

EEE450   OPTIMIZATION TECHNIQUES   3 0 0 3

Unit 1
Introduction to optimization - engineering application of optimization - statement of an optimization problem - optimal problem formulation - classification of optimization problem - optimality criteria - classical optimization techniques.
Non–linear programming I: One dimensional minimization methods. Unimodal functions - elimination methods - interpolation methods - implementations in a multivariable optimization problems.

Unit 2
Non-linear programming II: Unconstrained optimization techniques.
Classification - direct search methods: Random search method, grid search method, Powell's method, Simplex method - descent methods: Steepest descent method, conjugate gradient method, Newton's method, Marquardt method, DFP method, BFGS method.
Non-linear programming III: Constrained optimization techniques.
Lagrange multiplier techniques – Karush – Kuhn - Tucker optimality conditions, direct method: Random search method, complex method, Zoutendijk's method of feasible directions - indirect methods: Penalty function methods.

Unit 3
Modern methods of optimization - genetic algorithms - simulated annealing - ant colony optimization - Tabu search - neural – network based optimisation laboratory practice. Problems & programming exercise in C and Matlab.

TEXTBOOKS:
1. *Kalyanmoy Deb, "Optimisation for Engineering Design Algorithms and Examples" ,PHI,2000*
2. *Singiresu. S. Rao, "Engineering Optimization, Theory and Practice", New Age International publishers,1996.*

REFERENCE:
Ronald L. Rardin, "Optimization in Operations Research", Prentice Hall,1998.

EEE451   POWER SYSTEM STABILITY   3 0 0 3

Unit 1
Introduction to power system stability problem - basic concepts and definitions of rotor angle stability, voltage stability and voltage collapse - midterm and long term stability - classification of stability - small signal stability - fundamental concepts of stability of dynamic systems - small signal stability of a single machine infinite bus system - effects of excitation system.

Unit 2
Small signal stability of multi machine systems - characteristics of small signal stability problems - transient stability - an elementary view of transient stability - simulation of power system dynamic response - performance of protective relaying - case study.

Unit 3
Sub synchronous oscillations – introduction - torsional interaction with power system - voltage stability - basic concepts - voltage collapse - prevention of voltage collapse - midterm and long term stability - nature of system response severe upsets - case studies.
Methods of improving stability - transient stability enhancement - small signal stability enhancement.

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

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

EEE452   RENEWABLE ENERGY AND ENERGY CONSERVATION   3 0 0 3

Unit 1
Historical development of energy demand and supply systems. Impact of fossil fuel based systems. Energy scenario – global and national; Renewable energy potential – global and national. Renewable energy technologies – stand-alone, hybrid and grid-connected systems.
Solar energy: Solar radiation, its measurements and analysis. Solar angles, day length, angle of incidence on tilted surface, sunpath diagrams, shadow determination. Extraterrestrial characteristics, effect of earth atmosphere, measurement & estimation on horizontal and tilted surfaces.
Principle of photovoltaic conversion - dark and illumination characteristics, figure of merits of solar cell, efficiency limits, variation of efficiency with band-gap and temperature. Equivalent circuit. Crystalline and thin-film cells. Multi-junction cells.

Concentrated PV cell.

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

Small hydro power - resource assessment, environmental restrictions, SHP schemes – types, construction and equipment selection, load frequency control.

Unit 2

Wind energy: Atmospheric circulations. Wind shear and turbulence. Wind monitoring and resource assessment; Weibull parameters. Classification of wind regimes. Aerodynamic principles - lift and drag forces. Power coefficient and Betz limit. Types and characteristics of wind turbines.

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

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

Small WEGs – stand-alone and hybrid systems.

Unit 3

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

Energy conservation in electrical equipment: Energy efficient lighting – luminous efficiency of lamps, efficient lamps, energy conservation codes and lighting design. Energy conservation in motors – estimation of operating efficiency of industrial motors, right selection of motor ratings, energy efficient motors; auto-stop control, delta-star operation, voltage control; Energy conservation in variable speed operation of pumps and fans – demerits of mechanical resistance control, advantages of variable speed drives, specific energy consumption, system design using VSD.

TEXTBOOKS / REFERENCES:

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

EEE453   FLEXIBLE AC TRANSMISSION SYSTEMS   3 0 0 3

Unit 1

FACTS concept and general system considerations - transmission interconnections, flow of power in an AC system, loading capability, power flow and dynamic stability considerations of a transmission interconnection, basic types of FACTS controllers, IEEE definitions, FACTS devices in India and abroad.

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

Unit 2

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

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

Unit 3

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

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

Case studies of practical applications of various FACTS devices.

TEXTBOOK:

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

REFERENCES:

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

EEE454 **POWER SYSTEM CONTROL** **3 0 0 3**
(Pre-requisite: EEE332)

Unit 1

Introduction: System load variation: System load characteristics, Load curve - daily, weekly and annual, load duration curve, load factor, diversity factor. Overview of system control: Governor control, LFC, EDC, AVR, system voltage control, security control.

Real power – frequency control: Need for voltage and frequency regulation in power system, basic P-f and Q-V control loops. Fundamentals of speed governing mechanisms and modeling, regulation of two synchronous machines in parallel, LFC control of a single area and two area systems, static analysis.

Unit 2

Multi area systems, tie-line with frequency bias control of two-area and multi-area systems, state variable model.

Reactive power – voltage control: Typical excitation system, static and dynamic analysis, effect of generator loading, static shunt capacitor/reactor VAR compensator, synchronous condenser, tap-changing transformer, static VAR system, modeling, system level voltage control.

Unit 3

Economic dispatch: Incremental cost curve, co-ordination equations with loss and without losses, solution by iteration method. (No derivation of loss coefficients). Base point and participation factors. Economic controller added to LFC control.

Computer control of power systems: Energy control centers - system states and their transition, plant level and system level controls, recent trends of real-time control of power systems.

TEXTBOOK:

Olle I. Elgerd, "Electric Energy Systems Theory – An Introduction", Tata Mc Graw Hill Publishing Company, New Delhi, 2004.

REFERENCES:

1. Allen J. Wood and Bruce F. Wollenberg, "Power Generation, Operation and Control", John Wiley & Sons, 1984.

2. P. Kundur, "Power System Stability & Control", Mc Graw Hill Publications. Co., 1994.

3. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

4. A.K. Mahalanbis, D.P. Kothari and S.I. Ahson, "Computer Aided Power System Analysis and Control", Tata McGraw Hill Publishing Company, New Delhi, 1990.

5. L.K. Kirchmayer, "Economic Operation of Power System", John Wiley & Sons, 1953.

EEE455 **HIGH VOLTAGE ENGINEERING** **3 0 0 3**

Unit 1

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

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

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

Breakdown in composite dielectric.

Unit 2

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

Measurement of high voltages and currents - high DC, AC and impulse voltages, direct, alternating and Impulse currents.

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

1. C. L. Wadhwa , "High voltage Engineering", New age international (p) Ltd, Publishers,Reprint,2001

2. Kuffel. E and Abdullah. M, "High Voltage Engineering", Paragamon press, Oxford, London, 1970.

3. Gallghar P. J. and Pearmain A. J, "High voltage measurement, Testing and Design", John Wiley & Sons, NewYork, 1982.

4. Kuffel. E. and Zaengl. W. S, "High voltage Engineering. Fundamentals", Paragamon press, Oxford, London, 1986.

EEE456   **SPECIAL ELECTRIC MACHINES**   **3 0 0 3**

Unit 1

Introduction: Stepper motor, permanent magnet electrical motors: Permanent magnet materials, permanent magnet AC machine drives, permanent magnet DC motors, permanent magnet synchronous motors.

Unit 2

Brushless DC motor, construction, operating principle, EMF equation, torque equation, phasor diagram and torque & speed characteristics. Reluctance Motors: Synchronous reluctance motors.

Unit 3

Switched reluctance motors with sinusoidal excitation, reluctance motors with rectangular excitation. Linear electric machines: Linear induction motors, linear synchronous motors.

TEXTBOOK:

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

REFERENCES:

1. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives ", Clarendon Press, Oxford, 1989.

2. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford, 1989.

3. T. J. E. Miller (Ed.), "Electronic Control of Switched Reluctance Motor", Newman Power Engineering Series, 2001.

4. Paul Acamley, "Stepping Motor – A Guide to Theory and Practice", IEE London. 2002.

5. B. K. Bose, "Modern power electronics and AC drives", Prentice Hall of India, New Delhi.

EEE457   **UTILISATION OF ELECTRIC ENERGY**   **3 0 0 3**

Unit 1

Electric lighting - definition of terms; Types of lamps and characteristics; Lighting requirements; Illumination standards; Design of lighting.

Electric heating – comparison with other heating methods; Resistance heating, induction heating, arc furnace, dielectric heating; Electric welding – types, equipment and modern techniques.

Unit 2

Electrochemical processes - electrolysis. Electroplating. Electrodeposition. Extraction of metals. Electric drives - selection of motors in various applications; Electric drive systems in various industries; Speed control of motors; Variable speed drives.

Unit 3

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

Electric vehicles – types of electric vehicles and hybrid vehicles; motors and batteries for EV; Drive systems.

TEXTBOOK:

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

REFERENCES:

1. Soni, Gupta and Bhatnagar, "A Course in Electrical Power", Fourth Edition Dhanpat Rai & Sons, 1996

2. H Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai & Sons

3. C. James Erickson, "Handbook of Electrical Heating for Industry", IEEE Press, 1994

4. Howard B Cary and Scott C Helzer, "Modern Welding Technology", Prentice Hall, 2004

EEE458   **POWER CONVERTERS**   **3 0 0 3**
(Pre-requisite: EEE341)

Unit 1

DC-DC switched mode converters: Operating principles, steady state analysis for continuous and discontinuous current operations, performance calculations of buck converter, boost converter, buck–boost converter, cuk converter & full bridge converter - comparison of DC-DC converters.

Unit 2

Switched mode DC power supplies: Overview of linear and switched mode power supplies, other types of converters: Flyback converter, forward converter, push pull converter, half bridge converter & full bridge converter.

Unit 3

Design of snubbers, drive circuits, magnetics, voltage feed forward PWM control and current mode control, feedback compensators, unity power factor rectifiers. Introduction to resonant converters - classification of resonant converters - basic resonant circuit concepts. Zero current and Zero voltage switching. Simulation of DC-DC converters and complete SMPS systems.

TEXTBOOK:

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

REFERENCES:

1. Daniel W. Hart, 'Introduction to Power Electronics', Prentice Hall of India, 1997.

2. George C. Chryssis, 'High Frequency Switching Power Supplies', McGraw-Hill International, 1999.

3. Otmar Kit Genstein, 'Switched Mode Power Supplies', John Wiley & Sons, 1994.

4. *Abraham I. Pressman, 'Switching Power Supply Design', McGraw-Hill Company Inc, 1999.*
5. *Rashid,' Power Electronics circuits, Devices, and Applications', Third Edition, Pearson Education, 2003.*

EEE459   NETWORK SYNTHESIS   3 0 0 3

Unit 1
Network functions, two port parameters, interconnection of two ports, incidental dissipation, analysis of ladder networks.
Elements of realizability theory, causality and stability, Hurwitz polynomial, positive real functions, synthesis procedure.

Unit 2
Synthesis of one port network with two kind of elements, properties of LC immitance function, synthesis of LC driving point immitance, properties of RC driving point impedance, synthesis of RC and RL admittance, properties of RL impedance and RC admittance, synthesis of RLC function.

Unit 3
Elements of transfer function synthesis, properties of transfer function, zero of transfer function, synthesis of Y_{21} and Z_{21} with 1© termination, synthesis of constant resistive network.
Filter design, filter design principles, approximate problem, transient response of low pass filter, synthesis of low pass filter, magnitude and frequency normalization, frequency transformation.

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

EEE461   ADVANCED CONTROL THEORY   3 0 0 3
(Pre-requisite: EEE342)

Unit 1
State variable analysis and design: State models – solution of state equations – controllability and observability - pole assignment by state feedback – full and reduced order observers.
Nonlinear systems: Common types of non-linear phenomena – linearization – singular points – phase plane method – construction of phase trajectories.

Unit 2
System analysis by phase plane method – describing function method – describing

function of non-linear elements.
Stability analysis of non-linear systems: Stability analysis by describing function method – jump resonance – Liapunov's and Popv's stability criteria.
Optimal control: Problem formulation – necessary conditions of optimality – state regulator problem – Matrix Riccati equation – infinite time regulator problem.

Unit 3
Output regulator and tracking problems – Pontryagin's minimum principles – time - optimal control problem.
Adaptive control: Classification – model reference adaptive control (MRAC) systems – different configuration, classification, mathematical description – direct and indirect MRAC – self tuning regulator (STR) – different approach to self tuning, recursive parameter estimation, implicit and explicit STR.

TEXTBOOK:
Nagrath I. J., and Gopal, M., "Control System Engineering", Fourth Edition, New Age Publishing Company, 2006.

REFERENCES:
1. *Kirk D.E., "Optimal Control Theory-an Introduction", Prentice Hall Incorporated, 1970.*
2. *Chalam V.V., "Adaptive Control Systems", Marcel Dekker, Incorporated, 1987.*
3. *Stanley M. Shinners, "Modern Control System Theory and Design", John Wiley and Sons, 1998.*
4. *Gopal. M., "Modern Control System Theory", Second Edition, New Age International Private Limited, Reprint, 1995.*

EEE462   DIGITAL CONTROL SYSTEMS   3 0 0 3
(Pre-requisite: EEE342)

Unit 1
Sampled data - signal reconstruction, discrete transfer functions, discrete system stability frequency response analysis, models for sampled continuous systems, state space analysis of discrete time systems, errors and non-linearity due to quantization in ADC.

Unit 2
Discrete time sensitivity functions, internal model, principle for digital control, design by pole assignment. System identification, RLS method, minimum variance control, self tuning methods, dead beat control, state estimation, Luenberger observer,

Unit 3
Kalmann filter DSP based digital control SCADA, architecture and design, introduction to control system tool box. Design of state variables feedback systems, controllability and observability.

TEXTBOOK:

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

REFERENCES:

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

EEE463   PROCESS CONTROL AND INSTRUMENTATION   3 0 0 3

Unit 1

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

Unit 2

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

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

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

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

Unit 3

Model predictive control - batch process control - plant-wide control & monitoring - plant wide control design - instrumentation for process monitoring - statistical process control - introduction to Fuzzy logic in process control - introduction to OPC - introduction to environmental issues and sustainable development relating to process industries.

Process automation - role of digital computer system in process control, distributed instrumentation and control system - PLC, DCS, SCADA.

TEXTBOOK:

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

REFERENCES:

1. *Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, "Process Dynamics and Control", Wiley Dreamtech India (P) Ltd, New Delhi,2004*
2. *Shinskey, F.G., "Process Control Systems: Applications, Design and Tuning" Third Edition, McGraw Hill Book Co, 1988.*
3. *Ernest O. Doebelin "Measurement systems applications and design", McGraw – Hill International Editions, McGraw- Hill Publishing Company.*
4. *Gregory K. McMillan, Douglas M. Considine , "Process/Industrial Instruments and Controls Handbook", Fifth Edition, McGraw Hill 1999*
5. *B. Wayne Bequette, "Process control, modeling, Design and simulation", Prentice Hall of India (P) ltd.*
6. *Steve Mackay, Edwin Wright, John Park, "Practical Data Communications for Instrumentation and Control", Newness Publications, UK, 2003*

EEE464 OPTO-ELECTRONICS AND LASER INSTRUMENTATION 3 0 0 3

Unit 1

Introduction - characteristics of optical radiation, luminescence, irradiance - optical sources - photo detectors - opto-couplers and their application in analog and digital devices. Optical fiber fundamentals - modes, types of optical fibers - fiber coupling - fiber optic sensors for common industrial parameters - V, I, pressure, temperature - IR sources and detectors - fiber optic gyroscope   .

Unit 2

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

Unit 3

Material processing applications - laser heating, melting, scribing, splicing, welding and trimming of materials, removal and vaporization. Holographic Interferometry and applications **–** holography for non-destructive testing – medical applications - lasers and tissue interaction – surgery - dermatology .

TEXTBOOKS:

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

REFERENCES:

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

EEE471   EMBEDDED SYSTEMS DESIGN   3 0 0 3
(Pre-requisite: ECE310)

Unit 1
Embedded processors: Introduction to microprocessors – microcontrollers – digital signal processors - embedded processors – ARM cortex M3 processor - architecture - ARM instruction – addressing modes.

Unit 2
NXP's LPC17xx series microcontroller: Architecture - peripherals – input/output ports – timers – ADC – DAC - PWM. Serial protocols - UART, I²C, CAN, fire wire, USB, parallel protocols, PCI bus, ARM bus, wireless protocols, IrDA, bluetooth, IEEE 802.11. Application development using Keil IDE.

Unit 3
Real time embedded systems: Real time operating systems (RTOS) - task - task states – task management - scheduler - intertask communication and synchronization – exceptions and interrupts – time management - memory management – I/O subsystems. Commercial RTOS - uC/OS-II functions – porting RTOS on ARM boards.

TEXTBOOKS / REFERENCES:

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

EEE472   FUNDAMENTALS OF SOFT COMPUTING   3 0 0 3

UNIT 1
Basic concepts: Single layer perception, multi layer perception, supervised and unsupervised learning, back propagation networks, Kohnen's self organizing networks, Hopfield networks, distance measures.

Unit 2
Fuzzy sets: properties, membership functions, fuzzy operations, applications,

classification and regression tree, data clustering algorithms, rule based structure identification and regression trees, neuro fuzzy systems.

Unit 3
Simulated annealing: Evolutionary computing, survival of the fittest, fitness computation, cross over, mutation, reproduction, rank method, rank space methods, case studies on applications of soft computing.

TEXTBOOKS:

1. *Jang J. S. R, sun. C. T, Mizutani. E, "Neuro fuzzy and Soft Computing", Prentice Hall of India Private Limited,2002*
2. *Klir and Yuan, "Fuzzy sets and Fuzzy Logic; Theory and Applications", Prentice Hall of India Private Limited 2009.*

EEE473   DIGITAL SIGNAL PROCESSORS   3 0 0 3

Unit 1
TMS320C67xx: basic building blocks of a typical DSP processor – hardware multiplier – barrel shifter – MAC unit – modified Harvard architecture - pipelining. Architecture of TMS320C67xx DSP - instruction set – addressing modes.

Unit 2
Blackfin processor: Blackfin 5xx DSP – architecture - instruction set – addressing modes.

Unit 3
Programming using TMS320C67xx and Blackfin DSPs: Assembly language and C programming – integrated development environment - code composer studio and visual DSP++ - application development.

TEXTBOOK:

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

REFERENCES:

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

EEE474   DIGITAL IMAGE PROCESSING   3 0 0 3

Unit 1

Introduction: Introduction & applications, elements of visual perception, image sensing and acquisition, simple image formation, image sampling and quantization, representing digital epixels, image quality, introduction to colour image.

Image enhancement in spatial domain: Introduction to image enhancement, basic grey level transforms, histogram, histogram-processing equalization, matching & colour histogram, enhancement using arithmetic/logic operations, spatial filtering, smoothing spatial filtering, sharpening spatial filtering.

Unit 2

Image transform: Fourier transform, SHFT, DFT, FFT, DCT, Hadamard transform, wavelets transform (CWT, DWT), applications, other transforms.

Image enhancement in frequency domain: Smoothing frequency domain filtering, sharpening frequency domain filtering, a model for Image degradation/ restoration process, noise model, mean filtering and filtering, estimating degradation function, inverse filtering, minimum mean square error (wiener filter), color image smoothening, sharpening.

Unit 3

Segmentation & morphological operations: segmentation and threshold function, different algorithms in thresholding, line detection, edge detection, edge linking by graph search method, Hough transform, region based segmentation, matching, color segmentation, morphological-dilation and erosion, opening and closing, hit/miss transforms, representation boundary descriptors, regional descriptors.

TEXTBOOK:

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

EEE480   POWER SYSTEM MANAGEMENT   3 0 0 3

Unit 1

Introduction: Energy security, future of electricity, electricity acts and regulations.

Demand forecasting: Forecasting techniques and forecasting modelling.

Utility planning: Generation mix, conventional and non conventional generation, cogeneration, wheeling and banking, power pooling and trading, energy storage schemes. Concepts of smart grid.

Unit 2

Power system economics: Time value of money, methods of depreciation, payback calculation, cost-benefit analysis, internal rate of return, net present value, life cycle coating.

Power supply reliability: Power system reliability indices, reliability evaluation.

Unit 3

Energy management: Supply side management – issues and remedial measures.

Operation planning: Operation and maintenance, reactive power management, SCADA in power systems.

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

EEE481   ENERGY MANAGEMENT AND IT APPLICATIONS   3 0 0 3

Unit 1

Power sector in the country: Acts and policies, distribution reform, quality of supply and bench marking.

Principles of management: Aspects of management, customer relationship, management customer involvement conflict management.

Unit 2

Energy generation: Competitive market for generation, role of existing power industry, demand operation and reliability, renewable generation technologies, cost, distributed generation, case studies.

Deregulation of electric utilities: Reform motivation, separation of ownership and operation, independent system operators, retail providers.

Competitive market, distribution in a deregulated market, distribution automation.

Unit 3

Information technology application: Application of intelligent agents, evolutionary programming, virtual reality and artificial neural network to power engineering.

Application of internet to power system monitoring and trading, case studies. IT applications in smart grid.

TEXTBOOKS / REFERENCES:

1. *Loi Leilai (Ed),"Power System Restructuring and Deregulation: Trading, Performance and Information Technology", John Wiley publications, 2001.*
2. *IEEE working group on Distribution Automation (Edited) Distribution Automation, IEEE Tutorial Course 88EH0280-8-PWR, 1988.*
3. *Trippathi P.C., Reddy P.N.,"Principles of Management: Tata McGraw Hill, 2001.*
4. *Khan M.Y., Jain P.K., "Basic Financial Management", Second Edition, Tata McGraw Hill, 2005.*

EEE482   MANAGEMENT OF POWER DISTRIBUTION   3 0 0 3

Unit 1
Power sector in the country: Acts and policies, distribution reform, quality of supply and bench marking.
Principles of management: Aspects of management, customer relationship, management customer involvement conflict management.

Unit 2
Change management in power distribution: Change management: Concepts and processes, change requirement, emerging developments.
Communication skills and motivation: Communication issues and aspects, motivation issues and aspects, developing communication skills.

Unit 3
Financial management: Accounting principles, financial statements, financial analysis, cost management.

TEXTBOOKS/REFERENCES

1. *Trippathi P.C., Reddy P. N. "Principles of Management: Tata McGraw Hill, 2001.*
2. *Heinz Weihrich, Harold Koontz, "Management- A Global Perspective", Tenth Edition, Tata McGraw Hill, 2001.*
3. *Prasanna Chandra, "Financial Management-Theory & Practice", Sixth Edition, Tata McGraw Hill, 2004.*

EEE491   POWER SYSTEM SIMULATION LAB.   0 0 3 1

Development of software packages to calculate line parameters, load flow analysis, short circuit analysis, transient stability analysis, power system transients, load frequency dynamics and economic dispatch.
Mini projects using standard simulation software.

EEE492   POWER ELECTRONICS LAB.   0 0 3 1

SCR characteristics, MOSFET switching characteristics, AC phase control using SCR, Triac and Diac, single phase half controlled bridge converter, UJT relaxation oscillator for SCR triggering application, series inverter, single phase transistorized inverter, speed control of DC motor using chopper drive, simulation of full bridge converter, single phase single pulse width modulated MOSFET inverter, sinusoidal unipolar pulse width modulation,

EEE499   PROJECT   10 cr

The project shall be focused on the synthesis of the knowledge gained over the past seven semesters, by taking up a work of relevance to the area of specialization covering – design / development / realization / application / conceptual ideas / state-of-the-art technology. A report should be submitted in approved format before final examination.

EIE 413   BIOMEDICAL INSTRUMENTATION   3 0 0 3

Unit 1
Human anatomy and physiology: Systems of the body - cell resting potential and action potential - origin and characteristics of ECG, EEG, EMG, EOG, and ERG.
Electrodes and transducers: Biopotential electrodes - electrode-tissue interface, EEG, EMG electrodes – microelectrodes - biochemical transducers - optical biosensors.

Unit 2
Signal processing: Introduction, sampling, A/D conversion and signal to noise ratio and signal conditioning.
Recorders & monitors: Preamplifiers, sources of noise, amplifiers for ECG, EEG & EMG - design considerations - evoked potential systems - biomedical recorders.
Medical imaging techniques: Principle of X-ray machine, digital radiography, CT, MRI, ultrasonic imaging, PET and SPECT scanners, gamma camera.

Unit 3
Diagnostic & 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 - nebuliser, inhalator, aspirator, humidifier and ventilator. Telemetry and telemedicine, Laser application in medicine.
Electrical safety: Physiological effects of electricity, micro & macro shock hazards - electrical safety codes & standards - protection of patients, power distribution and equipment design.

TEXTBOOK:

Leslie Cromwell, Fred. J. Weibell, Erich. A. Pfeiffer, "Biomedical Instrumentation & Measurements", Second Edition, Pearson Education., 2001.

REFERENCES:

1. *John G Webster, "Medical Instrumentation-Application and Design", Fourth Edition, John Wiley and Sons, 2007.*
2. *R S Khandpur, "Handbook of Biomedical Instrumentation ", First Edition, Tata McGraw-Hill Publishing Company Limited, 2004.*

ENG111   COMMUNICATIVE ENGLISH   2 0 2 3

Objectives:

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

Unit 1

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

Unit 2

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

Unit 3

Practical sessions (listening & speaking)**:** Introduction to English pronunciation including minimal pairs and word stress – differences between British and American English – listening comprehension and note-taking.
Activities: Short speeches, seminars, quizzes, language games, debates, discussions and book reviews, etc.

TEXTBOOKS:

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

REFERENCES:

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

ENG112   TECHNICAL COMMUNICATION   2 0 2 3

Objectives:

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

Unit 1

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

Unit 2

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

Unit 2

Technical paper writing: Library research skills - documentation style - document editing – proof reading – formatting.
Practice in oral communication: Group discussion, interviews and technical presentations.

REFERENCES:

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

ENG250   PROFESSIONAL COMMUNICATION   1 0 2 2

Unit 1

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

Unit 2

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

Unit 3

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

REFERENCES:

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

ENG251   BUSINESS COMMUNICATION   1 0 2 2

OBJECTIVES:

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

Unit 1

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

Unit 2

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

Unit 3

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

Activities - case studies & role-plays

BOOKS RECOMMENDED:

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

ENG252   INDIAN THOUGHT THROUGH ENGLISH   1 0 2 2

Objectives:

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

Unit 1

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

Unit 2

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

Unit 3

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

Short Story:

REFERENCES:

1. *"The Golden Treasury of Indo-Anglian Poetry", Ed. V.K. Gokak (1923-1965)*
2. *"Ten Twentieth Century Indian Poets", by R. Parthasarathy, OUP, 1976.*
3. *"The Remains of the Feast" by Gita Haiharan from In Other Words; New Writing by Indian Women, ed. Urvashi Butalia and Ritu Menon, The Women's Press Limited, 34,Great Sutton Street, London.*
4. *"Three Plays of Rabindranath Tagore", OUP, Madras, 1979.*
5. *"An anthology of Popular Essays and Poems". Ed. A.G. Xavier, Macmillan India Ltd., 1988.*
6. *"Hymns of Darkness", 1976.*
7. *"Letters from a Father to His Daughter", Allahabad Law Journal Co. Ltd., Allahabad.*
8. *Vidya, intranet, Amrita Vishwa Vidyapeetham.*
9. *"Mashi" and Other Stories, Rupa and Co. Paperback – 2002.*
10. *"My India", Oxford University Press, New Delhi – 2000- paperback.*
11. *"Prison and Chocolate Cake", Victor Gollencz, London. Indian Edition, Jaico Publishing, Bombay*
12. *"Twelve Modern Short Stories", Macmillan Publication.*
13. *"Malgudi Days", R.K. Narayan, Indian Thought Publications, 1996, 23rd reprint 2007.*
14. *Diamond Dust and Other Stories, Anita Desai, Published by Vintage, 2001.*
15. *The Complete Works of Swami Vivekananda, Advaita Ashram, Calcutta.*

ENG253   INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE 1 0 2 2
(Pre-requisite: Nil;Equivalent course in 2007 curriculum: Nil)

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

Unit 1
Poetry
Seamus Heaney – Digging; Philip Larkin – Ambulances; W.B.Yeats - Prayer for my daughter; W. H Auden - Miss Gee; Peter Porter - Your Attention Please; Rabindranath Tagore 's poems "Defamation" and "Playthings".

Unit 2
Drama
Oscar Wilde - Importance of Being Earnest; Anton Chekov – Proposal; Scenes from the great tragedies of Shakespeare.

Unit 3
Essays
Bibhuti Mishra "When I took over from her"; R.K.Narayan "Junk"; M K Naik " The Postman's Knock",

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

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

ENV200   ENVIRONMENTAL STUDIES   3 1 0 4

Unit 1
Overview of the global environmental crisis; Biogeochemical cycles; Climate change and related international conventions and treaties and regulations; Ozone hole and related international conventions and treaties and regulations; Overpopulation; Energy crisis; Water crisis, groundwater hydrogeology, surface water resource development

Unit 2
Ecology, biodiversity loss and related international conventions, treaties and regulations; Deforestation and land degradation; Food crisis; Water pollution and related international and local conventions, treaties and regulations; Sewage domestic and industrial and effluent treatment; Air pollution and related international and local conventions, treaties and regulations; Other pollution (land, thermal, noise).

Unit 3
Solid waste management (municipal, medical, e-waste, nuclear, household hazardous wastes); Environmental management, environmental accounting, green businesses, eco-labeling, environmental ethics, environmental impact assessment; Constitutional, legal and regulatory provisions; Sustainable development;

TEXTBOOK:
"Environmental Studies - From Crisis to Cure" by R. Rajagopalan, Oxford University Press.2005,ISBN 0-19-567393-X.
REFERENCE BOOKS:
1. *G.T. Miller Jr., "Environmental Science", 11th Edition, Cenage Learning India Pvt. Ltd., 2008.*
2. *Benny Joseph "Environmental Studies", Tata McGraw-Hill Publishing Company Limited, 2006.*

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

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

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

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

TEXTBOOK:

Metro St Michel - Publisher: CLE international

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

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

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

Unit 3   University Restaurant
Inquiry; Express an opinion; Ask questions (continuation); Food, meals, taste, preferences; Nutrition, diet, choose a menu or diet, Expression of quantities (*beaucoup, peu*).
Grammar - Partitif (expressing quantity) (*du, de la, pas de*….); Comparison (plus ...que, moins….que, autant …que); Interrogation (continuation), inversion, *Est-ce que, qu'est-ce que ?.*

TEXTBOOK:

Metro St Michel - Publisher: CLE international

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

To have an elementary exposure to German language; specifically
1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;

4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.
(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.)

Some useful websites will be given.

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

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavour of this course is to activate this knowledge and develop the skill of communication.
Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

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

Some German culture. Films.

GER211   GERMAN FOR BEGINNERS I   1 0 2 2

Unit 1
Greetings; Introducing one-self (formal and informal context), saying their name, origin, living place, occupation.
Numbers 1-100; Saying the telephone number.
Countries and Languages.
Grammar: Structure – W - Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.
Vocabulary: Professions.

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

Unit 3
Number above 1000. Orientation in Shopping plazas: asking the price, where do I

find what, saying the opinion.
Grammar: Accusative – definite article. Adjectives and plural forms.
Vocabulary: Furniture and currencies.

GER212   GERMAN FOR BEGINNERS II   1 0 2 2

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

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

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

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

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads

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

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

REFERENCE:
The Bhagavad Gita, Commentary by Swami Chinmayananda

HUM251   INTRODUCTION TO INDIA STUDIES   1 0 2 2

Preamble:
This paper will introduce the students to the multiple dimensions of the contribution of India to

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

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

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

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

TEXTBOOK:
Material given by the Faculty
BACKGROUND LITERATURE:
1) *Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture (Kolkata) publication.*
2) *Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.*
3) *Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.*
4) *Outlines of Indian Philosophy, M. Hiriyanna, MLBD.*
5) *An Advanced History of India, R. C. Majumdar et al, Macmillan.*
6) *India Since 1526, V. D. Mahajan, S. Chand & Company*
7) *The Indian Renaissance, Sri Aurobindo.*
8) *India's Rebirth, Sri Aurobindo.*
9) *On Nationalism, Sri Aurobindo.*
10) *The Story of Civilization, Volume I: Our Oriental Heritage, Will Durant, Simon and Schuster, New York.*
11) *Eternal Values for a Changing Society, Swami Ranganathananda, Bharatiya   Vidya Bhavan.*
12) *Universal Message of the Bhagavad Gita, Swami Ranganathananda, Advaita Ashrama.*
13) *Awaken Children: Conversations with Mata Amritanandamayi*
14) *Indian Aesthetics, V. S. Seturaman, Macmillan.*
15) *Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.*
16) *Web of Indian Thought, Sister Nivedita*

17) *Essays on Indian Nationalism, Anand Kumaraswamy*
18) *Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi*
19) *The Invasion That Never Was, Michel Danino*
20) *Samskara, U. R. Ananthamurthy, OUP.*
21) *Hayavadana, Girish Karnard, OUP.*
22) *Naga-Mandala, Girish Karnard, OUP.*

HUM252   GLIMPSES OF ETERNAL INDIA   1 0 2 2

Unit 1
Introduction
A peep into India's glorious past
Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramarajya – Yudhisthira's ramarajya; Sarasvati - Sindhu Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmanya Dharma and the rise of Jainism and Buddhism – the sixteen Mahajanapadas and the beginning of Magadhan paramountcy – Kautilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2
India's contribution to the world: spirituality, philosophy and sciences
Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.
The arrival of Europeans, British paramountcy and colonization
What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wrecked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

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

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

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

REFERENCES:

1. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
2. *Somayaji, D.A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
3. *Sen, S.N. & K.V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
4. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
5. *Bose, D.M. et. al. A Concise History of Science in India. New Delhi: 1971.*
6. *Bajaj, Jitendra & M.D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
7. *Bajaj, Jitendra & M.D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
8. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
9. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
10. *Vivekananda, Swami. Selections from the Complete Works of Swami Vivekananda. Kolkata: Advaita Ashrama.*
11. *Mahadevan, T.M.P. Invitations to Indian Philosophy. Madras: University of Madras.*
12. *Hiriyanna, M. Outlines of Indian Philosophy. Motilal Banarsidass.*
13. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
14. *Majumdar, R.C. et. al. An Advanced History of India. Macmillan.*
15. *Mahajan, V.D. India Since 1526. New Delhi: S. Chand & Company.*
16. *Durant, Will. The Case for India. Bangalore: Strand Book Stall, 2008.*
17. *Aurobindo, Sri. The Indian Renaissance / India's Rebirth / On Nationalism.*
18. *Nivedita, Sister. The Web of Indian Life. Kolkata: Advaita Ashrama.*
19. *Durant, Will. The Story of Civilization. Volume 1 – Our Oriental Heritage. New York: Simon & Schuster.*
20. *Ranganathananda, Swami. Eternal Values for A Changing Society. Bombay: Bharatiya Vidya Bhavan.*
21. *Ranganathananda, Swami. Universal Message of the Bhagavad Gita. Kolkata: Advaita Ashrama.*
22. *Seturaman, V.S. Indian Aesthetics. Macmillan.*
23. *Coomaraswamy, Ananda K. The Dance of Shiva. New Delhi: Sagar Publications.*
24. *Coomaraswamy, Ananda K. Essays on Indian Idealism. New Delhi: Munshiram Manoharlal.*
25. *Danino, Michel. The Invasion That Never Was.*
26. *Kautilya. Arthasastra.*

27. *Altekar, A.S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
28. *Altekar, A.S. The Position of Women in Hindu Civilization. New Delhi: Motilal Banarsidass.*
29. *Sircar, D.C. Studies in the Religious Life of Ancient and Medieval India. New Delhi: Motilal Banarsidass.*
30. *Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times.New Delhi: Motilal Banarsidass.*
31. *Madhavananda, Swami & R.C. Majumdar eds. The Great Women of India. Kolkata: Advaita Ashrama.*
32. *Dutt, R.C. The Economic History of India. London, 1902.*
33. *Dharampal. Collected Works.*
34. *Dharampal. Archival Compilations (unpublished)*

HUM253   GLIMPSES INTO THE INDIAN MIND: 1 0 2 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.*

HUM254   GLIMPSES OF INDIAN ECONOMY AND POLITY   1 0 2 2

Unit 1
Introduction
General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.
Ancient India – up to 600 B.C.
Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusarthas; The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King (Sri Rama) and the ideal state (Ramarajya) – Yudhisthira's ramarajya; Sarasvati - Sindhu civilization and India's trade links with other ancient civilizations; Towards chiefdoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of the Indo-Gangetic plain.

Unit 2
Classical India: 600B.C. – 1200 A.D.
The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya's *Arthasastra;* Of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India's maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas
Medieval India: 1200 A.D. – 1720 A.D.
Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacy in the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.

Unit 3
Modern India: 1720 - 1947
the Indian market and economy before the arrival of the European traders;

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

Independent India – from 1947

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

Conclusion

REFERENCES:

1. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
2. *Kautilya. Arthasastra.*
3. *Altekar, A.S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
4. *Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times. New Delhi: Motilal Banarsidass.*
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17. *Sabavala, S.A. and R.M. Lala, eds. J.R.D. Tata: Keynote. New Delhi: Rupa & Co., 2004.*
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19. *Lala, R.M., For the Love of India: The Life and Times of Jamsetji Tata. New Delhi: Penguin, 2006.*
20. *Thapar, Romila. The Penguin History of Early India: From the Origins to AD 1300. New Delhi Penguin, 2002.*
21. *Majumdar, R.C., et. al. An Advanced History of India. Macmillan.*

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

Unit 1

Introduction

Western and Indian views of science and technology

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

Unit 2

Indian sciences

Introduction; Ancient Indian medicine: towards an unbiased perspective;

Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD

Science and technology under the British rule

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

Unit 3

Science and technology in Independent India

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

Building upon the Indian tradition

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

Conclusion

REFERENCES:

1. *Joseph, George Gheverghese. The Crest of the Peacock: Non-European Roots of Mathematics. London: Penguin (UK),2003.*
2. *Iyengar, C.N. Srinivasa. History of Hindu Mathematics. Lahore: 1935, 1938 (2 Parts).*
3. *Amma, T.A. Saraswati. Geometry in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
4. *Bag, A.K. Mathematics in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*

5. *Sarma K.V. & B.V. Subbarayappa. Indian Astronomy: A Source-Book. Bombay: Nehru Centre, 1985.*

6. *Sriram, M.S. et. al. eds. 500 Years of Tantrasangraha: A Landmark in the History of Astronomy. Shimla: Indian Institute of Advanced Study, 2002.*

7. *Bajaj, Jitendra & M.D. Srinivas. Restoring the Abundance: Regeneration of Indian Agriculture to Ensure Food for All in Plenty.Shimla: Indian Institute of Advanced Study, 2001.*

8. *Bajaj, Jitendra ed. Report of the Seminar on Food for All: The Classical Indian Discipline of Growing and Sharing Food in Plenty. Chennai: Centre for Policy Studies, 2001.*

9. *Bajaj, Jitendra & M.D. Srinivas. Annam Bahu Kurvita: Recollecting the Indian Discipline of Growing and Sharing Food in Plenty. Madras: Centre for Policy Studies, 1996.*

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17. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*

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

* The syllabus and the study material in use herein has been developed out of a 'summer programme' offered by the Centre for Policy Studies (CPS), Chennai at

the Indian Institute of Advanced Study (IIAS), Rashtrapati Nivas, Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M.D. Srinivas (Chairman) and Dr J.K. Bajaj (Director) of the CPS.

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

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

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

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

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

Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.
By the end of the semester they the students will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

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

Unit 1
Linear systems of equations, Gauss elimination, rank of a matrix, linear dependence. Solutions of linear systems: existence, uniqueness, general form, eigen values, eigen vectors, some applications of eigen value problems, symmetric, skew-symmetric and orthogonal matrices, complex matrices: Hermitian, Skew Hermitian, unitary, similarity of matrices, basis of eigen vectors, diagonalization. (Sections: 6.3, 6.4, 6.5, 7.1, 7.2, 7.3, 7.4, and 7.5)
Limits and continuity. (Sections (in textbook 1): 2.2, 2.3, 2.4, 2.5, 2.6)

Unit 2
Derivatives, curve sketching, improper integral. (Sections (in textbook 1): 3.1, 4.1, 4.3, 4.4, 8.8)
Basic concepts and ideas, exact differential equations, integrating factors, orthogonal trajectories of curves. (Sections: 1.1, 1.5, 1.8)

Unit 3
Reviewof linear differential equations and Bernoulli equation, modelling: mixing problem, electric circuits. Review of homogeneous linear equations of second order, Euler-Cauchy equations, solution by undetermined coefficients, solution by variation of parameters. System of linear equation, basic concepts and theory, homogeneous systems with constant coefficients, phase plane, critical points. Criterion for critical points and stabilty. (Sections: 1.6, 1.7, 2.1, 2.2, 2.3, 2.6, 2.9, 2.10, 3.1, 3.2, 3.3, 3.4)

TEXTBOOKS:

1. *'Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.*

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

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

Unit 1

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

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

Unit 2

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

Unit 3

Periodic functions, trigonometric series, Fourier series, functions of any period p = 2L, even and odd functions, half range expansions (theorem statement only), complex Fourier series, applications of Parseval's identity. (Sections: 10.1 to 10.5)
Basic concepts, modeling; vibrating string, wave equation, separation of variables, use of Fourier series, d'Alembert's solution of the wave equation, heat equation; solution by Fourier series. (Sections: 11.1 to 11.5)

TEXTBOOK:

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

MAT211   INTEGRAL TRANSFORMS AND COMPLEX ANALYSIS   3 1 0 4

Unit 1

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

Unit 2

Complex line integral, Cauchy integral theorem, Cauchy integral formula, derivatives of analytic functions. (Sections: 13.1, 13.2, 13.3, 13.4,)
Power series, Taylor series and Maclaurin series. Laurent series, zeros and

singularities, residues, Cauchy residue theorem, evaluation of real integrals using residue theorem. (Sections: 14.4, 15.1, 15.2, 15.3, 15.4)

Unit 3

Laplace transforms, inverse transforms, linearity, shifting, transforms of derivatives and Integrals, differential equations, unit step function, second shifting theorem, Dirac's delta function. Differentiation and integration of transforms. Convolution, integral equations, partial fractions, differential equations, systems of differential equations. (Sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7)
Fourier integrals (Fourier integral theorem statement only), Fourier cosine and sine transforms, Fourier transforms. (Sections: 10.8 to 10.10)

TEXTBOOK:

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

MAT212 MATHEMATICAL STATISTICS AND NUMERICAL METHODS 3 1 0 4

Unit 1

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

Unit 2

Confidence interval and central limit theorem, testing of hypothesis. (Sections: 23.3, 23.4)
Solution of equations by iterative methods, interpolation. (Sections: 17.2, 17.3)

Unit 3

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

TEXTBOOK:

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

MEC100   ENGINEERING MECHANICS   3 1 0 4

Unit 1

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

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

Unit 2

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

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

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

Unit 3

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

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

TEXTBOOKS:

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

REFERENCES:

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

MEC180   WORKSHOP A   1 0 2 2

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

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

Pneumatics and PLC workshop:

Study of pneumatic elements – design and assembly of simple circuits using basic pneumatic elements – design and assembly of simple circuits using electro-

pneumatics. Study of PLC and its applications – simple programming using ladder diagrams.

Sheet metal workshop:

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

Welding workshop:

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

Demo and practice workshop:

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

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

REFERENCES:

Concerned Workshop Manual

MEC181   ENGINEERING DRAWING   1 0 3 2

Use of drawing instruments – drawing practice – lettering – dimensioning – sketching.

Orthographic projections – projection of points; projection of lines; projection of planes; projection of solids.

Section of solids; Intersection of solids; development of surfaces.

Orthographic views of three-dimensional solids.

Isometric projection.

TEXTBOOK:

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

REFERENCES:

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

MEC182   COMPUTER AIDED DRAWING   1 0 3 2

Introduction to CAD

Preparation of drawings using CAD Tools

Introduction to VBA / LISP

Introduction to 3D modeling and Surface Modeling

TEXTBOOKS:

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

REFERENCES:

CADian Manual

MEC209   MECHANICAL ENGINEERING   4 0 0 4

Unit 1

Energy: Forms, sources and classification of energy. Utilization of energy with simple block diagrams.

Thermodynamics: Concepts of thermodynamic system, properties – specific volume, pressure, temperature - Zeroth law of thermodynamics, energy forms – work and heat. First law of thermodynamics – for a closed system undergoing a cycle, for a process, energy as a property, specific heats, first law applied to steady flow devices - second law of thermodynamics – concept of heat engines and refrigerators, Kelvin Planck and Clausius statements, irreversibilities, Carnot cycle.

Unit 2

I.C. engines: Classification, I.C. engines parts, 2/4 – stroke petrol and 4-stroke diesel engines. P-V diagrams of Otto and diesel cycles (no derivation for thermal efficiency). Simple problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency and specific fuel consumption.

Refrigeration and air conditioning: Refrigerants, properties of refrigerants, list of commonly used refrigerants. Refrigeration definitions - refrigerating effect, ton of refrigeration, ice making capacity, COP, relative COP, unit of refrigeration. Principle and working of vapor compression refrigeration. Principles and applications of air conditioners, room air conditioner

Water turbines: Classification, principles and operations of Pelton wheel, Francis turbine and Kaplan turbine

Mechanical power transmission systems: Belt, rope and gear drives – types, comparison and fields of application.

Lathe: Principle of working of a centre lathe. Parts of a lathe. Operations on lathe - turning, facing, knurling, thread cutting, drilling, specification of lathe.

Unit 3

Milling machine: Principle of milling, types of milling machines. Principle & working of horizontal and vertical milling machines.

Computer numerical control: Introduction to NC, CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning.

Robotics: History of robots, types of robots, robot configuration, types of joints: rotary, prismatic joint, cylindrical joint, spherical joint, robot sensors and robot applications.

TEXTBOOKS:

1. *Y. A. Cengel and Michael A. Boles, " Thermodynamics – An Engineering Approach", Tata McGrawHill, 2007*
2. *Narayana Pillai and C. R. Ramakrishnan, " Principles of Fluid Mechanics and Fluid Machines", University Press Ltd, 2003*
3. *Serope Kalpakjian and Steven R Schmid, "Manufacturing Engineering Technology', 5th edition, Prentice Hall, 2006.*
4. *Mikell P. Groover, "Automation, Production systems and computer integrated Manufacturing", 3rd edition, Prentice Hall of India, 2008*

REFERENCES:

1. *R. E. Sonntag, C. Borgnakke and G. J. Van Wylen, "Fundamentals of Thermodynamics", John Wiley and Sons, 2002*
2. *V.B. Bhandari, "Design of Machine Elements", Tata McGraw Hill, 2007*

MNG400   PRINCIPLES OF MANAGEMENT   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

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

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

TEXTBOOKS:

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

REFERENCES BOOKS:

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

PHY100   PHYSICS   3 0 0 3

Unit 1

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

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

Unit 2

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

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

PHY181   PHYSICS LAB.   0 0 3 1

Experiments on mechanics

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

Experiments on optics

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

Experiments on electricity

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

TEXTBOOK:

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

REFERENCE:

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

PHY250   ELECTRICAL ENGINEERING MATERIALS   3 0 0 3

Unit 1

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

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

Unit 2

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

Unit 3

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

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

TEXTBOOK:

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

REFERENCES:

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

PHY251   OPTOELECTRONIC DEVICES   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

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

REFERENCES:

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

PHY252   PHYSICS OF SEMICONDUCTOR DEVICES   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOKS:

1. *C Kittel, "Introduction to Solid State Physics", Wiley, 7ᵗʰ Edn., 1995.*

2. *DA Neamen, "Semiconductor Physics and Devices", TMH, 3ʳᵈ Edn., 2007.*

REFERENCES:

1. *SM Sze, "Physics of Semiconductor Devices", Wiley, 1996.*

2. *P Bhattacharya, "Semiconductor Opto- Electronic Devices", Prentice Hall, 1996.*

3. *MK achuthan & KN Bhat, "Fundamentals of Semiconductor Devices", TMH, 2007.*

4. *J Allison, "Electronic Engineering Materials and Devices", TMH, 1990.*

PHY253   ELECTROMAGNETIC FIELDS AND WAVES   3 0 0 3

Unit 1

Electrostatics: Coulombs law and electric field intensity, field due to a continuous volume charge distribution, field of a line charge, field of sheet of charge, electric flux density, Gauss's law, application of Gauss's law, Maxwell's first equation.
Poisson's and Laplace's equations: The potential field of a point charge, potential field of a system of charges :conservative property, potential gradient, the dipole.

Unit 2

Poisson's and Laplace's equations, uniqueness theorem, examples of the solution of Laplace's equation, solution of Poisson's equation.
Electromagnetics: Biot Savart law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, derivation of steady magnetic field laws, Faraday's laws, displacement current, Maxwells equations in point and integral form, retarded potentials

Unit 3

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

TEXTBOOK:

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

REFRENCES:

1. *David J Griffiths, "Introduction to Electrodyanamics", Prentice-Hall of India, New Delhi, 1999 (2nd edition).*

2. *J D Jackson, "Classical Electrodynamics", Weiley Eastern, 2004 (2nd edition).*

3. *B.Chakraborty, "Principles of Electrodynamics", Books and Allied Publishers, 2002*

PHY254   MICROELECTRONIC FABRICATION   3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

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

TEXTBOOK:

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

REFERENCE:

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

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

PHY255   ELECTRONIC MATERIALS SCIENCE   3 0 0 3

Unit 1
Types of bonding in solids, Crystallography and crystalline defects: Crystallography, Directions and planes, Crystalline defects, line defects, Planar defects, Volume defects; Binary and Ternary Phase Diagrams: Lever rule and phase rule, Eutectic, peretectic and Eutectoid systems, Applications of Phase diagrams; Basic Quantum Physics - atomic structure, Use of band theory and occupation statistics to explain existence and basic properties of metals and nonmetals. Working of Semiconductor Devices using band diagrams and their electrical characteristics: pn junctions, BJT, MOSFET.

Unit 2
Use of band theory to explain optoelectronic properties of materials and optoelectronic devices: LEDs, Solar Cells, Lasers, pin diodes, photodiodes; Magnetic properties and Superconductivity: Magnetic moments and Magnetic Permeability, types of magnetism, saturation magnetization, magnetic domains, soft and hard magnetic materials, superconductivty and its origin, Giant Magneto Resistance, Josephson effect, Energy band diagrams and Magnetism, Applications of magnetic materials- Magnetic recording materials, etc.

Unit 3
Optical Properties of Materials: Reflection, Refraction, Dispersion, Refractive Index, Snells Law, Light Absorption and Emission, Light Scattering, Luminescence, Polarization, Anisotropy, Birefringerence; Dielectric Properties of Materials: Polarization and Permittivity, Mechanisms of polarization, dielectric properties- dielectric constant, dielectric loss, dielectric strength and breakdown, Piezoelectricity, Ferreoelectricity, and Pyroelectricity, Dielectric Materials

TEXTBOOK:

S.O. Kasap, Principles of Electronic Materials and Devices, 2006, 3rd edition, Tata McGraw Hill.
REFERENCE:
D. Jiles: Introduction to the Electronic Properties of Materials, Chapman & Hall. 1994.

PHY260   PHYSICS OF LASERS AND APPLICATIONS   3 0 0 3

Unit 1
Review of some basic concepts and principle of laser.
Introduction to light and its properties: Reflection, refraction, interference, diffraction and polarization. Photometry – calculation of solid angle. Brewster's law. Snell's law and, its analysis.
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 Dw FWHM . natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.
Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3
Types of LASERS
Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS. gas LASER: (i) He-Ne LASER - principle, construction, working and application. (i) CO_2 LASER - principle, construction, working and application.
Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi conductor diode LASERS.
Applications in Communication field:
LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.
Applications of LASERS in other fields:
Holography: Principle, types, intensity distribution, applications. laser induced fusion. Harmonic generation. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

REFERENCES:

1. *William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).*
2. *BB Laud, "Lasers and Non linear Optics", New Age International (P) Ltd., New Delhi.*
3. *Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).*

4. *KR Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.*

5. *T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).*

PHY261   LASERS IN MATERIAL PROCESSING   3 0 0 3

Unit 1

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

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

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

Unit 2

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

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

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

Unit 3

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

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

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

REFERENCES:

1. *Steen, WM, Laser Material Processing (3rd Edition), Springer Verlag, 2003, ISBN 1852336986.*

2. *Silvast, WT, Laser Fundamentals, Cambridge University Press, 1998, ISBN 0521556171.*

3. *J. F. Ready, D.F. Farson. LIA Handbook of Laser Materials Processing Laser Institute of America, 2001.*

4. *M. von Allmen. Laser-Beam Interactions with Materials, Springer, 1987*

5. *D. Bauerle. Laser Processing and Chemistry, Springer, 2000*

6. *W.W. Duley, UV lasers : effects and applications in materials science, Cambridge University, Press, Cambridge ; New York, 1996.*

7. *J. Dutta Majumdar, and I. Manna, Laser Material Processing, Sadhana, Vol. 28, Year: 2003, 495-562.*

PHY262   NON-LINEAR DYNAMICS   3 0 0 3

Unit 1

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

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

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

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

Unit 2

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

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

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

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

Unit 3

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

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

Fractals: Cantor sets, curves, trees, gaskets, sponges, landscapes.

Calculations of fractal dimension: similarity, capacity and correlation dimensions, entropy, BDS statistic, minimum mutual information, practical considerations.

Fractal measure and multifractals: convergence of the correlation dimension, multifractals, examples and numerical calculation of generalized dimensions.

Non-chaotic fractal sets: affine transformations, iterated functions systems, Mandelbrot and Julia sets.

Spatiotemporal chaos and complexity: examples, cellular automata, coupled map lattices, self-organized criticality**.**

TEXTBOOK:

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

REFERENCES:

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

PHY263 CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY 3 0 0 3

Unit 1

Introduction

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

Concept of quantum confinement and phonon confinement

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

Unit 2

Tools for characterization:

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

Nanoscale materials – properties and applications:

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

Unit 3

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

Nanoelectronics and nanodevices:

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

TEXTBOOKS:

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

PHY264   THIN FILM PHYSICS   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

Mechanical behaviors: stress, adhesion, hardness, stiffness.

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

TEXTBOOK:

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

REFERENCES:

1. *L.T. Meissel and R.Glang, "Hand book of thin film technology", McGraw Hill, 1978.*
1. *A.Goswami, "Thin Film Fundamentals ", New Age International, Pvt Ltd, New Delhi, 1996.*
2. *O.S.Heavens "optical Properties of Thin Films" by, Dover Publications, newyork 1991.*

3. *Milton Ohring "Materials science of thin films deposition and structures", Academic press, 2006.*
4. *Donald L.Smith "Thin Film deposition principle and Practice", McGraw –Hill international Edition, 1995.*

PHY270   MEDICAL PHYSICS   3 0 0 3

Unit 1
Ultrasonics - production methods and properties - acoustic impedance - Doppler velocimetry - echo cardiography – resolution – speckle - ultrasound imaging - therapeutic use of ultrasound - use in diagnostics of cardiac problems.
X-rays – production – intensity - hard and soft X-rays - characteristic and continuous X-ray spectrum - attenuation of x-rays by hard and soft tissues – resolution – contrast X-ray imaging - fluoroscopy modes of operation - image quality - fluoroscopy suites - radiation dose – computed-aided tomography (CAT)

Unit 2
Nuclear medicine - principles of nuclear physics – natural radioactivity, decay series, type of radiation and their applications, artificially produced isotopes and its application, accelerator principles; Nuclear Isomerism, internal conversion - ideal energy for radiotherapy based on interactions. Radionuclide used in medicine - radioisotope production – dosimetry – safety - radiation hazards – PET.
Nuclear magnetic resonance physics - magnetic moment – magnetization – relaxation - nuclear magnetic resonance spectroscopy.

Unit 3
Nuclear magnetic resonance imaging (MRI) – principle - chemical shift - magnetic resonance signal induction and relaxation - pulse sequencing and spatial encoding.
Laser physics – characteristics of laser radiation, mode locking - power of laser radiation - lasers as diagnostic tool - lasers in surgery - laser speckle, biological effects, laser safety management.

TEXTBOOK:

Hendee W R and Rittenour E E, "Medical Imaging Physics", John Wiley & Sons, Chicago, 2001.
REFERENCE BOOKS
1. *Glasser.O.Medical Physics Vol.1, 2, 3 Book Publisher Inc Chicago, 1980*
2. *Jerraold T Bush Berg etal, The essentials physics of medical imaging, Lippincott Williams and wilkins(2002)*

PHY271   ADVANCED CLASSICAL DYNAMICS   3 0 0 3

Unit 1
Introduction to Lagrangian dynamics
Survey of principles, mechanics of particles, mechanics of system of particles,

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

Unit 2
Central field problem
Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.
Rotational kinematics and dynamics
Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body.

Unit 3
Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.
Practical rigid body problems
Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite maneuvering and attitude control - coning maneuver - Yo-yo despin mechanism - gyroscopic attitude control, gravity-gradient stabilization.

TEXTBOOKS:
1. *H. Goldstein, Classical Mechanics, Narosa Publishing House, New Delhi, 1980, (Second Edition)*
2. *H. Goldstein,Charles Poole, John Safko, Classical Mechanics, Pearson education, 2002 (Third Edition)*
3. *Howard D. Curtis, Orbital Mechanics for Engineering Students, Elsevier, pp.475 — 543*
4. *Anderson.John.D, Modern Compressible flow, Mc Graw Hill.*
REFERENCE BOOKS:
1. *D. A. Walls, Lagrangian mechanics, Schaum Series, McGrawHill, 1967.*
2. *J. B. Marion and S. T. Thornton, Classical dynamics of particles and systems, Ft. Worth, TX: Saunders, 1995.*

PHY272   QUANTUM PHYSICS AND ITS APPLICATIONS   3 0 0 3

Unit 1
Review of Planck's relation, De-Broglie relation and uncertainty principle basic concepts - Schrodinger equation: probabilistic interpretation of wave function, one dimension problems – particle in a box, harmonic oscillator, potential barrier and tunneling. Hydrogen atom, electrons in a magnetic field - X-ray spectra - periodic table.

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:

A Beiser, Perspectives in Modern Physics,Mc Graw Hill

REFERENCES;

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

PHY273   COMPUTATIONAL PHYSICS   3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

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

TEXTBOOK:

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

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

PHY274   ASTROPHYSICS   3 0 0 3

Unit 1

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

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

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

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

Unit 2

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

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

Unit 3

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

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

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

REFERENCES:

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

SSK111   SOFT SKILLS I   0 0 3 1

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

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

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

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

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

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

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

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

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

TEXTBOOKS:

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

REFERENCES:

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

SSK112   SOFT SKILLS II   0 0 3 1

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

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

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

Reading comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving level – III: Money related problems; Mixtures; Symbol based problems; Clocks and calendars; Simple, linear, quadratic and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics.

Data sufficiency: Concepts and problem solving.

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

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

TEXTBOOKS:

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

REFERENCES:

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

SSK113   SOFT SKILLS III   0 0 3 1

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

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

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

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

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

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

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

TEXTBOOKS:

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

REFERENCES:

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