## 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)

Experiment for Demonstration

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

### CHY250 CATALYTIC CHEMISTRY 3 0 0 3

Unit 1

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

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

Unit 2

Catalysis by macromolecules, Phase transfer catalysis.

**Catalysis by Enzymes:** Introduction - kinetics of enzyme catalyzed reaction,

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

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

Unit 3

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

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

***TEXTBOOKS:***

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

***REFERENCES:***

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

## CHY251 CHEMISTRY OF ENGINEERING MATERIALS 3 0 0 3

Unit 1

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

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

Unit 2

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

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

**Photochemistry in Electronics:** Photochemical reactions - laws of absorption





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

Unit 3

Florescence and Phosphorescence - chemiluminescence - photo sensitization.

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

***TEXTBOOK:***

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

***REFERENCE:***

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

## CHY252 CHEMISTRY OF ADVANCED MATERIALS 3 0 0 3

Unit 1

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

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

Unit 2

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

Unit 3

**Functional electro active polymers:** Conjugated polymers - synthesis, processing and doping of conjugated polymers: polyacetylene, polyaniline, polythiophene, poly (p-phenylenevinylene) - ionically conducting polymers - applications of conjugated polymers. Semi-conducting, poly ferrocene - photo resist

optical fibers and sensors, photo chromic & thermo chromic materials.

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

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

***TEXTBOOKS:***

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

***REFERENCES:***

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

## CHY253 ADVANCED POLYMER CHEMISTRY 3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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





***TEXTBOOKS:***

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

***REFERENCES:***

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

## CHY254 POLYMERS FOR ELECTRONICS 3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

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

***TEXTBOOK:***

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

***REFERENCE:***

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

**CHY255 CHEMISTRY OF TOXICOLOGY 3 0 0 3**

Unit 1

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

Unit 2

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

Unit 3

**Toxicant Analysis and Quality Assurance Principles:** Introduction to procedures, principles and operation of analytical laboratories in toxicology. Summary of the general policies - analytical laboratory operation, analytical measurement systems, quality assurance (QA) - quality control (QC) procedures.
**Environmental Risk Assessment:** Environmental risk assessment procedures - particular environmental risk problem - appropriate endpoints - development of conceptual models, analyzing exposure – effects, information - characterizing exposure - ecological effects - management of risks.
**Future Considerations for Environmental and Human Health:** Changes in toxicology - evaluation of future risk assessment - more fundamental aspects of toxicology - in vivo and in vitro toxicity - biochemical toxicology - molecular toxicology - development of selective toxicants.

***TEXTBOOK:***

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

***REFERENCES:***

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





**CHY256 CHEMISTRY OF NANOMATERIALS 3 0 0 3**

Unit 1

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

Unit 2

Langmuir-Blodgett (LB) technique, chemical vapour deposition, plasma arcing and ball milling.
**Carbon nanostructures:** Carbon Clusters: Fullerenes, structure, synthesis, alkali doped $C_{60}$ - superconductivity in $C_{60,}$ applications of fullerenes. Carbon nanotubes: Classification, properties, synthesis, characterization, and potential applications, growth mechanism of carbon nanotubes.
**Other Nanostructures:** Quantum Dots: Preparation, properties and applications of Au, CdS and CdSe quantum dots,

Unit 3

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

***TEXTBOOKS:***

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

***REFERENCES:***

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

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

## CHY257 BIOMATERIALS SCIENCE 3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

***TEXTBOOK:***

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

***REFERENCES:***

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

## CHY258 ENVIRONMENTAL CHEMISTRY 3 0 0 3

Unit 1

**Air and air pollution (earth's atmosphere):** Regions - ozone - CFC and other





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

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

Unit 2

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

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

Unit 3

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

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

***TEXTBOOKS:***

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

***REFERENCES:***


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


## CHY259 INSTRUMENTAL METHODS OF ANALYSIS 3 0 0 3

Unit 1

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

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

Unit 2

Gas chromatography - principle and applications – gel chromatography.

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

Unit 3

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

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

***TEXTBOOKS:***


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






***REFERENCES:***


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


## CHY260 ORGANIC SYNTHESIS AND STEREOCHEMISTRY 3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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

***TEXT BOOKS:***


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


***REFERENCES:***


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


## CHY261 UNIT PROCESSES IN ORGANIC SYNTHESIS 3 0 0 3

Unit 1

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

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

Unit 2

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

Unit 3

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

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

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

***TEXTBOOK:***

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

***REFERENCES:***

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

## CHY262 MEDICINAL ORGANIC CHEMISTRY 3 0 0 3

Unit 1

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

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

Unit 2

**Enzymes and hormones:** Enzymes - nomenclature, classification and





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

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

Unit 3

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

***TEXTBOOKS:***

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

***REFERENCES:***

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

## CHY263 ORGANIC REACTION MECHANISMS 3 0 0 3

Unit 1

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

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

Unit 2

Michael and 1,4-addition reaction - Favorskii rearrangement - benzilic acid

rearrangement - reaction mechanism in basic media - Mannich reaction - enols and enolates.

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

Unit 3

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

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

***TEXTBOOK:***

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

***REFERENCES:***

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

## CHY264 GREEN CHEMISTRY AND TECHNOLOGY 3 0 0 3

Unit 1

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

Unit 2

Greener strategies of the synthesis of ibuprofen synthesis, teriphthalic acid etc.





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

Unit 3

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

***REFERENCES:***

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

## CHY270 CORROSION SCIENCE 3 0 0 3

Unit 1

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

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

Unit 2

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

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

**Corrosion Inhibitors:** Passivators - Vapour phase inhibitor.

Unit 3

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

**Corrosion protection:** Automobile bodies – engines – building construction.

***TEXTBOOKS:***

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

***REFERENCES:***

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

## CHY271 ELECTROCHEMICAL ENERGY SYSTEMS AND PROCESSES 3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

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





***TEXTBOOKS:***

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

***REFERENCES:***

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

## CHY272 COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING 3 0 0 3

Unit 1

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

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

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

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

Unit 2

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

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

Unit 3

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

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

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

***TEXTBOOKS:***

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

***REFERENCES:***

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

## CHY273 FUEL CELLS - PRINCIPLES AND APPLICATIONS 3 0 0 3

Unit 1

**Introduction:** relevance, importance and classification of fuel cells.

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

Unit 2

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

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





Unit 3

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

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

***TEXTBOOK:***

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

***REFERENCES:***

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

## CHY274 SOLID STATE CHEMISTRY 3 0 0 3

Unit 1

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

Unit 2

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

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

Unit 3

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

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

*REFERENCES:*


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


## CSE100 COMPUTER PROGRAMMING 3 0 0 3

Unit 1

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

Unit 2

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

Unit 3

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

***TEXTBOOK:***


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






***REFERENCES:***


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


## CSE180 COMPUTER PROGRAMMING LAB. 0 0 3 1

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

## CSE360 INTRODUCTION TO DATA STRUCTURES AND ALGORITHMS 3 0 0 3

(Pre-requisite: CSE100)

Unit 1

**Linear data structures:** time and space complexity, stacks and queues – implementation and applications. Linked lists – singly linked lists, doubly linked lists, circular lists and application of linked lists. Non-linear data structures: trees - representation and traversals, binary trees, binary search trees - operations, graphs – representation and traversals - BFS, DFS.

Unit 2

**Sorting and searching:** Bubble sort, selection sort, Insertion sort, quick sort, radix sort, merge sort, heaps – binary heap and its application, linear and binary search.

Unit 3

**Storage management and garbage collection:** fixed block storage allocation, first fit storage allocation, storage release, buddy systems, garbage collection - compaction. Algorithm design techniques: greedy algorithms, divide and conquer method, dynamic programming, backtracking.

***TEXTBOOKS:***

1. *Jean Paul Tremblay and Paul G. Sorenson, "An Introduction To Data Structures With Applications", Second Edition, Tata McGraw-Hill., 2001*
2. *Mark Allen Weiss, "Data structures and Algorithm Analysis in C++", Second Edition, Pearson Education, 2001.*

***REFERENCES:***

1. *Adam Drozdek," Data Structures and Algorithms in C++", Second Edition, PWS Publishing, 2002.*
2. *Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", McGraw-Hill 2000.*

## CSE380 INFORMATION TECHNOLOGY ESSENTIALS 3 0 0 3

Unit 1

Computer hardware and system software concepts: computer architecture, system software, operating systems, computer networking. programming fundamentals: problem solving concepts, modular approach 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 - AN INDIAN PERSPECTIVE 1 0 2 2

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

Unit 1

**Goals of Life – Purusharthas**

What are Purusharthas (Dharma, Artha, Kama, Moksha); Their relevance to Personal life; Family life; Social life; & Professional life; Followed by a Goal setting workshop;

**Yogic way of Achieving Life Goals** – (Stress Free & Focused Life)

Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop);

**Experiencing life through its Various Stages**

Ashrama Dharma; Attitude towards life through its various stages (Teachings of Amma);

Unit 2

**Personality Development**

What is Personality – Five Dimensions – PanchaKosas (Physical/ Energy/Mental/ Intellectual/ Bliss); Stress Management &Personality; Self Control & personality; Fundamental Indian Values & Personality;

**Learning Skills (Teachings of Amma)**

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

**Communication Skills - An Indian Perspective;**

Unit 3

**Developing Positive Attitude & Friendliness**- (Vedic Perspective);

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

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

***REFERENCE BOOKS:***


1. *Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9*
2. *Complete works of Swami Vivekananda (Volumes 1 to 9)*
3. *Mahabharata by M.N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)*
4. *Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modern needs) by Swami Ranganathananda. (Volumes 1 to 3)*







5. *Message of Upanishads, by Swami Ranaganathananda published by Bharatiya Vidya Bhavan, Bombay.*
6. *Personality Development – Swami Vivekananda published by Advaitha Ashram, Kolkatta.*
7. *Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development- Swami Budhananda published by Advaitha Ashram, Kolkatta*
9. *Ultimate Success - Swami Ramakrishnananada Puri published by Mata Amritanandamayi Math, Kollam*
10. *Yoga In Daily Life - Swami Sivananda – published by Divine LIife Society*
11. *Hindu Dharma - H.H. Sri Chandrasekharandra Saraswati published by Bharatiya Vidya Bhavan, Bombay*
12. *All about Hinduism – Swami Sivananda - Published by Divine Life Society*
13. *The Mind and its Control by Swami Budhananda published by Advaitha Ashram, Kolkatta*
14. *Krida Yoga - Vivekananda Kendra, Publication.*
15. *Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi*
16. *New perspectives in Stress Management - Dr H R Nagendra & Dr R Nagaratna published by Swami Vivekananda Yoga Prakashana, Bangalore.*
17. *Mind Sound Resonance Technique (MSRT) published by Swami Vivekananda Yoga Prakashana, Bangalore.*
18. *Yoga & Memory - Dr H R Nagendra & Dr.Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.*


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

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

Unit 1

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

Unit 2

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

Unit 3

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

***TEXTBOOK:***

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

***REFERENCE**:*

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

## CUL153 EXCELLENCE IN DAILY LIFE 1 0 2 2

Unit 1

1 The anatomy of 'Excellence'. What is 'excellence'? Is it judged by external factors like wealth?
2 The Great Flaw. The subject-object relationship between individual and world. Promote subject enhance excellence.
3 To work towards excellence, one must know where he is. Our present state.. An introspective analysis. Our faculties within.

Unit 2

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

Unit 3

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

***REFERENCES:***

*The Bhaja Govindam and the Bhagavad Gita.*

## CUL154 YOGA PSYCHOLOGY 1 0 2 2

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

Unit 1

**Introduction**





**Introduction to Modern Psychology**

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

**Introduction to Indian Psychology**

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

**Patanjali Yoga Sutra – 1**

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

**Patanjali Yoga Sutra – 2**

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

Unit 2

**Patanjali Yoga Sutra – 3**

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

**Patanjali Yoga Sutra – 4**

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

**Patanjali Yoga Sutra – 5**

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

**Patanjali Yoga Sutra – 6**

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

**Patanjali Yoga Sutra – 7**

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

Unit 3

**Patanjali Yoga Sutra – 8**

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

**Patanjali Yoga Sutra – 9**

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

**Patanjali Yoga Sutra – 10**

Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery

over the senses.

**Report review**

**Conclusion**

***REFERENCES:***


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


## ECE100 ELECTRONICS ENGINEERING 3 0 0 3

***Objective:*** *To understand the working of basic electronic devices such as diodes, BJTs and FETs; Introduce the student to the operation and design of fundamental building blocks of electronic systems like power supplies, amplifiers and oscillators; Develop skills to analyze specifications of simple electronic circuits and carry out their design.*

Unit 1

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

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

Unit 2

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

Unit 3

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





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

***TEXTBOOK:***

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

***REFERENCES:***


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


## 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.*

## ECE211 ELECTRONIC CIRCUITS I 3 0 1 4

(Pre-requisite: ECE100)

Unit 1

**Diode and its applications:** Review of diode characteristics, diode models, physics of diode operation, design of clipper and clamper circuits, voltage multiplier circuits. **MOS field effect transistors:** Introduction, device structures and physical operation, IV characteristics, brief analysis as an amplifier and as a switch. Biasing, small signal operation models, single stage MOS amplifiers, MOSFET capacitances and high frequency model.

Unit 2

**BJT:** Introduction – device structures and physical operation, IV characteristics, BJT as an amplifier and as a switch, brief Idea of dc analysis, biasing circuits, single stage BJT amplifiers, BJT internal capacitances and high frequency model.

Unit 3

**Integrated circuit amplifiers:** Current sources, current mirrors and current steering circuits, high frequency response basics, CS and CE amplifiers with active loads, high frequency response of CS and CE amplifiers, common gate and common base amplifiers with active loads, Cascode amplifiers, source and emitter follower, CE and CS amplifiers with emitter(source) degeneration, transistor pairings. **Power amplifiers:** Analysis and comparison of power amplifiers.

***TEXTBOOKS:***

1. *Adel. S. Sedra, Kenneth C. Smith, "Microelectronic Circuits", Fifth Edition, Oxford University Press, 2005.*
2. *Sundaram Natarajan, "Microelectronics, Analysis and Design", First Edition, Tata McGraw Hill Publishing Company Limited, 2006.*

***REFERENCES:***

1. *Schilling, Belove, "Electronic Circuits", Third Edition, Tata McGraw Hill Publishing Company Limited, 2006.*





2. *Richard. C. Jaeger, "Microelectronic Circuit Design", Second Edition, Tata McGraw Hill Publishing Company Limited, 2006.*
3. *NIIT, "Electronic Circuits, Principles, Operation and Design", Second Edition, Prentice Hall India Private Limited, 2006.*

## 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.*

**ECE290 DIGITAL SYSTEMS LAB. 0 0 3 1**

1. Realization of basic logic functions using universal logic gates.
2. Construction of simple decoder & multiplexer circuits using logic gates.
3. Design of combinational circuits for BCD to decimal conversion to drive 7-segment display using multiplexer.
4. Construction of simple arithmetic circuits–adder, subtractor using logic gates, multiplexers, decoders
5. Realization of RS-JK and D flip flops, universal register
6. Realization of synchronous and asynchronous up and down counter.
7. Adder circuit using shift register and full adder.

**ECE291 SIGNALS AND SYSTEMS LAB. 0 0 3 1**

1. Periodicity and non periodicity of continuous time and discrete time signals
2. Even and odd components of continuous time and discrete time signals.
3. Generation and operation of signals.
4. Experiments on LTI systems.
5. Response of discrete time system such as zero input, zero state, total response.
6. Sampling and reconstruction of signal. Quantization and S/N ratio of a signal.
7. Convolution Integral and convolution sum of a continuous time and discrete time signals.
8. Fourier transforms Fourier series, DTFT, DTFS of a continuous time and discrete time signals.
9. Z-Transform and Laplace transform of a continuous time and discrete time signals systems.

**ECE292 DIGITAL SIGNAL PROCESSING LAB. 0 0 3 1**

DFT computation - computational experiments with digital filtering - DSP processor implementation - sampling & waveform generation - FIR & IIR filters implementation - Fast Fourier transforms - quantization noise - adaptive filters – multirate signal processing - Mini project.

**ECE293 ELECTRONIC CIRCUITS LAB. I 0 0 3 1**

1. Linear power supply
2. Operational amplifier circuits
3. Wave form generation using op- amp

4. Instrumentation amplifier, IC power amplifier
5. High power amplifier
6. Precision rectifier
7. Familiarization with simulation software.

## ECE310 INTRODUCTION TO MICROCONTROLLERS AND APPLICATIONS 3 1 0 4

(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 - $E^2$PROM.

**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.*





## ECE311 ELECTRONIC CIRCUITS II 3 1 0 4

(Pre-requisite: ECE211)

Unit 1

**Introduction:** Basic BJT and MOS differential pairs – differential and common mode gains and input impedances, CMRR.

**Feedback:** Introduction, properties of negative feedback, basic topologies, analysis of ideal and practical voltage-shunt and voltage series configurations, closed loop frequency response.

Unit 2

**Operational amplifiers:** Ideal Op-amp, practical Op-amp, inverting configuration, non-inverting configuration, differential configuration, practical Op-amp parameters, open-loop and closed-loop frequency response, gain-bandwidth product, slew rate, CMRR.

**Op-Amp applications:** Adder, integrators, differentiators, voltage comparators, Schmitt trigger, peak detector, sample and hold circuit, precision rectifier circuits. Data converter circuits **-** D/A converters: binary weighted type, R-2R ladder type, A/D converters: feedback type converter, flash converter.

Unit 3

**Oscillators, filters and tuned amplifiers:** Principle, Op amp RC oscillators, monostable, bistable and astable multivibrator, filters: filter transmission, types and specifications, transfer function, design of Butterworth and Chebyshev filters, tuned amplifiers.

***TEXTBOOK:***

*Adel.S.Sedra, Kenneth.C.Smith, "Microelectronic Circuits", Fifth Edition, Oxford University Press, 2005.*

***REFERENCES:***

1. *Schilling, Belove, "Electronic Circuits", Third Edition, Tata McGraw Hill Publishing Company Limited, 2006.*
2. *Richard.C.Jaeger, "Microelectronic Circuit Design", Second Edition, Tata McGraw Hill Publishing Company Limited, 2006.*
3. *Donald.E.Neaman, "Electronic Circuit, Analysis and Design", Second Edition, Tata McGraw Hill Publishing Company Limited, 2006.*

## ECE312 MICROPROCESSORS 3 0 0 3

(Pre-requisite: ECE210)

Unit 1

**Architecture of 8085 microprocessor:** Functional block diagram – registers, ALU, bus systems – timing and control signals – machine cycles and timing diagrams.

**Programming of 8085:** Instruction formats – addressing modes – instruction set - need for assembly language - development of assembly language programs.

Unit 2

**Memory interfacing:** Interface requirements – address space partitioning – buffering of buses – timing constraints - memory control signals – read and write cycles – typical EPROM, RAM Interfacing.

**I/O interfacing:** Memory mapped I/O scheme – I/O mapped I/O scheme – input and output cycles – simple I/O ports – programmable peripheral interface (8255). Data transfer schemes – interfacing simple keyboards and LED displays.

Unit 3

**Interrupts:** Interrupt feature – need for interrupts - characteristics of Interrupts – types of Interrupts – interrupt structure – methods of servicing interrupts - development of interrupt service subroutines – multiple interrupt requests and their handling – programmable Interrupt controller (8259).

***TEXT BOOK:***

*Ramesh S Goankar, "Microprocessor Architecture: Programming and Applications with the 8085 ", Fifth Edition, Penram International, 2002.*

***REFERENCES:***

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

## ECE313 VLSI DESIGN 3 1 0 4

(Pre-requisite: ECE210)

Unit 1

**Introduction to VHDL:** Design units VHDL statements - data flow – behavioural - structural modeling – library - package - subprograms function - procedure – generics – configuration.

**An overview of VLSI:** Basic concepts of VLSI design, MOSFETs: basic physics, I-V characteristics and models, MOSFETs as switches, NMOS and CMOS physical layouts and stick diagrams.

Unit 2

**Physical structure of integrated circuits:** NMOS and CMOS layers, designing FET arrays, FET sizing and unit transistor, physical design of logic gates and design hierarchies.

**Analysis of MOS logic gates:** DC switching characteristics of NMOS and CMOS inverters, DC characteristics of NAND and NOR gates, transient response, gate design for transient performance





Unit 3

**Designing high speed CMOS logic networks:** Gate delays, driving large capacitive loads, logical effort, BiCMOS drivers, clocking and data flow control - advanced techniques in CMOS logic circuits: Mirror circuits, pseudo-NMOS, tristate circuits, clocked CMOS, dynamic CMOS logic circuits, dual-rail logic networks.

***TEXTBOOKS:***

1. *David A Hoges, Horace Jackson, Resve Saleth, " Analysis and Design of Digital Integrated Circuits", Third Edition, McGraw Hill Publishing Company Limited, 2003*
2. *D.A. Pucknell, K. Eshrghian, "Basic VLSI Design", Third Edition, Prentice Hall India Private Limited, 1994.*

***REFERENCES:***

1. *Peter J. Ashenden, "The Designer's Guide to VHDL", Second Edition, Morgan Kaufmann; 2001*
2. *Sung-Mo Kang, Yusuf Leblechi, "CMOS Digital Integrated Circuits- Analysis and Design", Third Edition, Tata McGraw Hill Publishing Company Limited, 2003.*

## ECE351 IMAGE PROCESSING 3 0 0 3

(Pre-requisite: ECE220)

Unit 1

**Review of matrices**: Order, matrix operation, diagonal matrix, identity matrix, symmetric matrix, inverse, rank.

**Review of vector spaces**: Row vector, column vector, linearly independent, vector norms, orthogonality, eigen values, eigen vectors. Covariance of matrices.

**Review of probability and random variables**: set, probability, random variables, expected value and moments, Gaussian pdf, multivariate Gaussian density, linear transformation of random variables, random process.

**Introduction**: The origins of digital image processing - examples of fields that use DIP.

**Image digitization & sampling**: Elements of visual perception brightness & contrast - image sensing & acquisition - image sampling & quantization - some basic relationships between pixels.

**Image enhancement in spatial domain**: Image enhancement in the spatial domain - some basic gray level transformations - histogram processing - enhancement using arithmetic/logic operations - basics of spatial filtering - smoothing and sharpening spatial filters.

Unit 2

**Image enhancement in frequency domain**: Review of sampling and discrete fourier transform - image enhancement in the frequency domain – introduction - smoothing - sharpening, frequency domain filtering - homomorphic filtering.

**Color image processing fundamentals:** Color image processing - Pseudo color image processing - basics of full-color image processing.

Unit 3

**Image compression:** Fundamentals - image compression models - error-free compression - lossy compression – applications of image compression.

**Image transforms**: Introduction to transformation used for Image processing applications - cosine – Hadamard – Haar – sine - KL transforms & their properties.

***TEXTBOOK:***

*Rafael C. Gonzalez, "Digital image processing", Third Edition, PHI Private Limited, New Delhi, 2008*

***REFERENCE:***

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

## ECE376 EMBEDDED SYSTEMS 3 0 0 3

(Pre-requisite: ECE210)

Unit 1

**Hardware fundamentals**: Introduction to embedded sytems – application areas – hardware/software architectures of embedded system – compiling, linking and locating – downloading and debugging – emulators and simulators – types of memory – flash memory – built-in on the microprocessor – control and status register – device drivers and its design – CISC /RISC – RTOS and architectures – selecting an architecture.

Unit 2

**Processor design for an embedded system:** Single purpose processor design – peripherals - optimizing the processor, program, FSMD, data path, FSM – general purpose processor design - architecture – programmer's view – development environment - ASIP's – digital signal processors - selecting an microprocessor.

Unit 3

**High performance RISC architecture:** ARM processor, ARM architecture, ARM organization and implementation – ARM instruction set - THUMB instruction set – basic ARM assembly language program, ARM CPU cores.

**Real time operating systems:** Tasks and task states – mutexes and semaphores – shared data – message queues – mail boxes and pipes – memory management – interrupt routine – encapsulating semaphores and queues – hard real time scheduling – power saving.

**Case studies: Embedded C programming** Multiple closure problems, basic outputs with PPI – controlling motors – bidirectional control of motors – H bridge – telephonic systems - inventory control systems.

***TEXTBOOKS:***

1. *David E. Simon, "An Embedded Software Primer", Pearson Education, 2003.*
2. *Steave Furber, "ARM system On Chip Architecture", Addison Wesley, 2000.*





***REFERENCES:***

1. *Arnold S. Berger, "Embedded System Design", CMP Books, USA 2002.*
2. *Michael Barr, "Programming Embedded Systems with C and GNU", O Reilly, 2003.*
3. *Frank vahid, Tony givargis "Embedded system design a uniform hardware/software introduction", John Wiley & sons*

## ECE377 DIGITAL IC DESIGN 3 0 0 3

(Pre-requisite: ECE210)

Unit 1

**Mixed logic circuits:** Entered variable K-map minimization, multiple output minimization, resubstitution, decomposition, factorization**;** non-arithmetic combinational logic with EV K-maps, arithmetic logic with EV K-maps, carry look ahead adder, carry save adder, propagation delay & timing defects in combinational logic.

Unit 2

**Multilevel minimization and optimization:** Lumped path delay diagram, binary decision diagram (BDD), reduced ordered BDD.

**Synchronous state machine:** Design & analysis of simple state machines, state assignment, state reduction techniques, detection and elimination of output races, glitches, static hazards.

Unit 3

**Asynchronous state machine -** design & analysis of simple state machines, state assignment, state reduction techniques, ASM charts.

**Fault analysis and detection:** Boolean difference method and path sensitization method.

***TEXTBOOK:***

*Richard F. Tinder, "Engineering Digital Design", Academic Press, 2000.*

***REFERENCES:***

1. *Eugene Fabricius, "Modern Digital Design & Switching Theory", CRC Press, 1992.*
2. *Samuel C. Lee, "Digital Circuits and Logic Design", Prentice Hall India Private Limited, 2006.*
3. *Morris Mano, "Digital Design", Third Edition, Pearson Education,*

## ECE390 MICROCONTROLLER LAB. 1 0 3 2

1. Programming PIC microcontroller
2. Programming 8051 microcontroller
3. Programming exercises which include interfacing using PIC Micro controller.

**ECE392 VLSI DESIGN LAB. 0 0 3 1**

1. Simulation of digital logic circuits using VHDL: adder – multiplexer – decoder – encoder - flip-flop – counters - shift registers.
2. Design and simulation of schematics and layouts using front-end VLSI tools**:** inverter – adder – MUX – encoder - flip-flop – counters - shift registers.

**ECE450 DIGITAL SIGNAL PROCESSORS AND APPLICATIONS 3 0 0 3**

(Pre-requisite: ECE220)

Unit 1

**Programmable architecture:** Review of digital signal processing concepts. Basic architectural features, DSP communicational building blocks, bus architecture & memory data addressing capabilities, address generation unit, programmability & program execution, speed Issues, features for external interfacing.

Unit 2

**Programmable digital signal processors:** Commercial digital signal processing devices, data addressing modes of TMS320C54XX digital signal processors, data addressing modes of TMS320C54XX processors. Memory space of TMS320C54XX processors, program control, TMS320C54XX instruction & programming, on-chip peripherals, interrupts of TMS320C54XX processors, pipeline operation of TMS320C54XX processors.

**Implementation of basic DSP algorithms**: The Q notation, FIR filters, IIR filters interpolation of filters. Decimation filters. PID controller, adaptive filters, 2-D signal processing. FFT algorithm for DFT computation, butterfly computation overflow and scaling, Bit reversed index generation. FFT implementation on the TMS320C54XX, Computation of signal spectrum.

Unit 3

**Interfacing concepts:** Memory space organization, external bus interfacing signals, memory interface, parallel I/O interface programmed I/O interrupts and I/O. Direct memory access (DMA). Synchronous serial interface, a multi–channel buffered serial port (Mc.BSP). Mc.BSP programming CODEC interface circuit, CODEC programming. CODEC-DSP interface.

***TEXTBOOK:***

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

***REFERENCES:***

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





**ECE451 INTRODUCTION TO SOFT COMPUTING 3 0 0 3**

(Pre-requisite: MAT212)

Unit 1

**Basic concepts:** Single layer perceptron - multi layer perceptron - supervised and unsupervised learning - back propagation networks - Kohnen's self-organizing networks – hop field 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 - data clustering algorithms - rule based structure identification – neuro-fuzzy systems.

Unit 3

**Evolutionary computing:** Simulated annealing, survival of the fittest – fitness computation – cross over - mutation – reproduction – rank method – rank space methods. Case studies on applications of soft computing.

***TEXTBOOK:***

*J S R Jang, C T Sun, E Mizutani, "Neuro–Fuzzy and Soft Computing", Prentice Hall India Private Limited, 2002.*

***REFERENCES:***

1. *Timothy J Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.*
2. *D E Goldberg, "Genetic Algorithm", Addison Wesley, 1994.*
3. *S Rajashekaran, G A Vijalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall India Private Limited, 2003*

**ECE452 ADAPTIVE SIGNAL PROCESSING 3 0 0 3**

(Pre-requisite: ECE220)

Unit 1

**Adaptive systems:** Definition and characteristics, areas of application, general properties, open-loop and closed-loop adaptations, applications of closed-loop adaptation, example of an adaptive system.

**Stochastic processes and models:** Partial characterization of discrete-time stochastic process, mean Ergodic theorem, correlation matrix, stochastic models, wold decomposition, asymptotic stationary of an autoregressive process, Yule-Walker equations, power spectral density, properties of power spectral density, transmission of a stationary process through a linear filter, cramer spectral representation for a stationary process, power spectral estimation.

Unit 2

**Wiener filters:** Linear optimum filtering: principle of orthogonality, minimum mean-square error, Wiener-Hopf equations, error-performance surface, multiple linear regression model.

**Linear prediction:** Forward linear prediction, backward linear prediction, Levinson-Durbin algorithm, properties, Schur-Cohen test.

**Method of steepest descent:** basic idea of the steepest-descent algorithm, the steepest-descent algorithm applied to the Wiener filter, stability.

Unit 3

**Least-mean-square (LMS) adaptive filters:** Overview of the structure and operation of the LMS algorithm, LMS adaptation algorithm, applications, statistical LMS theory, comparison of the LMS algorithm with the steepest-descent algorithm.

**Method of least squares:** Statement, data windowing, principle of orthogonality, minimum sum of error squares, normal equations and linear least square filters, time average correlation matrix, singular value decomposition. Introduction to RLS algorithm and Kalman filtering.

*TEXTBOOK:*

*Simon Haykin, "Adaptive Filter Theory", Fourth Edition, Pearson Education, 2002.*

*REFERENCES:*

1. *John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, "Theory and Design of Adaptive Filters", Prentice Hall India Private Limited, 2004.*
2. *Bernard Widrow and Samuel. D. Stearns, "Adaptive Signal Processing", Pearson Education, 2001.*

## ECE453 BIOMEDICAL SIGNAL PROCESSING 3 0 0 3

(Pre-requisite: ECE220)

Unit 1

**Introduction:** Computers in medicine; human anatomy and physiology; cell structure; origin of bio electric potentials; biomedical signals. Review of discrete time signals and systems; DFT and Z transforms.

**Neurological signal processing:** The brain and its potentials; electrophysiological origin of brain waves; EEG signal and its characteristics; EEG analysis; linear prediction theory; autoregressive (AR) method; recursive estimation of AR parameters; spectral error measure; adaptive segmentation; transient detection and elimination. Sleep EEG data acquisition and classification of sleep stages; the Markov model and Markov chains; dynamics of sleep – wake transitions.

Unit 2

**Adaptive interference/noise cancellation:** Principle of adaptive filter; steepest-descent algorithm; the Widrow-Hoff LMS adaptive algorithm; adaptive noise canceller





- canceling donor-heart interference in heart transplant electrocardiography, cancellation of electrocardiography signal from the electrical activity of the chest muscles, cancellation of high frequency noise in electro-surgery.

Unit 3

**Cardiological signal processing:** ECG data acquisition; ECG lead system; ECG parameters and their estimation, arrhythmia analysis monitoring; ECG recording. ECG data reduction techniques, direct data compression techniques; direct ECG data compression techniques; transformation compression techniques. Prony's method of exponential modeling; exponential parameter estimation; clinical applications of Prony's method.

***TEXTBOOKS:***

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

***REFERENCE:***

*Leslie Cromwell, "Biomedical Instrumentation and Measurements", Second Edition, Prentice Hall India Private Limited, 2005.*

## ECE454 SPEECH PROCESSING 3 0 0 3

(Pre-requisite: ECE221)

Unit 1

**Introduction:** Speech signal, digital speech processing, digital transmission and storage of speech, speech synthesis systems, speaker verification and identification, speech recognition systems, aids-to-the-handicapped, enhancement of signal quality.

**Digital models for speech signal:** Introduction, process of speech production, acoustic theory, lossless tube models, digital model for speech signals.

Unit 2

**Time domain models for speech processing:** Time dependent processing of speech, short-time energy and average magnitude, average zero-crossing rate, speech vs. silence discrimination, pitch period estimation, short-time autocorrelation function, average magnitude difference function, pitch period estimation.

**Short–time fourier analysis:** Introduction, interpretation in terms of fourier transforms and linear filtering, sampling rates of $X_n(e^{j\omega})$ in time and frequency, filter bank summation and overlap addition methods for short time synthesis, modifications to the short-time spectrum, additive modifications, basic model for short-time analysis and synthesis of speech, design of digital filter banks - practical considerations, design of IIR and FIR filters, implementation of filter banks - FFT

approach. Digital coding of time - dependent fourier transform - phase Vocoder - channel Vocoder.

Unit 3

**Homomorphic speech processing:** Homomorphic systems for convolution (computational considerations), the complex cepstrum of speech, pitch detection, formant estimation, homomorphic Vocoder.

**Linear predictive coding of speech:** Basic principles, autocorrelation method, computation of gain, solution of the LPC equations - Durbin's recursive solution, applications of LPC parameters for pitch detection, formant analysis; an LPC Vocoder - quantization considerations, voiced-excited LPC Vocoders, linear prediction analyzer.

***TEXTBOOK:***

*Lawrence R. Rabiner, Ronald.W.Schafer, "Digital Processing of Speech Signals", Pearson Education, 2003.*

***REFERENCES:***

1. *M. Kondoz,* ***"Digital Speech: Coding for Low Bit Rate Communication Systems",*** *John Wiley and Sons, 2004.*
2. *Thomas. F. Quatieri, "Discrete-time Speech Signal Processing: Principles and Practice," Pearson Education, 2003.*
3. *Lawrence R. Rabiner and Bernard Gold, "Theory and Application of Digital Signal Processing", Prentice Hall India Private Limited, 2001.*

## ECE455 WAVELET-BASED SIGNAL PROCESSING AND APPLICATIONS 3 0 0 3

(Pre-requisite: ECE220)

Unit 1

**Fourier transform, STFT and introduction to wavelet:** Short time fourier transform, continuous wavelet transform, discrete wavelet transform with haar bases, daubechies wavelet system and their design.

Unit 2

**Filter banks and wavelets**: Introduction to biorthogonal wavelets, frequency domain approach, wavelet packets, M-band wavelet and multiwavelets, lifting schemes, ridgelets and curvelets.

Unit 3

**Applications:** Image compression using wavelets, JPEG standard-quantization, entropy coding, EZW coding, speech, audio, compression, feature extraction, denoising applications of wavelet, communication applications of wavelet, medical and biomedical signal and image processing.





***TEXTBOOK:***

*K. P. Soman and Ramachandran, "Insight into wavelets from theory to practice", Third Edition, Prentice-Hall India, 2010*

***REFERENCES:***

1. *Gilbert Strang,Truong Nguyen, "Filter banks", Wellesly-Cambridge Press, 1997.*
2. *Raghuveer M. Rao and Ajith S. Bopardikar, "Wavelet Transforms, Theory and Applications", Addison Wesley, 1999.*
3. *Burrus, S. C. Ramesh, A. Gopinath and Haitao Guo, "Introduction to wavelets and wavelet transforms- A primer", Prentice Hall, 1997.*

## ECE456 SPOKEN LANGUAGE PROCESSING 3 0 0 3

(Pre-requisite: ECE220, ECE221)

***Objectives:***

*The course is expected to give the student a detailed understanding of how the signal processing concepts learned in the previous semesters can be used in practical applications such as text to speech synthesis, speech coding for telecommunication and speech recognition applications.*

Unit 1

Speech analysis: source filter modeling, speech sounds, lip radiation, linear prediction, lattice filters, Levisnon-Durbin recursion.

Feature extraction for speech processing: short term fourier transform, wavelets, cepstrum, sinusoidal and harmonic representations, mel frequency cepstral coefficients (MFCC), perceptual linear prediction (PLP), mel filterbank energies, use of temporal patterns (TRAPS) in speech processing.

Unit 2

Principles of speech coding: main characteristics of a speech coder, key components of a speech coder, from predictive coding to CELP, improved CELP coders, wide band speech coding, audio-visual speech coding.

Speech synthesis: linguistic processing, acoustic processing, training models automatically, text pre-processing, grapheme to phoneme conversion – rule based and decision tree approaches, syntactic prosodic analysis, prosodic analysis, speech signal modelling.

Unit 3

Principles of speech recognition: Hidden Markov models (HMM) for acoustic modeling, observation probability and model parameters, HMM as probabilistic automata, Viterbi algorithm, language models, n-gram language modeling, and difficulties with the evaluation of higher order n-grams and solutions.

Spoken keyword spotting approaches, evaluation metric, spoken language identification – approaches, acoustic, phonotactic, LVCSR based.

***TEXTBOOKS:***

1. *Joseph Mariani (Ed), "Spoken Language Processing", John Wiley & Sons, 2009.*
2. *Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, "Spoken Language Processing, A guide to theory, algorithm and system development", Prentice Hall, Inc, New Jersey, USA, 2001*

## ECE457 PATTERN RECOGNITION TECHNIQUES AND ALGORITHMS 3 0 0 3

(Pre-requisite: MAT212)

Unit 1

**Introduction:** Applications of pattern recognition, statistical decision theory, image processing and analysis.

**Probability:** Introduction, probability of events, random variables, joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators.

Unit 2

**Statistical decision making:** Introduction, Bayes' theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving-one-out technique, characteristic curves, estimating the composition of population.

**Nonparametric decision making:** Introduction, histograms, kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminant functions, minimum squared error discriminant functions, choosing a decision making technique.

Unit 3

**Clustering:** Introduction, hierarchical clustering, partitional clustering.

**Processing of waveforms and images:** Introduction, gray level scaling transformations, equalization, geometric image scaling and interpolation, smoothing transformations, edge detection, Laplacian and sharpening operators, line detection and template matching, logarithmic gray level scaling, the statistical significance of image features.

*TEXTBOOK:*

*Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall India Private Limited, 2003.*

*REFERENCES:*

1. *Christopher.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.*
2. *Keppel, Brown, Welch, "Forensic Pattern Recognition", Prentice Hall India Private Limited, 2007.*





## ECE458 KERNEL METHODS IN SPOKEN LANGUAGE PROCESSING 3 0 0 3

(Pre-requisite: ECE220, ECE221)

***Objectives:***

*The course is expected to help the student understand the concepts of Kernel methods and its applications. An introduction into vector spaces and linear algebra is aimed to refresh the basic concepts necessary for a good understanding of the course. Finally, an application of Kernel methods to spoken language processing with a case study of how it is used for speaker recognition will be discussed.*

Unit 1

Introduction: Vector spaces, inner product spaces, Hilbert spaces, operators – eigen values and eigen vectors, solution to linear equations, classification vs regression, dual representation of linear machines.

Kernel induced feature spaces: implicit mapping into feature space, making kernels, characterization of kernels, reproducing kernel Hilbert spaces, making kernels from kernels, making kernels from features, kernels and Gaussian processes.

Unit 2

Optimization theory: Problem formulation, Lagrangian theory, duality, Gaussian mixture models, expectation – maximization (EM) algorithm for training.

Support vector machines: classification, maximal margin classifier, soft margin optimization, linear programming SVM, SVM regression.

Unit 3

Applications for kernel methods for spoken language processing: traditional approaches to speech processing, potential problems of the probabilistic approach, support vectors for binary classification, introduction to speaker recognition, text and language independence, type of errors, evaluation metric, DET and EER, cost function – weighted error rate, applications, Gaussian mixture models for feature extraction, SVM for speaker identification.

***TEXTBOOKS:***

1. *Nello Cristianini, and John Shaw Taylor, "An Introduction to support vector machines, and other Kernel based learning methods", Cambridge University Press, 2000.*
2. *Joseph Mariani (Ed), "Spoken Language Processing", John Wiley & Sons, 2009.*
3. *Joseph Keshet, Samy Bengio (Eds), "Automatic Speech and Speaker Recognition: Large Margin and Kernel Methods", John Wiley & Sons, 2009.*

***REFERENCE:***

*Bernhald Scholkopf, and Alexander J Smola, "Learning with Kernels: Support vector machines, regularization, optimization and beyond", The MIT Press, Cambridge, Massachusets, 2001.*

**ECE476 ANALOG IC DESIGN 3 0 0 3**

(Pre-requisite: ECE211)

Unit 1

**Introduction to analog integrated circuits:** Analog integrated circuit design, notation, symbols and terminology, analog signal processing, example of analog VLSI mixed signal circuit design.

**CMOS technology:** Basic MOS semiconductor fabrication process, PN junction, the MOS transistor, passive components, other considerations of CMOS technology, integrated circuit layout - CMOS device modeling, simple MOS large signal model, other MOS large signal model parameter, small signal model for the MOS transistor, computer simulation model, sub threshold MOS model, SPICE simulation of MOS circuit.

Unit 2

**Analog CMOS sub circuits:** MOS switch, MOS diode/active resistor, current sinks and sources, current mirror, current and voltage reference, band gap reference - CMOS amplifier, inverter, differential amplifier, Cascode amplifier, current amplifier, output amplifier, high gain amplifier architecture.

Unit 3

**CMOS operational amplifier:** Design of CMOS op-amps, compensation of op-amps, design of two stage op-amps, power supply rejection ratio of two stage op-amps, Cascode op-amps, simulation and measurement of op-amps, Marco models for op-amps.

***TEXTBOOK:***

*P. Allen and D. Holberg, "CMOS Analog Circuit Design", Second Edition, Oxford University Press, 2002*

***REFERENCES:***

1. *B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001*
2. *D. Johns and K. Martin, "Analog Integrated Circuit Design", First Edition, John Wiley and Sons, 1997*
3. *P. Gray, P. Hurst, S. Lewis, and R.G. Meyer, "Analysis and Design of Analog Integrated Circuits", Fourth Edition, John Wiley and Sons, 2001*

**ECE477 VLSI TECHNOLOGY 3 0 0 3**

(Pre-requisite: ECE311)

Unit 1

**Properties of crystals:** Crystal structure, crystal growth and epitaxy.

Unit 2

**Processing technology:** Unit processes for VLSI-oxidation, photolithography,





diffusion and ion implantation. Deposition of metal and dielectric films by vacuum evaporation, sputtering and CVD techniques, metallization, models and simulations. Wet and dry etching techniques.

Unit 3

**Device and circuit fabrication:** Isolation techniques, self aligned processes. Resistors and capacitors, MOS based silicon ICs-NMOS and CMOS ICs. Memory devices, SOI devices, BJT based ICs $I^2L$ and ECL transistors - BICMOS technology.

***TEXTBOOK:***

*Gary. S. May and S.M. Sze, "Fundamentals of semiconductor fabrication", First Edition, John Wiley, 2003.*

***REFERENCES:***

1. *S. M. Sze, "VLSI Technology", Second Edition, Tata McGraw Hill Publishing Company Limited, 2003.*
2. *James D. Plummer, Michael D. Deal, Peter B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Prentice Hall India Private Limited, 2000.*
3. *S. M. Sze, "Semiconductor Devices: Physics and Technology", Second Edition, John Wiley and Sons, 2002.*

**ECE478 VLSI SYSTEM DESIGN 3 0 0 3**

(Pre-requisite: ECE313)

Unit 1

**Introduction to verilog HDL:** ASIC/ FPGA design flow – why HDL? – overview of digital design with verilog HDL - hierarchical modeling concepts - basic concepts – modules and ports.

**Overview of different levels of abstractions:** Gate level modeling – dataflow modeling – behavioral modeling – switch level modelling.

Unit 2

**Logic synthesis with verilog HDL:** Impact of logic synthesis – interpretation of a few verilog constructs – synthesis design flow – concepts of Verification.

**Introduction to FPGA fabrics:** FPGA architectures – SRAM-based FPGAs – permanently programmed FPGAs – circuit design of FPGA fabrics – architecture of FPGA fabrics – logic implementation of FPGAs – physical design for FPGAs.

Unit 3

**Architecture and large-scale systems:** Behavioral design – design methodologies – busses – platform FPGAs – multi FPGA systems – novel architecture – a tour of FPGA design cycle using Xilinx ISE Webpack.

***TEXTBOOK:***

1. *Samir Palnitkar, "Verilog HDL", First Edition, Prentice Hall India Private Limited, 2003.*

2. *Wayne Wolf, "FPGA-Based System Design", First Edition, Prentice Hall India Private Limited, 2004.*

***REFERENCES:***

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

## 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.*

## ECE482 ECONOMETRICS 3 0 0 3

Unit 1

**Review of statistics** – random variables – moments – distributions – least squares – hypothesis testing - hetroskedacity – ACF.

**Index models** – mean variance analysis – estimating beta-multi index models – CAPM and multifactor models – market model – Fama – Macbeth – event studies – basic structure of event studies – normal and abnormal returns – quantitative events.

Unit 2

**Time series analysis** - ARMA (p, q) – Var (p) – non-stationary processes – predicting asset returns – random walk – efficient market hypothesis – predictor methods – security and technical analysis – empirical evidence – maximum likelihood estimation – test principles – QMLE. ARCH and GARCH – non linear extensions – multivariate GARCH.

Unit 3

**Option pricing** – BS model – estimation of volatility of a random walk model – kernel density estimation and regression – examples of non-parametric estimation. Risk measures – symmetric dispersion measures – down side risk.

***TEXT BOOK:***

*Paul Soderlid, "Lecture notes in Financial Econometrics", University of St. Gallen, Switzerland-2009.*

***REFERENCES:***

1. *J. M. Wooldridge, "Introductory Econometrics: A modern Approach," Second Edition. South western college publishing, Thomson learning, 2003*
2. *Philip Hans Franses, "A concise introduction to Econometrics," Cambridge University Press, 2002*

## ECE484 SIGNAL PROCESSING FOR BUSINESS APPLICATIONS 3 0 0 3

Unit 1

**Introduction -** fourier vs wavelets, seasonality filtering, signal denoising, identification of structural breaks, scaling, aggregate heterogeneity and time scales, multiscale cross correlation.

**Review of linear filters** – the EWMA and volatility estimation, the Hodrick – Prescott filter, Baxter – king filter, filters in technical analysis of financial markets. Optimum linear estimation, weiner filer, recursive filtering and Kalman filter, prediction with Kalman filter, vector Kalman filter estimation, applications.

Unit 2

**Discrete wavelet transforms** – properties, DWT filters, the maximal overlap DWT, multi resolution analysis, ANOVA, practical issues, filtering FX intraday seasonalities, causality and co-integration in economics, money growth and inflation, long memory processes, fractional difference processes (FDP), the DWT of FDP, simulation of FDP, OLS estimation of FDP, approximate maximum likelihood estimation of FDP, application to stock prices, generalization of DWT and MODWT, applications to money supply, wavelets and seasonal long memory – applications to money supply, GNP, seasonality and trends, unemployment, consumer price index, tourism revenues.

Unit 3

Market modes, moving averages, momentum functions, Hilbert transforms, measuring cycle periods, signal to noise ratio, the sine wave indicator, the instantaneous trend line, identifying market modes, designing profitable trading system, transform arithmetic, FIR, IIR, removing lag, adaptive moving averages, Ehlers filters, measuring market spectra - optimum predictive filters - adapting standard indicators.

***TEXTBOOKS:***

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

***REFERENCE:***

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

## EEE100 ELECTRICAL ENGINEERING 3 0 0 3

Unit 1

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

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

Unit 2

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

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

Unit 3

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





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

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

***TEXTBOOK:***

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

***REFERENCES:***

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

## EEE180 WORKSHOP B 1 0 2 2

**Electrical workshop**:

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

**Personal computer hardware workshop**:

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

**Electronics and basic microprocessor workshop**:

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

**PIC microcontroller workshop**:

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

## 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.*





**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.*

## 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.*

## 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*

## EIE210 INDUSTRIAL INSTRUMENTATION I 3 1 0 4

(Pre-requisite: EEE212)

Unit 1

**Basics – e**lements of a generalized instrumentation system, classification of instruments (deflection, null type) I/O configuration, method of correction for spurious inputs, static characteristics, errors in measurements, their statistical analysis and dynamic characteristics.

**Primary sensing elements and transducers and their signal conditioning** - definitions, classification of transducers, potentiometers, strain gauges, variable inductance transducers, LVDT, synchros, resolvers, capacitive transducers, Piezo electric transducers, hall effect transducers, semiconductor photoelectric transducers, optical encoders.

Unit 2

**Temperature measurement -** introduction, various methods, bimetallic thermometers**,** RTD, thermistor, thermocouple, semi conductor thermometers, radiation pyrometers.

**Pressure measurement** - introduction, various methods, dead weight tester, manometers, elastic pressure elements (bourdon tube, diaphragm, bellows) electro-mechanical pressure transducers (concepts only) low pressure measurement – Mcleods gauge, viscosity gauge, Pirani gauge, thermocouple gauge, ionization gauges. **Force and torque measurement** force and torque measurement using strain gauges.

Unit 3

**Flow and level measurement** - introduction, various methods, variable head flow meters, orifice, venturi, pitot tube, rotameter, EM flow meter, hotwire anemometers, turbine flow meters, ultrasonic meter, vortex shedding flow meter, nutating disc, lobed impeller and rotary vane meters. Level measurement – classification, sight-glass, electrical methods, pressure based detector, buoyancy methods, radiation based (gamma) and ultrasonic detectors.

***TEXTBOOK:***

*A. K. Sawhney, Puneet Sawhney, "A Course In Mechanical Measurements And Instrumentation", Twelfth Edition, Dhanpat Rai and Company Private Limited, 2007*

***REFERENCES:***

1. *E. O. Doeblin, "Measurement system Application and design", Fifth Edition, Tata McGraw-Hill Publishing Company Limited, 2007.*
2. *C. Rangan, V. S. V. Mani, G. R. Sarma, "Instrumentation Devices", Second Edition, Tata McGraw-Hill Publishing Company Limited, 2001.*
3. *T. G. Beckwith, Roy D Marangoni and John H. Lientar V, "Mechanical Measurements", Fifth Edition, Pearson Education, 2006.*
4. *Patranabis. D, "Principles of Industrial Instrumentation", Second Edition, Wheeler Publishing Company Limited, 2007.*

## EIE310 ELECTRICAL AND ELECTRONIC MEASUREMENTS I 3 1 0 4

(Pre-requisites: EIE210, ECE211)

Unit 1

**Electro mechanical instruments**

PMMC instruments, galvanometer, DC ammeter, DC voltmeter, rectifier voltmeter,





rectifier ammeter, deflection instrument errors, series ohmmeter, shunt ohmmeter, VOM ammeter, electrodynamic instruments.

**Multimeters**

Transistor voltmeter, op-amp voltmeter, ohmmeter function in electronic instruments, A.C. electronic voltmeter, current measurement with electronic instruments, analog electronic voltmeter, multimeter probes, digital voltmeter systems, digital multimeter.

Unit 2

**Resistance measurements**

Voltmeter and ammeter method, substitution method, Wheatstone's bridge, low resistance measurement, low resistance measuring instruments, high resistance measurement, high resistance measuring instruments.

Inductance and capacitance measurement

RC and RL equivalent circuits, AC bridge theory, capacitance and inductance bridges, Q-meter.

Unit 3

**Oscilloscopes**

CRO: CRT, deflection amplifier, waveform display, oscilloscopes time base, dual trace oscilloscope, oscilloscope controls, measurement of voltage, frequency and phase, pulse measurements oscilloscope probes, X, Y and Z displays, DSO and its applications.

**Signal generators and waveform analyzing instruments**

Low-frequency signal generators, function generators, pulse generators, RF signal generators, sweep frequency generators, frequency synthesizer, arbitrary waveform generator, distortion meter, spectrum analyzer, digital spectrum analyzer.

***TEXTBOOK:***

*David A. Bell, "Electronic Instrumentation and Measurements", Second Edition, Pearson Education/ Prentice Hall of India Private Limited, 1997.*

***REFERENCES:***

1. *Anand M. M. S, "Electronic Instruments and Instrumentation Technology", Prentice Hall of India Private Limited, 2004.*
2. *Kalsi. H, "Electronic Instrumentation", Second Edition,Tata-McGraw Hill Publishing Company Limited, 2004.*

## EIE311 INDUSTRIAL INSTURMENTATION II 3 0 0 3

(Pre-requisite: EIE210)

Unit 1

**Measurement of force, torque, velocity**

Electric balance – different types of load cells – magnets – elastics load cell -

strain gauge load cell - different methods of torque measurement, strain gauge, relative regular twist-speed measurement - revaluation counter - capacitive tacho-drag up type tacho D.C and A.C tacho generators – stroboscope.

Unit 2

**Measurement of acceleration, vibration and density:** Accelerometers – LVDT, piezo- electric, strain gauge and variable reluctance type accelerometers – mechanical type vibration instruments – seismic instrument as an accelerometer and vibrometer – calibration of vibration pickups – units of density, specific gravity and viscosity used in industries – Baume scale API scale – pressure head type densitometer – float type densitometer – ultrasonic densitometer Bridge type gas densitometer.

Unit 3

**Measurement of viscosity, humidity and moisture:** Viscosity terms – say bolt viscometer – rotameter type viscometer – industrial consistency meters – humidity terms – dry and wet bulb psychrometers – hot wire electrode type hygrometer – dew cell – electrolysis type hygrometer – commercial type dew point meter – moisture terms – different methods of moisture measurement – moisture measurement in granular materials, solid penetrable materials like wood, web type material.

***TEXTBOOK:***

*R K Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1999.*

***REFERENCES:***

1. *A. K. Sawhney, Puneet Sawhney, "A Course In Mechanical Measurements And Instrumentation", Twelfth Edition, Dhanpat Rai and Company Private Limited, 2007*
2. *Patranabis. D, "Principles of Industrial Instrumentation", Second Edition, Wheeler Publishing Company Limited, 2007.*
3. *E. O. Doeblin, "Measurement system Application and design", Fifth Edition, Tata McGraw-Hill Publishing Company Limited, 2007.*
4. *C. Rangan, V. S. V. Mani, G. R. Sarma, "Instrumentation Devices", Second Edition, Tata McGraw-Hill Publishing Company Limited, 2001.*
5. *T. G. Beckwith, Roy D Marangoni and John H. Lientar V, "Mechanical Measurements" Fifth Edition, Pearson Education, 2006.*

## EIE330 PROCESS CONTROL 3 1 0 4

(Pre-requisites: ECE311, EEE342, EIE210)

Unit 1

**Introduction** - need for process control - process variables - degrees of freedom - characteristics of liquid, gas, thermal systems - mathematical model of first order





level, pressure and thermal process - higher order process - interacting and non-interacting systems - continuous and batch process - self regulation - servo and regulatory operation.

Unit 2

**Basic control actions** - characteristics of ON/OFF, proportional (P), single speed floating, integral(I) and derivative(D) control modes - composite control modes – PI, PD, PID control modes - response of controllers for different types of test inputs - pneumatic and electronic controllers to realize various control actions - selection of control modes for different processes.

Control types and tuning - feed forward – ratio – cascade – averaging - multivariable control. Tuning of controllers - process reaction curve, continuous cycling, damped oscillation – Ziegler-Nichols -1/4 decay ratio methods.

Unit 3

**Final control elements** - current to pressure (I/P) and pressure to current (P/I) converters - pneumatic and electric actuators - valve positioners - control valves – types – characteristics – sizing - selection criteria – cavitation and flashing.

Dynamics and control of processes - distillation column - control of top and bottom product composition - reflux ratio control of chemical reactors - control of heat exchangers - steam boiler - drum level and combustion control - piping and Instrumentation diagrams.

***TEXTBOOK:***

*Stephanopoulos, "Chemical Process control", Pearson Education, 2006.*

***REFERENCES:***

1. *Pollard.A, "Process control", Heinemann Educational Books, 1971.*
2. *Harriott.P, "Process Control", Tata Mc-Graw Hill Publishing Company Limited, 1972.*
3. *C.D.Johnson, "Process control Instrumentation Technology" Eighth Edition, Pearson Education, 2006.*

## EIE331 ELECTRICAL MACHINES 3 1 0 4

(Pre-requisites: EEE100, EEE212)

Unit 1

**D.C. machines:** Principle and theory of operation of D.C. generator - generator action - constructional features of D.C. machines - armature reaction - commutation - characteristics of shunt, series and compound generators - principle of operation of D.C. motor - back E.M.F - torque equation - characteristics of shunt, series and compound motors - losses and efficiency calculations - applications of D.C. motors - motor starters - speed control of D.C. motors.

Unit 2

**Transformers:** Principle, constructional details of shell and core type transformer - EMF equation - no-load and on load operation. Test on transformer - equivalent circuit - regulation and efficiency calculations - auto transformer - principle of operation – phasor diagram - three phase transformer connections.

Synchronous machines: Construction and principle of operation of alternators - EMF equation - determination of regulation by synchronous impedance method - theory of operation of synchronous motor - Phasor diagram - methods of starting - variation of current and power factor with excitation - synchronous condenser and P.F. improvement.

Unit 3

**Induction machines:** Construction and principle of operation – classification of induction motor - torque equation – torque slip characteristics - maximum torque - effect of rotor resistances - starting and speed control.

Special machines: Types of single phase motor – double field revolving theory – capacitor start capacitor run motors – shaded pole motor – repulsion type motor – universal motor – hysteresis motor – stepper motor.

***TEXTBOOKS:***

1. *Nagrath I J and Kothari D P, "Electrical Machines", Second Edition, Tata McGraw-Hill, 2000.*
2. *Sen P C, "Principles of Electrical Machines and Power Electronics", Second Edition, John Wiley & Sons, Inc. Singapore, 1997.*

***REFERENCES:***

1. *Bimbhra P S, "Electrical Machinery", Khanna Publishers, 2004.*
2. *Gupta B R, and Vandana Singhal, "Fundamentals of Electrical Machines", New Age International Publishers, 2001.*
3. *Say M G, "Alternating Current Machines", Fifth Edition, Pitman, 1990.*

## EIE361 FIBER OPTIC SENSORS AND APPLICATIONS 3 0 0 3

Pre-requisite: EIE210)

Unit 1

**Lasers: principles and types**

Emission and absorption of radiation - Einstein relations - absorption of radiationn. Population inversion - 3 Level and 4 level systems – optical feedback - LASER cavity mirror configurations. Threshold conditions - LASER losses. Line shape function (concept only). LASER modes - axial and transverse. Classes of LASER - solid state lasers, semiconductor lasers, gas lasers, liquid dye lasers.

Unit 2

**LASER properties and applications**

Single mode operation, mode locking, Q-switching, properties of LASER lights - directionality, line width, beam coherence etc., applications - overview (more detailed coverage for instrumentation related applications), alignment, measurement of length, pollution detection, velocity measurement, holography, holographic interferometry, inspection, analytic technique, recording, communication, heat source, medical, printing, isotope separation, atomic fusion.

**Optical fiber fundamentals**

Physics of light, Refractive index, total internal reflection, optical fiber basics, concept of mode, types of fibers, attenuation, dispersion, multimode and single mode fibers, light sources(LEDs and LDs) and detectors (PIN diode, APDs).

Unit 3

**Opticalfiber applications**

Overview - communications, illumination and sensors. Fiber optic sensors - advantage over conventional sensors, block diagram of fiber optic sensors, intensity modulated sensors, phase modulated sensors, spectrally modulated sensors, distributed fiber optic sensors. Industrial applications of fiber optic sensors - introduction, temperature measurement, pressure measurement, level measurement, flow measurement, vibration measurement, chemical analysis, current measurement, voltage measurement, issues for industrial applications.

Fiber optic smart structures - introduction, fiber optic sensor systems, applications of fiber optic smart structures and skins, example of application of fiber optic sensors to smart structures.

***TEXTBOOKS:***

1. *Djafar and Lowell, "Fiber Optic Communication Technology", Pearson Education, , 2001*
2. *J. Wilson and J.F.B Hawkes, "Optoelectronics- an Introduction", Second Edition, Prentice Hall of India, 2001*

***REFERENCES:***

1. *R.P Khare, "Fiber optics and Optoelectronics", Oxford University Press,2004*
2. *Eric Udd, "Fiber Optic Sensors-An Introduction for Engineers and Scientists", Wiley Interscience, 2006*
3. *William M. Steen," Laser Material Processing', Third Edition, Springer International, 2005*

## EIE390 MEASUREMENTS AND CONTROL SYSTEMS LAB. 0 0 3 1

(Pre-requisites: ECE292, ECE293)

Basic experiments with Opamps: adder, subtractor, integrator, differentiator, precision rectifiers, oscillators and design of electrical filters.

Measurements of resistance. Inductance, capacitance

Calibration of ammeter and voltmeter.

Determine the response of First and Second order system using RLC circuit and determination of the performance indices.

Determine the response of lead, lag, and lead-lag circuits for various inputs.
Plotting the root locus, bode plots with and without compensation for a given transfer function, using MATLAB.
Study of characteristics of pressure, temperature, flow, torque, displacement transducers.

**EIE391 PROCESS CONTROL LAB. 0 0 3 1**

(Pre-requisites: EIE390)

Implementation and performance evaluation of closed loop control for
1. Flow
2. Level
3. Pressure
4. Temperature Processes

**EIE397 SEMINAR 2 0 0 2**

The aim of 'Seminar' is to train students in giving higher-level technical presentation. The topics for presentation can be chosen by the student with assistance from the teachers. These may include the topics in the area of the student's project.

**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.*

**EIE440 INDUSTRIAL AUTOMATION 3 1 0 4**

(Pre-requisites: ECE310, EIE311, EIE330)

Unit 1

**Introduction to industrial automation**
**Programmable Logic Controller (PLC) basics:**
An overall look and programmable logic controllers, PLC: A look inside, general PLC programming procedures, devices to which PLC I/O modules are connected, programming On/Off inputs and to produce On/Off outputs, digital gate logic, creating ladder diagrams from process control descriptions, register basics, timers, counters, **Intermediate, data handling, working with bits and advanced PLC functions** Arithmetic functions, comparison functions, SKIP and master control relay functions, jump functions, data move and other functions, digital bit functions, sequencer and matrix functions, controlling a robot with a PLC, analog PLC operation, PID control,

Unit 2

Alternative programming languages, auxiliary commands and functions, PLC installation, troubleshooting and maintenance, selecting a PLC.
**Distributed digital control systems (DCS) (only concept):**
Introduction, history, distributed vs centralized, advantages of DCS, function requirements of DCS, system architecture functional levels (with an example).
**Computer based instrumentation**
PC based instrumentation system, principles of data acquisition systems (DAS): sampling concepts (review), D/A and A/D converters, DAS: AI, AO, Digital I/O, timing I/O, Data acquisition configurations, interfacing to IBM PC, expansion buses PCI and its variants, specifications of general purpose DAQ board, serial communication concepts and overview of following interfaces RS232, RS485, UART, $I^2C$, SPI, USB, IEEE 1394, virtual instrumentation systems, IEEE P1451 standard-smart sensors.

Unit 3

**Networked data acquisition:**

Network data communication, LAN, OSI model, LAN characteristics, types, TCP/IP, WLAN, HART communication, field buses, MODBUS, PROFIBUS, FOUNDATION FIELDBUS, industrial Ethernet.

***TEXTBOOKS:***

1. *John W. Webb and Ronald A Reis, "Programmable Logic Controllers - Principles and Applications", PHI learning Pvt Ltd, Fifth Edition, 2009*
2. *Mathivanan. N. "PC-Based Instrumentation Concepts and practice", Prentice Hall India Pvt Ltd, 2007*

***REFERENCES:***

1. *Slawomir Tumanski "Principles of electrical measurement". CRC Press Taylor & Francis Group, 2006*
2. *Krishna Kant, "Computer based industrial control" Prentice Hall India Pvt Ltd, 1997*
3. *Frank D.P., "Programmable Logic Controllers", Second Edition, Tata Mc-Graw-Hill Publishing Company Limited, 1997.*

## EIE461 ANALYTICAL INSTRUMENTATION 3 0 0 3

(Pre-requisite: EIE311)

Unit 1

**Potentiometry:** Reference electrodes - PH meters - ion selective electrodes - on-line potentiometric analyzers. Chemical sensors, conductivity meters - oxygen analyzers, turbidimetry and nephelometry.

**Gas chromatography** - gas chromatographs - gas chromatographic columns - liquid phases and column selection - detectors for gas chromatography, process gas chromatography.

Unit 2

**Liquid chromatography** – high performance liquid chromatography (HPLC) - gradient elution – derivatization - HPLC instrumentation.

**Absorption and emission spectroscopy -** UV and visible spectrometry - sources, wavelength selection, cell selection, detectors. Instruments for absorption photometry.

Unit 3

**IR spectrometry** – instrumentation - radiation sources and detectors, dispersive and nondispersive spectrometer, IR process analyzer.

**Raman spectrometry -** instrumentation, sample handling and illumination, structural analysis.

**Automatic chemical analyzers** - discrete analyzers, continuous flow methods, centrifugal analyzers, automatic elemental analyzers, laboratory robots, the automated laboratory.





***TEXTBOOK:***

*Willard, H .H, Merrit L. L, Dean J.A Seattle F.L., "Instrumental Methods of Analysis", 7th Edition, CBS Publishing and Distribution, 1995.*

***REFERENCES:***

1. *Skoog, D. A and West D.M., "Principles of Instrumental Analysis", Pearson Education/ Prentice Hall of India Private Limited, 1985.*
2. *Ewing G. W., "Instrumental Methods of Analysis", Tata McGraw-Hill Publishing Company Limited, 1992.*
3. *Liptak B. G., "Instrument Engineers Handbook: Process Measurement and Analysis Vol. I", Fourth Edition, Chilton Book Company, 2003*

## EIE462 ADVANCED SENSORS 3 0 0 3

(Pre-requisite: EIE311)

Unit 1

**Introduction to advanced sensors technology:** Design and development of sensors using VLSI technology, silicon planar technology, micromachining technology. Micro Electro Mechanical Systems (MEMS) overview. Nano technology enabled sensors.

Unit 2

**Design of sensors:** Micro sensors for sensing radiation, mechanical, magnetic, chemical and other signals. Thick and thinfilm sensors, design principles.

**Semiconductor sensors fabrication**: Metal Oxide Semiconductors (MOS) structures, process steps.

Unit 3

**Chemical and biochemical sensors:** Polymers, Chemically Modified Electrodes (CME), affinity sensors, potentiometric and amperometric devices, catalytic sensors, gas sensors. Biosensors. Optical sensors and integrated optics.

**Interfacing and signal processing:** Intelligent and smart sensors, concepts of redundant and multi-sensory systems.

***TEXTBOOKS:***

1. *Middlehock S., Audel S. A., "Silicon Sensors", Academic Press, 1989.*
2. *Jiri Janata, Robert J. Huber, "Solid State Chemical Sensors", Academic Press, 1985*

***REFERENCE:***

*John Wilson (ed), "Sensor Technology Handbook", First Edition, Newnes, 2004.*

## EIE463 PRINCIPLES OF 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.

Unit 2

**Modulation:** Necessity, introduction to analog and digital modulation.

**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.

Unit 3

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

**Pulse communication:** Introduction, PWM, PPM, PCM.

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

***TEXTBOOKS:***

1. *George Kennedy, Bernard Davis, "Electronic Communication Systems", Fifth Edition, Tata McGraw Hill Publishing Company Limited, 2006.*
2. *Wayne Tomasi, "Electronic Communication Systems, Fundamentals through Advanced", Fourth Edition, Pearson Education, 2002.*

***REFERENCES:***

1. *Simon Haykin, "An Introduction to Analog and Digital Communication", Fourth Edition, JohnWiley and Sons2003.*
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*

## EIE464 VIRTUAL INSTRUMENTATION 3 0 0 3

(Pre-requisite: CSE100, EIE221, EIE311)

Unit 1

**Introduction** – history – advantages - virtual instrumentation software - front panel, block diagram, and connector pane - LabVIEW palettes - LabVIEW controls and indicators - data flow.

**LabVIEW programming -** data types - numeric, boolean, string, file I/O - while and for loops, case and sequence structures, formula nodes - express VI - array and cluster functions - error handling - basic LabVIEW programming – architecture - graphs and charts - creating sub VI.





Unit 2

**Data acquisition -** digital to analog conversion, analog to digital conversion - data acquisition using National instruments – DAQmx - signal generation using National instruments – DAQmx - software and hardware installation.

**Data analysis -** time domain and frequency domain analysis - fast fourier transforms, power spectrum - digital filtering – windowing - instrument control - serial communication - RS 232/RS485 - control of a GPIB (General Purpose Interface Bus) interface - system buses - interface buses - instrument drivers.

Unit 3

**Advanced systems** - LabVIEW based fuzzy logic and genetic algorithms – SAMI (Standard Architecture for Measurement for Instrumentation) model - applications of virtual Instruments in various fields.

***TEXTBOOKS:***

1. *Gary Johnson & Richard Jennings, "LabVIEW Graphical Programming", Fourth Edition, Mc-Graw Hill (International Edition), 2006.*
2. *National Instruments LabVIEW Manual*

***REFERENCES:***

1. *L. Wells, "The LabVIEW Student Edition User's Guide", Pearson Education, 1995*
2. *Lisa K. wells & Jeffrey Travis, "LabVIEW for Everyone-Graphical Programming Made Even Easier", Prentice Hall of India Private Limited, 1997.*
3. *J. Rahman, Herbert Pichlik, 'LabVIEW – Applications and Solutions', Prentice Hall of India Private Limited, 1996*

## EIE465 ELECTRICAL AND ELECTRONIC MEASUREMENTS II 3 0 0 3

(Pre-requisite: EIE310)

Unit 1

**Potentiometers:** DC potentiometers, polar type & co-ordinate type AC potentiometers, application of AC potentiometers in electrical measurement.

**Magnetic measurement:** Ballistic galvanometer, flux meter**,** determination of hysteresis loop, measurement of iron losses.

Unit 2

**Measurement of power and energy, time and frequency** - dynamometer type wattmeter and induction type energy meter - single phase and three phase - testing and calibration of energy meter - power factor meter, time measurement, frequency measurement.

**Instrument transformers**

Current and potential transfers, ratio and phase angle errors, design considerations and testing.

Unit 3

**Electrical laboratory practice:** Safety, grounds, circuit protection devices, cables, connectors, switches and relays, input impedance, output impedance and loading power transfer and impedance matching.

**Interference signals and their elimination or reduction**. Capacitive interference, inductive interference, input shielding, electromagnetic interference and shielding, input guarding to reduce ground-loop interference, internal noise.

***TEXTBOOK:***

*A. K. Shawney "A course in electrical and electronic measurements and instrumentation", Dhanpat Rai and Sons, New Delhi, 2007*

***REFERENCES:***

1. *Stanley wolf, Richard I. M. Smith "Student reference manual", Prentice Hall of India, 2001.*
2. *Helfric A, D and Cooper W. D "Modern electronic instrumentation and measurement techniques", Prentice Hall of India,1997*
3. *Kantrowitz, Kousourou, and zucker "Electronic measurements", Prentice Hall, New Jersey,2001*
4. *H. S. Kalsi "Electronic instrumentation", Tata McGraw- Hill, New Delhi, 2004*

## EIE466 INSTRUMENTATION SYSTEM DESIGN 3 0 0 3

(Pre-requisite: EIE440)

Unit 1

**Signal processing circuits** - bridge circuits, amplifiers for strain gage, resistance temperature detector, compensation, linearisation of thermistor, charge amplifier, square root extractor for flowmeters - design of transmitters with 4-20mA output. **Instrumentation project design -** documentation, process function diagrams and interlock, interface diagrams, process flow diagrams, piping and instrumentation diagrams, specification sheets, loop wiring diagrams, ladder diagrams, isometrics, installation, bill of material, control console, centers and panels.

Unit 2

**Enclosure and electronic design** - enclosure design guidelines - grounding and shielding techniques, protection against electromagnetic interference and electrostatic discharge, packaging. Electronic design guidelines - noise, component limits, sensitive devices, input filters, and clamping suppressors.

**Design aspects and selection criteria** - flow, temperature, pressure, and level transducers.

Unit 3

Design of temperature instrumentation system, selection criteria, self heating effects in resistive temperature transducers, power-dissipation constant and calculations.

**Pressure and flow instrumentation -** design of pressure instrumentation - diaphragm, Bourdon tubes and bellows - flow instrumentation design - orifice, rotameter, venturimeter.





***TEXTBOOKS:***

1. *J. M. Bacon, "Instrument Installation Project Management System", ISA, 1989.*
2. *McMillan, G.K., Considine D.M, "Process Instruments and Controls Handbook" Fifth Edition, McGraw Hill International Publishing Company, 1999*

***REFERENCE:***

*Liptak B. G., "Instrument Engineers Handbook: Process Control Vol. II", Fourth Edition, Chilton Book Company, 2003.*

## EIE467 ENVIRONMENTAL AND POLLUTION MONITORING INSTRUMENTATION 3 0 0 3

Pre-requisite: EIE311)

Unit 1

**Introduction** - environmental constituents, biochemical cycle, causes of pollution, different sensors for measurement of pollution, off-line measurement and continuous monitoring - environmental toxicology and hazards, environmental regulation - devices and techniques as related to environmental engineering.

Unit 2

**Air pollution analysis** - sources and classification of atmospheric pollutants, characteristics of air pollutant particulates, gaseous pollutants, their monitoring. Analysis of aerosols - water pollution analysis - physical examination, chemical characterization - industry specific wastewater treatment technology for chloro-alkali, electroplating, distillery, tannery, pulp and paper, fertilizer, coal washery and coke oven effluents.

**Biological investigation** – dissolved oxygen, biological oxygen demand, bacteriological examination, types of water quality monitoring instrumentation - effluent analysis - physical methods of characterization - density, viscosity, temperature, turbidity, volatile and dissolved solids, oil and immiscible liquids, color, odor, radio activity, analysis of organic pollutants.

Unit 3

**Noise pollution and its measurements -** units, devices and map noise control systems - noise pollution monitoring equipment - frequency spectrum analysis of machine noise. Audiometric survey - radiation pollution and its measurements and control.

**Environmental testing**: Dry heat, dry cold, damp heat, salt spray, dust, altitude bump, vibration drop/topple, free fall, and study of ISO 14001.

***TEXTBOOK:***

*S. M. Khopkar, "Environmental Pollution Analysis", First Edition Reprint, New Age International, 2001.*

***REFERENCES:***

1. *Peary H.S., Rowe D.R., Tchobanoglous G., "Environmental Engineering", Tata McGraw Hill Publishing Company, 1995.*
2. *Michael Campbell, "Sensor Systems for Environmental Monitoring", First Edition, Springer, 1998.*

**EIE471 ROBOTIC CONTROL 3 0 0 3**

(Pre-requisite: EEE342, EIE331)

Unit 1

**Basic concepts -** automation and robotics – an over view of robotics – present and future applications – classification by coordinate system and control system, dynamic stabilization.

**Power sources and sensors -** hydraulic, pneumatic and electric drives – variable speed arrangements, path determination - machine vision – ranging – fiber optic and tactile sensors.

Unit 2

**Manipulators, actuators and grippers** - construction of manipulators, manipulator dynamic and force control, electronic and pneumatic manipulators, pneumatic, hydraulic actuators, stepper motor control circuits, end effecter, various types of grippers, design.

**Kinematics** - differential transformation and manipulators, Jacobians – problems. Dynamics. Lagrange, Euler and Newton – Euler formations – problems. Forward and inverse kinematic problems, solutions of inverse kinematic problems, multiple solution, Jacobian work envelop – hill climbing techniques.

Unit 3

**Path planning** - trajectory planning and obstacle avoidance, skew motion, joint integrated motion – straight line motion – robot programming, languages and software packages.

**Applications** - multiple robots – machine interface – robots in manufacturing and non-manufacturing applications – robot cell design selection of a robot.

***TEXTBOOK:***

*M. P. Groover, Mitcheel Weiss, Roger N.N, Nicholas Odrey; "Industrial Robotics Technology, Programming and Applications", Mc-Graw-Hill (International Edition), 1986.*

***REFERENCES:***

1. *K. S. Fu, R.C. Gonzales, C.G.S Lee, "Robotics: Control, Sensing, Vision And Intelligence", Mc-Graw Hill (International Edition), 1987.*
2. *M. W. Spong, S. Hutchinson and M. Vidyasagar, "Robot modeling and control", Wiley India, 2005.*
3. *R. K Mittal, I.J Nagrath, "Robotics and Control", Tata Mc-Graw Hill Publishing Company Limited, 2002*

**EIE472 ADVANCED PROCESS CONTROL 3 0 0 3**

(Pre-requisite: EIE330)

Unit 1

**Control loops and controllers:** Analysis and properties of flow, pressure, level, temperature control loops - linear and non linear controllers - digital controller





(position and velocity algorithms - effect of sampling time) hardware structures - features and specification - single loop and multi loop controllers and the application programs - Non-linear controller - two state-three state - proportional time - dual mode optimal switching.

Unit 2

**Multiloop and multivariable process control:** Interaction and decoupling control system - C-M relative process gain matrices and applications - robust control - statistical process control.

**Intelligent controllers:** Model based controller - optimal controller using Kalman filter, predictive controller.

Unit 3

**Expert controllers:** Expert system and expert controllers - fuzzy logic system and fuzzy controllers - artificial neural network controller - neuro-fuzzy control system.

**Applications:** Application of advanced process control systems for cement, paper and pulp, steel plants.

***TEXTBOOKS:***

1. *Liptak B. G., "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II", Chilton Book Company, 2001.*
2. *Johnson C. D., "Process Control Instrumentation Technology", Eighth Edition, Pearson Education, 2005.*
3. *McMillan, G.K., Considine, D.M, "Process Instruments and Controls Handbook" Fifth Edition, McGraw-Hill International Publishing Company, 1999*

***REFERENCE:***

*Popovic, Bhatkar, "Distributed Computer Control Systems in Industrial Automation", CRC Press, 1990.*

**EIE490 INDUSTRIAL AUTOMATION LAB. 0 0 3 1**

(Pre-requisite: EIE391)

1. Study of SCADA
2. Virtual instrumentation
3. Study of DCS, PLC, interfacing transducers and instruments to PC.

**EIE499 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.

## ENG111 COMMUNICATIVE ENGLISH 2 0 2 3

***Objectives:***

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

Unit 1
Reading: Different styles of communication – reading comprehension - critical thinking and analysis – note-making.

Unit 2
Writing: Prewriting techniques - kinds of paragraphs - basics of continuous writing; Grammar and usage – topics including spelling and number rules (Workbook).

Unit 3
Practical sessions (listening & speaking)**:** Introduction to English pronunciation including minimal pairs and word stress – differences between British and American English – listening comprehension and note-taking.
Activities: Short speeches, seminars, quizzes, language games, debates, discussions and book reviews, etc.

***TEXTBOOKS:***

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

***REFERENCES:***

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

## ENG112 TECHNICAL COMMUNICATION 2 0 2 3

***Objectives:***

*To introduce the students to the elements of technical style*
*To introduce the basic elements of formal correspondence*





*To introduce technical paper writing skills and methods of documentation*
*To improve oral presentation skills in formal contexts*

Unit 1
Mechanics of writing: Grammar rules – punctuation - spelling rules - tone and style - graphical representation.

Unit 2
Different kinds of written documents: Definitions – descriptions – instructions – recommendations - manuals - reports – proposals; Formal correspondence: Letter writing, including job applications with resume.

Unit 2
Technical paper writing: Library research skills - documentation style - document editing – proof reading – formatting.
Practice in oral communication: Group discussion, interviews and technical presentations.

***REFERENCES:***

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

## ENG250 PROFESSIONAL COMMUNICATION 1 0 2 2

Unit 1
**Reading Comprehension**: Focus will be on understanding of the given information, vocabulary, inference, logical thinking, and decision - making.

Unit 2
**Work place Communication**: Writing suggestions, recommendations - reports like, incident report, progress report, trip report, feasibility report – resume writing - formal and business letters – memos, circulars, notices - agenda, meetings, minutes.

Unit 3
**Practical**: Telephonic conversations, interviews, group and panel discussions, and oral presentations.

***REFERENCES:***

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

## ENG251 BUSINESS COMMUNICATION 1 0 2 2

***OBJECTIVES:***

*To introduce business vocabulary*

*T o introduce business style in writing and speaking*

*To expose students to the cross-cultural aspects in a globalised world*

*To introduce the students to the art of persuasion and negotiation in business contexts.*

Unit 1

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

Unit 2

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

Unit 3

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

**Activities -** case studies & role-plays

***BOOKS RECOMMENDED:***

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

## ENG252 INDIAN THOUGHT THROUGH ENGLISH 1 0 2 2

***Objectives:***

*To expose the students to the greatness of Indian Thought in English*

*To develop a sense of appreciation for the lofty Indian Thought*

*To develop an understanding of the eclectic Indian*





Unit 1

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

Unit 2

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

Unit 3

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

**Short Story:**

***REFERENCES:***

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

## ENG253 INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE 1 0 2 2

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

Objectives -

· *to expose the students to different genres of Literature*

· *to inculcate reading skills*

· *to provide deeper critical and literary insights*
· *to enhance creative thinking*
· *to help the student develop critical and analytical skills*
· *to promote the aesthetic sense*

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

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

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

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

***REFERENCES:***

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

## ENV200 ENVIRONMENTAL STUDIES 3 1 0 4

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





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

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

***TEXTBOOK:***

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

***REFERENCE BOOKS:***

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

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

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

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

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

***TEXTBOOK:***

*Metro St Michel - Publisher: CLE international*

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

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

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

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

***TEXTBOOK:***
*Metro St Michel - Publisher: CLE international*

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

To have an elementary exposure to German language; specifically
1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;
4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.

(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.)

Some useful websites will be given.





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

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

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

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

Some German culture. Films.

**GER211 GERMAN FOR BEGINNERS I 1 0 2 2**

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

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

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

**GER212 GERMAN FOR BEGINNERS II 1 0 2 2**

Unit 1
Shopping and orientation in supermarket; Conversation between the customer and

salesman; Where one finds what in supermarket; Asking for requests and suggestions.
Grammar: Dative of personal pronouns. Imperative form.
Vocabulary: Consumables and measurements;

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

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

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

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads

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

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

***REFERENCE:***
*The Bhagavad Gita, Commentary by Swami Chinmayananda*

**HUM251 INTRODUCTION TO INDIA STUDIES 1 0 2 2**

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

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





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

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

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

***TEXTBOOK:***
*Material given by the Faculty*
*BACKGROUND LITERATURE:*


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

**HUM252 GLIMPSES OF ETERNAL INDIA 1 0 2 2**

Unit 1

Introduction

A peep into India's glorious past

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

Unit 2

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

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

The arrival of Europeans, British paramountcy and colonization

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

Unit 3

Women in Indian society

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

Modern India

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





Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion

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

***REFERENCES:***


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

30. Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times.New Delhi: Motilal Banarsidass.
31. Madhavananda, Swami & R.C. Majumdar eds. The Great Women of India. Kolkata: Advaita Ashrama.
32. Dutt, R.C. The Economic History of India. London, 1902.
33. Dharampal. Collected Works.
34. Dharampal. Archival Compilations (unpublished)

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

Unit 1
Introduction
General Introduction; 'His + Story' or 'History'?; The concepts of 'nation', 'national identity' and 'nationalism'; Texts and Textualities: Comparative Perspectives

Unit 2
Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak;
Rabindranath Tagore;

Unit 3
Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao; V.S. Naipaul.
Conclusion

***REFERENCES:***

1. *Tilak, Bal Gangadhar. The Orion / Arctic Home in the Vedas.*
2. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
3. *Vivekananda, Swami. "Address at the Parliament of Religions"/"The Future of India"/"In Defence of Hinduism" from Selections from the Complete Works of Swami Vivekananda.*
4. *Aurobindo, Sri. The Renaissance in India / On Nationalism.*
5. *Coomaraswamy, Ananda K. Essays in Indian Idealism (any one essay) / Dance of Shiva.*
6. *Nivedita, Sister. "Noblesse Oblige: A Study of Indian Caste" / "The Eastern Mother" from The Web of Indian Life.*
7. *Gandhi, Mahatma. Hind Swaraj.*
8. *Nehru, Jawaharlal. "The Quest" from Discovery of India.*
9. *Ambedkar, B.R. "Buddha and His Dhamma" from Collected Works.*





10. *Saraswati, Chandrasekharendra. "The Sastras and Modern Life" from The Hindu Dharma.*
11. *Dharampal. Bharatiya Chitta, Manas and Kala / Understanding Gandhi.*
12. *Naipaul, V.S. India: A Wounded Civilization / India: A Million Mutinies Now.*

## HUM254 GLIMPSES OF INDIAN ECONOMY AND POLITY 1 0 2 2

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

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

Unit 3
Modern India: 1720 - 1947
the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was 'traditional' or 'Indian') – British attitude towards Indian trade, commerce and economy and the

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

Independent India – from 1947

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

Conclusion

***REFERENCES:***


1. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
2. *Kautilya. Arthasastra.*
3. *Altekar, A.S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
4. *Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times. New Delhi: Motilal Banarsidass.*
5. *Dutt, R.C. The Economic History of India. London,1902.*
6. *Dharampal. Collected Works (Volumes IV & V).*
7. *Dharampal. Archival Compilations (unpublished).*
8. *Bajaj, Jitendra & M.D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
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10. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
11. *Tripathi, Dwijendra. The Oxford History of Indian Business. New Delhi: Oxford University Press, 2004.*
12. *McGuire, John, et al, eds. Evolution of World Economy, Precious Metals and India. New Delhi: Oxford University Press, 2001.*
13. *Tripathi, Dwijendra and Jyoti Jumani. The Concise Oxford History of Indian Business. New Delhi: Oxford University Press, 2007.*
14. *Kudaisya, Medha M. The Life and Times of G.D. Birla. New Delhi: Oxford University Press, 2003.*
15. *Raychaudhuri, Tapan and Irfan Haib, eds. The Cambridge Economic History of India. Volume 1. New Delhi: Orient Longman, 2004.*
16. *Kumar, Dharma, ed. The Cambridge Economic History of India. Volume 2. New Delhi: Orient Longman, 2005.*







17. *Sabavala, S.A. and R.M. Lala, eds. J.R.D. Tata: Keynote. New Delhi: Rupa & Co., 2004.*
18. *Mambro, Arvind ed. J.R.D. Tata: Letters. New Delhi: Rupa & Co., 2004.*
19. *Lala, R.M., For the Love of India: The Life and Times of Jamsetji Tata. New Delhi: Penguin, 2006.*
20. *Thapar, Romila. The Penguin History of Early India: From the Origins to AD 1300. New Delhi Penguin, 2002.*
21. *Majumdar, R.C., et. al. An Advanced History of India. Macmillan.*


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

Unit 1

Introduction

Western and Indian views of science and technology

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

Unit 2

Indian sciences

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

Science and technology under the British rule

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

Unit 3

Science and technology in Independent India

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

Building upon the Indian tradition

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

Conclusion

***REFERENCES:***


1. *Joseph, George Gheverghese. The Crest of the Peacock: Non-European Roots of Mathematics. London: Penguin (UK),2003.*
2. *Iyengar, C.N. Srinivasa. History of Hindu Mathematics. Lahore: 1935, 1938 (2 Parts).*
3. *Amma, T.A. Saraswati. Geometry in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
4. *Bag, A.K. Mathematics in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
5. *Sarma K.V. & B.V. Subbarayappa. Indian Astronomy: A Source-Book. Bombay: Nehru Centre, 1985.*

6. *Sriram, M.S. et. al. eds. 500 Years of Tantrasangraha: A Landmark in the History of Astronomy. Shimla: Indian Institute of Advanced Study, 2002.*
7. *Bajaj, Jitendra & M.D. Srinivas. Restoring the Abundance: Regeneration of Indian Agriculture to Ensure Food for All in Plenty.Shimla: Indian Institute of Advanced Study, 2001.*
8. *Bajaj, Jitendra ed. Report of the Seminar on Food for All: The Classical Indian Discipline of Growing and Sharing Food in Plenty. Chennai: Centre for Policy Studies, 2001.*
9. *Bajaj, Jitendra & M.D. Srinivas. Annam Bahu Kurvita: Recollecting the Indian Discipline of Growing and Sharing Food in Plenty. Madras: Centre for Policy Studies, 1996.*
10. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
11. *Somayaji, D.A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
12. *Sen, S.N. & K.V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
13. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
14. *Bose, D.M. et. al. A Concise History of Science in India. New Delhi: 1971.*
15. *Bajaj, Jitendra & M.D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
16. *Bajaj, Jitendra & M.D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
17. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
18. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*

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

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

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

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





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

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

Students will be given detailed lectures on Calligraphy.

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

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

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

Unit 1

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

Unit 2

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

Unit 3

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 AND PARTIAL DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1

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

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

Unit 2

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

Unit 3

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

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

***TEXTBOOK:***

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

## MAT211 INTEGRAL TRANSFORMS AND COMPLEX ANALYSIS 3 1 0 4

Unit 1

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

Unit 2

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

Power series, Taylor series and Maclaurin series. Laurent series, zeros and





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

Unit 3

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

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

***TEXTBOOK:***

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

## MAT212 MATHEMATICAL STATISTICS AND NUMERICAL METHODS 3 1 0 4

Unit 1

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

Unit 2

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

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

Unit 3

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

***TEXTBOOK:***

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

## MEC100 ENGINEERING MECHANICS 3 1 0 4

Unit 1

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

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

Unit 2

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

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

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

Unit 3

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

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

***TEXTBOOKS:***

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

***REFERENCES:***

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

## MEC180 WORKSHOP A 1 0 2 2

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

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

**Pneumatics and PLC workshop:**

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





**Sheet metal workshop:**

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

**Welding workshop:**

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

Demo and practice workshop:

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

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

***REFERENCES:***

*Concerned Workshop Manual*

## MEC181 ENGINEERING DRAWING 1 0 3 2

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

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

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

Orthographic views of three-dimensional solids.

Isometric projection.

***TEXTBOOK:***

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

***REFERENCES:***

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

## MEC182 COMPUTER AIDED DRAWING 1 0 3 2

Introduction to CAD

Preparation of drawings using CAD Tools

Introduction to VBA / LISP

Introduction to 3D modeling and Surface Modeling

***TEXTBOOKS:***

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

***REFERENCES:***

*CADian Manual*

## MEC401 OPERATIONS RESEARCH 3 0 0 3

Unit 1

Linear programming: Formulations - graphical solutions - simplex method - duality, dual simplex method.

Transportation model: Assignment model – travelling salesman problem.

Dynamic programming: concepts, Bellman's principle – solutions to simple problems.

Unit 2

Decision theory: Decision trees. Game theory - 2 person zero sum; mixed strategies; 2 x n and m x 2 games.

Network models - project networks - CPM/PERT - project scheduling – crashing networks and cost considerations - resource leveling and smoothing - shortest route problem, minimal spanning tree problem, maximal flow problem.

Unit 3

Sequencing model – 2 machines 'n' jobs, 'm' machines 'n' jobs – n jobs 2 machines. Inventory models: deterministic & probabilistic models. Quantity discounts. Selective inventory management.

Queuing models: Poisson arrival and exponential service times. Single server, multi-server. Queues - infinite and finite capacity queues.

Simulation **–** Monte Carlo simulation: simple problems.

***TEXTBOOK:***

*Taha, H.A., 'Operations Research: an Introduction', 8e, Prentice Hall, New Delhi, 2008.*

***REFERENCES:***

1. *Hillier, F .S. and Lieberman, G .J, 'Operations Research', 9e, McGraw Hill, 2010.*
2. *Ravindran, A., Phillips, D.J., and Solberg, J.J., 'Operations Research- Principles and Practice', John Wiley & Sons, 2005.*
3. *Wagner, H.M., 'Principles of Operations Research', Prentice Hall, New Delhi, 1998.*
4. *Hardley, G., 'Linear Programming', Narosa Book Distributors Private Ltd 2002.*

## MEC481 TOTAL QUALITY MANAGEMENT 3 0 0 3

Unit 1

Definition of quality - dimensions of quality. Quality planning - quality costs. Total quality management: historical review and principles – leadership - quality council - quality statements - strategic planning - deming philosophy. Barriers to TQM implementation.





Unit 2

Customer satisfaction – customer retention - employee involvement - performance appraisal - continuous process improvement - supplier partnership - performance measures. Seven tools of quality.

Statistical fundamentals - control charts for variables and attributes - process capability - concept of six-sigma - new seven management tools – benchmarking.

Unit 3

Quality function deployment (QFD) - Taguchi quality loss function - Total Productive Maintenance (TPM) - FMEA.

Need for quality systems - ISO 9000:2000 – elements of quality systems (such as ISO 9000:2000). Implementation of quality system – documentation - quality auditing, QS 9000-ISO 14000.

*TEXTBOOK:*

*Besterfiled, D, H., 'Total Quality Management', Pearson Education Asia, 1999.*

*REFERENCES:*

1. *Evans, J. R, and Lidsay, W. M., 'The Management and Control of Quality', 5e, Southwestern (Thomson Learning), 2002 .*
2. *Feigenbaum, A. V., 'Total Quality Management- vol I&II ', McGraw-Hill, 1991.*

## MEC482 FINANCIAL MANAGEMENT 3 0 0 3

Unit 1

Introduction: Financial management an overview – financial decisions in a firm – goal of FM – function of the financial system.

Fundamental valuation concepts: Time value of money – risk and return.

Unit 2

Capital budgeting: techniques of capital budgeting investment criteria – NPV – benefit cost ratio – IRR – payback period – ARR – investment appraisal in practice – estimation of project cost flows.

Unit 3

Working capital management: Current assets – financing ruling – profit criterion. Cash and liquidity management. Working capital financing.

Financial analysis and planning**:** Analyzing financial performance – break – even analysis and Leverages – financial planning and budgeting.

Mergers and takeovers - international trade.

***TEXTBOOK:***

*Chandra, P., 'Financial Management: Theory and Practice', 5e, TMH, 2001.*

***REFERENCES:***

1. *Denzil Watson & Antony Head, 'Corporate Finance- Principles and Practice', 2e, Pearson Education Asia, 2002.*
2. *Terry S. Maness, 'Introduction to Corporate Finance', McGraw Hill Book Company, 1988.*
3. *Eugene F. Brigham & Louis C. Gapenski, 'Financial Management – Theory and Practice', 12e, 2010.*

## MEC490 ENTERPRISE MANAGEMENT 3 0 0 3

Unit 1

Engineering economics: cost concepts - types of costs - cost functions. Cost controls: reduction – tools & applications. Pricing policies – methods – problems. Process design and improvement – process capacity – process layout – process reengineering – job design. Work standards – work measurement – work sampling – problems.

Unit 2

Supply chain management – basic concepts, SC dynamics, push-pull boundary, integrated supply chain, logistics, customer relationship, supplier relationship – selection, rating and development, procurement, SC metrics and performance measurement - problems. Lean manufacturing – concepts, wastes – tools viz., pull system, standardized work, takt time, kanban system, JIT, kaizen, SMED, 5S, value stream mapping, benefits of lean and implementation issues. Introduction to Six Sigma. Plant location – globalization, factors affecting location decisions, facility location - break-even method, rectilinear, factor-rating and centre of gravity – problems. Plant layout – types, process layout, product layout, systematic layout planning (SLP), line balancing problems. Capacity planning – aggregate planning – importance, planning process, methods – problems.

Unit 3

Role of IT in business performance improvement – e-commerce – e-purchasing – master production schedule, inventory lot sizing strategies, MRP basics – MRP explosion, Available To Promise(ATP) inventory – MRP calculations – MRP II – scheduling – Gantt chart – introduction to ERP – ERP software – ERP modules – ERP implementation.

***TEXTBOOKS:***

1. *L. J. Krajewski and L. P. Ritzman, 'Operations Management: Processes and Value chain, PHI Pvt. Limited, 2006.*
2. *R. L. Varshney and K. L. Maheshwari, 'Managerial Economics', S Chand & Sons, 1997(thirteenth edition).*





***REFERENCES:***

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

## 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.
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