ANNA UNIVERSITY: CHENNAI - 25

FACULTY OF SCIENCE & HUMANITIES

Approved Special Electives for M.S. / Ph.D. Degree Programs
(upto 16th AC 02.12.2010)
ANNA UNIVERSITY : : CHENNAI – 600 025.

SPECIAL ELECTIVES FOR FACULTY OF SCIENCE AND HUMANITIES

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>M/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 761 / CG101</td>
<td>Crystal Growth Theory **</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>PH 762 / CG102</td>
<td>Crystal Growth Experimental Techniques **</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>PH 763 / CG001</td>
<td>Epitaxial Growth**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 764 / CG002</td>
<td>Semiconductor Physics**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 765 / CG003</td>
<td>Characterization of Semiconductor Crystals**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 766 / CG004</td>
<td>Imperfection in Crystals**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 767 / CG005</td>
<td>Semiconductor Devices**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 768 / CG006</td>
<td>Fabrication and Characterization of Solar Cells**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 769 / CG007</td>
<td>Characterization Techniques**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 770 / CG008</td>
<td>Biological Crystallization**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 771 / CG009</td>
<td>Crystal Growth-Gel Medium **</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 772 / CG010</td>
<td>Liquid Phase epitaxy**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 773 / CG011</td>
<td>Oxide Crystals – Growth Properties and Applications**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 774 / CG012</td>
<td>Ferroelectrics**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 775 / CG013</td>
<td>Superconducting Material Preparation and Characterization**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 776 / CG014</td>
<td>Numerical Methods and Computer Programming **</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 777 / CG015</td>
<td>X-ray Crystallography**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 778 / CG016</td>
<td>Growth of Crystals From Vapour Phase**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH 779 / CG017</td>
<td>Semiconductor Device Fabrication**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PH780 / CG018</td>
<td>Special Characterization Techniques**</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>FS1911</td>
<td>Organic Synthesis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Code</td>
<td>Course Title</td>
<td>PH</td>
<td>CG</td>
<td>PHG</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------------</td>
<td>----</td>
<td>----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>FS1912</td>
<td>Asymmetric Synthesis</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS1913</td>
<td>Biosensors and Instrumentation</td>
<td>3</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>FS1914</td>
<td>Domination in graphs</td>
<td>3</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>FS1915</td>
<td>Domination related functions in graphs</td>
<td>3</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>FS1916</td>
<td>Crystal growth and spectroscopy</td>
<td>3</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>FS1917</td>
<td>Reservoir Sedimentation</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 1918</td>
<td>Genetic Engineering</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 1919</td>
<td>Analytical Technique in Biotechnology</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 1920</td>
<td>Key Components for All-optical Networks</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 1921</td>
<td>Biomimetic Oxidation Chemistry</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS1922</td>
<td>Bose Einstein Condensation</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS1923</td>
<td>ICT for Development</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 9001</td>
<td>Finite volume method</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 9002</td>
<td>Neural networks, fuzzy logic systems and genetic algorithms</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 9003</td>
<td>Vibrational Spectroscopy</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS 9004</td>
<td>Quantum mechanical computation of molecular models</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FS9005</td>
<td>Differential Subordination</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

** PH code used by Ph.D. Students / CG code used by M. Phil. Students**
Aim: To introduce the fundamentals and theoretical concepts of crystal growth
To enhance the understanding of the phenomena of nucleation and crystal growth

Objectives:
- To provide the basic understanding of the crystal growth of technologically important crystals
- To understand the concepts of homogeneous and heterogeneous nucleation
- To formulate the modeling of crystal based on various theories of crystal growth.

UNIT I

UNIT II
Homogeneous nucleation of Binary system - Induction period. Heterogeneous nucleation - Equilibrium concentration of embryos for different sizes - Energy of formation of a critical nucleus - Free energy of formation of a critical heterogeneous - cap shaped - disc shaped nucleus - Heterogeneous nucleation of Binary vapour - Secondary nucleation.

UNIT III
Theories of crystal growth - Surface energy theory - Diffusion theory - Adsorption layer theory - Volmer theory - Bravais theory - Kossel theory - Stranski's treatment - Two dimensional nucleation theory - Thermodynamics of nucleation - Free energy of formation of a two-dimensional nucleus - Possible shapes - Correction to the two-dimensional nucleation theory - Rate of nucleation - Mononuclear model - Polynuclear model - Birth and spread model - Modified Birth and spread model.

UNIT IV
Crystal growth by mass transfer processes - Bulk diffusion model - Surface diffusion growth theories - Mobility of adsorbed molecules on a crystal surface Physical modeling of BCF theory - BCF differential surface diffusion equation - Single straight step - Multiple straight parallel steps - Surface supersaturation and concentration near the step - Growth rate of an F-face - Giant dislocation steps - Description, Derivation, and interpretation of Temkin's model of crystal growth - PBC theory of crystal growth - Computer simulation technique

UNIT V
Effect of impurities on growth processes - Thermodynamics and structure of solutions adsorption - Dependence of growth and morphology on the concentration of impurities - Creation of defects – slip Plane and Twinning - Inclusions - Inclusions of the mother liquor - Inclusions of foreign particles - Dislocations from a seed - Creation of dislocations in surface processes - Orientation of Dislocations - Thermal stresses - Dislocations related to vacancies and impurities - Grain boundaries.
REFERENCES:

   K. Sangwal, Elementary Crystal Growth, Saan Publisher, UK, 1994
AIM: To introduce the basic concepts of various types of crystal growth methods and characterisation techniques

OBJECTIVES:
- To study the different types of crystal growth methods
- To provide the concepts of melt, vapor, solution and epitaxial growth technique
- To develop the knowledge on characterisation of grown crystal

UNIT I

UNIT II
Growth of crystals from vapour phase - Physical vapour deposition - Chemical vapour transport - Open and closed system - Thermodynamics of chemical vapour deposition process - Physical, thermo-chemical factors affecting growth process.

UNIT III

UNIT IV
Epitaxy - Vapour phase epitaxy (VPE) - Liquid phase epitaxy (LPE) - Molecular Beam Epitaxy (MBE) - Atomic layer Epitaxy (ALE) - Electroepitaxy - Metalorganic Vapour Phase Epitaxy - (MOVPE) Chemical Beam Epitaxy (CBE).

UNIT V

TOTAL PERIODS = 45
REFERENCES:
AIM: To introduce the fundamentals of various types of epitaxy. To enhance the understanding of the phase diagrams, epitaxial growth processes and instrumentation of epitaxial techniques.

OBJECTIVES: On completion of the course the student would be in position

- To understand the concepts of homoepitaxy and heteroepitaxy
- To derive the expressions for the kinetically controlled and thermodynamically controlled growth regimes in epitaxy
- To design the various reactor models in LPE, VPE, MOCVD, MBE, CBE and ALE

UNIT I (10)

UNIT II (10)

UNIT III (9)
Principle of method and apparatus - reactor design - growth of III-V compound Semiconductors - InP - GaAs - GaInAs - GaInAsP and other III-V compounds.

UNIT IV (6)
Mechanism of MOCVD growth - Thermodynamic concepts - growth rate calculations - applications of III-V materials grown from MOCVD - Low pressure MOCVD (LPMOCVD)

UNIT V (10)

TOTAL PERIODS = 45

REFERENCES:
1. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pretice Hall of India, New Delhi, 1994
AIM: To prepare the student for the understanding of the optical and electrical properties of semiconductor

OBJECTIVES:
- Introduce the fundamental concepts of semiconductor physics
- Evaluate the significant advantages in semiconductors for the use in optical and electrical devices
- Create an awareness of the usefulness of advanced semiconductors

UNIT I

UNIT II

UNIT III
UNIT IV
Thermal effects in Semiconductors: Thermal conductivity - Thermo-electric power - Thermomagnetic effects - condition of degeneracy - strong magnetic fields - relative magnitudes of the magnetic effects. Optical and High frequency effects in Semiconductor: Optical constants of semiconductors - the fundamental absorption - exciton absorption photoconductivity - the photo-magnetic effect - high frequency effects in magnetic field - impurity absorption - lattice absorption - Infra-red emission from semiconductors - diffusion of electron and positive holes. Methods of determining of characteristic properties of Semiconductors: The minimum energy gap - mobility of electrons and holes - carrier concentration - effective mass - energy levels in the forbidden band due to impurities - thermal methods - optical methods - minority carrier lifetime - injection ratio.

UNIT V
Application of semiconductors: Use of Semiconductors in electrical technology - Rectifiers - Transistors - Photodiode - Photo-electric power generator - Photo cells - Infra-red detectors - Infra-Red and Microwave modulators - Thermopiles - Thermo-electric refrigerators - Thermistors, Varistors and Other non-linear resistor.

TOTAL PERIODS = 45

REFERENCES:
AIM: To introduce the relevant aspects of semiconductor crystals evaluation and identify the factors responsible for the performance of the devices.

OBJECTIVES:
- Detailed understanding of the structural characterisation techniques related to X-ray diffraction.
- Evaluation of the optical techniques to characterize the semiconductor crystals.
- Discussion of the relevant characterisation techniques to estimate the usefulness of the semiconductor crystals for application purpose.

UNIT I
X-ray diffraction - Powder method - rotating crystal method - specimen preparation - measurement of d-values - indexing procedure for cubic and tetragonal crystals - Single crystal diffractometer - double crystal diffractometer - triple crystal diffractometer - four crystal diffractometer - determination of unit cell and space group.

UNIT II

UNIT III

UNIT IV
Optical, Scanning Electron Microscope (SEM) - morphological studies -- Transmission Electron Microscope (TEM) - structural analysis - Luminescence - Photoluminescence(PL) - Thermoluminescence (TL) - Electroluminescence (EL) - Bulk Analysis.

UNIT V

TOTAL PERIODS = 45

REFERENCES:
AIM: Comprehensive understanding of imperfection in crystals

OBJECTIVES:
- Evaluation of the different types of imperfections
- Understanding the process of defect dynamics
- To study the limitations imposed by imperfections on materials

UNIT I
Crystal Symmetry: Point group and space group symmetry operations - Space group diagrams - International notations - special positions - asymmetric unit and its importance - molecular weight determination - reciprocal lattice concept - interpretation of Bragg's law - Laue condition

UNIT II

UNIT III
Line tension - polygonal dislocations - force on a dislocation - the Peach and Coheler formula - interaction between dislocations - interaction between two parallel dislocations - Inclusions - Inclusions of the mother liquor - Inclusions of foreign particles - dislocation from a seed - propagation of dislocations - creation of dislocations in surface processes - orientation of dislocations - Thermal stresses - Dislocations related to vacancies and impurities - Grain boundaries.

UNIT IV
Imperfect Dislocations - Stacking faults and twins - Schottky dislocations - Frenkel dislocations - origin of growth dislocations - creep - cleavage - interaction of dislocations with other defects - interaction energy - elastic interaction - electrostatic interaction - Screw dislocations - interaction of dislocations with electrical properties and thermal properties of metals and semiconductors.

UNIT V

TOTAL PERIODS = 45
REFERENCES:
AIM: To impart sound knowledge of working principles of various types of electron and optical semiconductor devices.

OBJECTIVES:
- To understand different types of heterostructures in devices.
- To develop the skills in electron devices using ion implantation
- To know the concepts of unipolar and bipolar electron devices
- To develop the knowledge in microwave and optical devices
- To gain the knowledge of integrated circuits and sensors

UNIT I

UNIT II

UNIT III

UNIT IV
UNIT V
Applications of III-V Compounds: Semiconductor device processing for Integrated Circuits

TOTAL PERIODS = 45

REFERENCES:
AIM: To expose the students on the fundamentals and experimental aspects of solar cell fabrication and evaluation

OBJECTIVES:
- Conceptual understanding of the fundamentals involved in the solar cell fabrication process.
- Evaluation methodologies in estimating the efficiency of solar cells
- Expose the researchers to the actual fabrication process and to the need specific design issues of solar cell fabrication

UNIT I
Sources of energy - Solar cell energy conversion - Materials and material problems - Spectral distribution of solar radiation - The Sun and Sun Earth relative motion - Measurements of solar insolations - Solar simulation.

UNIT II
Photon absorption in semiconductors - Carrier transport across p-n junction solar cells - Heterojunction solar cells - Schottky barrier and MIS solar cells - Contacts and surface properties: Contact structures - Antireflection coatings - Surface texturing - Grid design - Etching - Solar cell arrays - Radiation damage on solar cells.

UNIT III
The calculation of solar efficiency - The ideal cell under illumination - The effects of series and parallel resistance - Other treatments of the calculation of the solar efficiency - The effect of temperature and illumination on solar cell efficiency - Loss analysis - Some common and emerging solar cells - Fabrication process and photovoltaic performance of some standard solar cells like Silicon, Gallium arsenide (GaAs), Indium phosphide (InP), Copper indium selenide (CuInSe2), Cadmium Telluride (CdTe), Cu2S based solar cells and polycrystalline thin film silicon solar cells and amorphous silicon solar cells - photoelectrochemical cell.

UNIT IV
Novel concepts in design of high efficiency solar cells - High intensity effects - Unconventional non-concentrator cells: Metal insulator semiconductor cells (MIS) - Induced junction cell and front surface field cell - Multiple pass cell - Liquid junction cells - Unconventional concentrator cells: parallal multiple vertical junction cells - Series multiple perpendicular junction cell - V grooved multijunction solar cell - Integrated back contact (IBC) cell - High low junction emitter cell - Graded band gap solar cell - Multiple cell systems: Spectrum splitting and cascade cells - Thermophotovoltaic (TPV) system - photoelectrolytic cell.

UNIT V
Characterization techniques - Photovoltaic measurements I-V characteristics - Spectral response - Optical scanning - light beam induced current (LBIC) pictures and electron beam induced current (EBIC) micrograph for the direct determination of minority carrier diffusion length - junction analysis: I-V analysis - Capacitance measurements - DLTS Technique - Material characterization - X-ray diffraction – Reflection high energy electron diffraction (RHEED) - Scanning electron microscopy (SEM) - Scanning
transmission electron microscopy (STEM) - Transmission electron microscopy (TEM) - Auger electron spectroscopy (AES) - Electron spectroscopy for chemical analysis (ESCA) - Secondary ion mass spectroscopy (SIMS).

TOTAL PERIODS = 45

REFERENCES:
4. Willard , Merrit, Dean and Settle, Instrumental methods of analysis, CBS publishers and distributors, India, 1986
PH 769 (Old Code: CG007) CHARACTERIZATION TECHNIQUES  

AIM: To enable the students to understand the importance of materials characterization  
To expose the students on Advanced Characterization Techniques

OBJECTIVE:
- Through this course, the students would be exposed to Advanced  
- Materials Characterization Techniques to understand the structural, optical,  
  mechanical and defect characteristics of the materials.

UNIT I (9)
Absorption & Emission spectroscopy - Nature of electromagnetic radiation - Atomic  
energy levels - Molecular electronic energy levels - vibrational energy levels - Raman  
effect - X-ray energy levels.

UNIT II (8)
Infrared spectroscopy - Near IR - Mid IR - Far IR Region - Correlation of infrared spectra  
with molecular structure - structural Analysis - Radiation sources - Detectors -  
Thermal Detectors - Photon Detectors - Spectrophotometers - Fourier Transforms  
Interferometer - Sample handling.

UNIT III (9)
Raman spectroscopy - Theory - Resonance Raman Spectroscopy - Comparison of Raman  
with Infrared Spectroscopy - Diagnostic - Structural Analysis - Polarization measurements  
- Instrumentation - Quantitative analysis.

UNIT IV (10)
X-ray methods - Production of X-rays and X-ray Spectroscopy - Instrumental units -  
Detectors for the measurements of radiation - Semiconductor detectors - Direct X-ray  
methods - Nuclear magnetic Resonance Spectroscopy - Basic principles - Quantitative  
analyses - Scanning Electron Microscopy - Electron Spectroscopy for Chemical Analysis  
- Electron Probe Micro Analysis.

UNIT V (9)
Thermal analysis - Differential Thermal Analysis - Instrumentation - Differential  
Scanning calorimetry - Thermogravimetry - Instrumentation - Methodology of  
Differential Scanning Calorimetry & Thermo Gravimetric Analysis - Conductance method -  
Electrical conductivity - Measurement of electrical conductance - Measurement of  
dielectric constant. Microhardness - Etching studies.

TOTAL PERIODS = 45

REFERENCES:
1. X.F. Zong, Y.Y. Wang, J. Chen, Material and Process Characterization for VLSI,  
World Scientific, New Jersey, 1988
2. S.M. Sze, Semiconductor Devices, Physics and technology, John Wiley Publishers,  
New York, 2000
1982
Sons Inc., New York, 1990
AIM: To introduce the subject of biomineralisation.
To introduce Crystallization of biological macromolecules and their application to structural biology.

OBJECTIVE:
- To expose the students to the basic science of crystallisation of biological molecules like proteins, enzymes etc., and their application to structural biology & drug designing.
- To understand the importance of the study of Biominerals to Materials Technology.
- To study the synthesis of Hydroxyapatite which is a bone and dental replacement material.

UNIT I
Crystal Growth from solution - Driving force for crystallization - solubility in biological fluids - growth kinetics - nucleation - Diffusion effects - Dissolution - Morphology in vivo & in vitro studies - Crystals responsible for the crystal deposition diseases - Mono sodium urate monohydrate - Calcium pyrophosphate dihydrate - Cholesterol - Steroids - Dicalcium phosphate dehydrate - hydroxyapatite - Calcium oxalate - Calcium hydrogen phosphate dihydrate crystals.

UNIT II

UNIT III

UNIT IV

UNIT V
The Importance of the Study of Biominerals to Materials Technology - Materials Development - the Scope of Biominerals - Problems in Materials Technology and Insights from Biology - An Interfacial Problem - Adhesion - The Toughness of Inorganic Materials -

REFERENCES:
AIM: To expose the students to the gel method of crystallization and its application to biomacromolecular crystallization and microgravity experiments

OBJECTIVE:
- To study about different types of gels and their suitability to grow organic and inorganic crystals

UNIT I

UNIT II
Gel structure & properties - Gel preparation and properties - Cooling of a sol - Chemical reaction – Precipitating agents - incompatible solvents - Gelling mechanism & Structure of silica gels - Gels as diffusion media.

UNIT III
Growth mechanism - Diffusion patterns & single crystal growth rates - Functions of the gel - Advantages of the gel growth - Habit modifications - Concentration of feed solution - Crystallization temperature - Gel structure - Addition of various impurities - Various types of gels - Spacial distribution.

UNIT IV
Nucleation - Evidence for homogenous nucleation - Nucleation control - Suitable reactants - Gels prepared with various acids - changing the gel structure - Intermediate neutral gel - effect of concentration variation.

UNIT V
Liesegang rings - Qualitative features - Spiral formation - Radiation effects - Effects of gravity - Effect of electric field - Sol coagulation models - Conditions of quasi stability - Effect of growth rate - Chemical reaction method - Complex dilution method - Solubility reduction method.

REFERENCES:
3. P.Ramasamy, UGC Summer School, Lecture notes, Crystal growth Centre, Anna University, Chennai, 1991

TOTAL PERIODS = 45
PH 772 (Old Code: CG010)  LIQUID PHASE EPITAXY  L T P C  3 0 0 3

AIM:  To enhance in-depth knowledge in the fundamentals and applications of Liquid Phase epitaxy.

OBJECTIVES:
- To make the students to understand the concepts of liquid phase epitaxy and should be in a position to fabricate Liquid Phase Epitaxial system for the growth of heterostructures of elemental and compound semiconductors.

UNIT I
Introduction to Epitaxy - Phase equilibria - Basic concept of LPE growth process - Impurity segregation - Substrate surface preparation - Operational consideration - Physical principles of the LPE process - Equilibrium cooling - Step cooling - Super cooling - Two phase solution cooling - Electroepitaxy - Advantages and disadvantages of LPE as a growth technique for device materials

UNIT II
Properties and Phase diagrams - Properties and phase diagrams of Binary, ternary and quaternary compounds semiconductors - Gallium arsenide - Gallium phosphide - Gallium antimonide - Indium phosphide - Indium antimonide - Indium arsenide - Gallium aluminium arsenide - Indium gallium arsenide - Indium arsenide phosphide - Gallium arsenide antimonide - Gallium arsenide phosphide - Indium arsenide antimonide - Aluminium gallium phosphide - Indium gallium arsenide phosphide

UNIT III
Apparatus and Methodology - Boat designs: Tip system - Dip system - Horizontal sliding boat system - Rotary slider - Wipingless growth system - Multi slice boat designs - Furnace design - Theory - Diffusion limited growth theory - Solid liquid phase diagram - Impurity incorporation model - Phase diagram - Homoepitaxy - Heteroepitaxy - Device application of LPE growth

UNIT IV
Properties and Characterization - Band gap - Electrical properties - Optical properties - Crystal perfection - Layers thickness control - Abrupt junctions - Selective area and structured substrate growth - Composition control

UNIT V

TOTAL PERIODS = 45

REFERENCES:
PH 773 (Old Code: CG011)  OXIDE CRYSTALS – GROWTH PROPERTIES  L T P C AND APPLICATIONS  3 0 0 3

AIM: To enable the students to study the fundamental properties of oxide materials and the crystal growth of oxide materials

OBJECTIVE:
- The explore the fundamental issues with regard to the growth of oxide single crystal and the associate difficulties, various crystal growth techniques for the growth of oxide crystals and the technological applications of oxide crystals.

UNIT I
Growth of oxide single crystals - Experimental set up - Czochralski technique - Verneuil technique - Flux technique.

UNIT II

UNIT III

UNIT IV
Characterization of grown crystals - X-ray Laue, powder diffraction and oscillation photographs - IR spectra analysis - ESCA - SEM and EPMA studies - TGA and DTA to analyse thermal properties - Study of lasing action in crystals - Phase conjugation studies - Holographic materials.

UNIT V
Single Crystals for Radiation Detectors - Introduction - Scintillation characteristics in general - Survey of typical scintillation crystals - Crystal growth of scintillation detectors - Scintillation characteristics - Radiation damage of scintillation crystals - Applications of high-Z scintillators.

TOTAL PERIODS = 45

REFERENCES:
AIM: To enhance the understanding of the Ferroelectric materials, which are the special class of electronic materials.

OBJECTIVE:
- To explore the importance and applications of Ferroelectric materials
- Study of domain structure and domain kinetics of Ferroelectrics, electrical and switching characteristics of Ferroelectric materials.

UNIT I

UNIT II
Optical and related properties - Refractive index and Birefringence - Optical dispersion - Thermooptic behaviour - Elasto optic behaviour - Electrooptic characteristics - Non-Linear optical effects - photo refractive effect - Light scattering effect - Absorption - Photoluminescence - Electro luminescence and Luminescence.

UNIT III

UNIT IV
Non-linear optics - wave propagation in Non-linear dielectrics - Electrooptic and Non-linear optic co-efficients - The nonlinear susceptibility - Optical second Harmonic generation.

UNIT V
Order-Disorder Ferroelectrics - Triglycine Sulphate - Sodium nitrate - Displacive Ferroelectrics - oxygen Octahedran - Applications of Ferroelectrics - Pyroelectric detection - Memories and display.

TOTAL PERIODS = 45

REFERENCES:
4. Amnon Yariv, Quantum mechanics, John Wiley and sons Inc, New York, 1975
PH 775 (Old Code: CG013) SUPERCONDUCTING MATERIAL L T P C PREPARATION AND CHARACTERIZATION 3 0 0 3

AIM: To enhance theoretical and modern technological aspects of Superconductivity and Superconducting materials.

OBJECTIVE:
- To explore the fascinating field of superconductivity, to study the mechanism of superconductivity, growth of superconducting single crystals, magnetic and electrical properties, to explore the applications of these materials.

UNIT I

UNIT II

UNIT III
Structure of LSCO - YBCO - BSCCO - TIBCCO - Domain structure - superstructure formation - structure modulation in superconducting materials

UNIT IV

UNIT V
Fullerenes - Making of fullerenes - deposition of graphitic soot - Isolation of Buckminster fullerenes C60 and higher fullerenes - Superconductivity in fullerenes - effects of different dopants - enhancement of Tc values - resistivity and susceptibility measurements - Growth of C60 single crystals.

TOTAL PERIODS = 45

REFERENCES:
Faculty of Science and Humanities (Approved in 3rd AC 22.11.2003) ITEM NO.3.4 (2(16))

PH 776 (Old Code: CG014) NUMERICAL METHODS AND COMPUTER PROGRAMMING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

AIM: To introduce the fundamentals of various types of numerical simulation techniques
To enhance the understanding of the numerical simulation in crystal growth by using computation methods

OBJECTIVES: On completion of the course the student would be in position
- To understand the basic concepts of numerical simulation
- To solve the heat and mass transfer related problems in crystal growth

UNIT I (9)

UNIT II (10)
Interpolation, curve fitting and statistics: Finite difference operator - Newton’s forward and backward interpolation formula - lagrange’s Interpolation – Lagrange’s inverse interpolation – curve fitting - principle of least squares –Linear correlation and regression analysis – sampling distributions - small and large samples – tests of hypothesis – students distribution – F-distribution - chi square distribution

UNIT III (9)

UNIT IV (8)
C programming: Introduction, operator, expressions, variables, input, output statements, control statements, functions, arrays, pointers, structures, unions – simple applications.

UNIT V (9)

TOTAL PERIODS = 45

REFERENCES:
AIM: To enhance the theoretical and experimental understanding of X-ray crystallography and structural characterization of materials.

OBJECTIVE:
- Through this course the students would be exposed to the X-ray diffraction analysis of material properties including structural analysis, determination of lattice parameters, symmetry properties and Texturing aspects of crystalline materials.

UNIT I (9)

UNIT II (8)

UNIT III (10)

UNIT IV (9)

UNIT V (9)

TOTAL PERIODS = 45

REFERENCES:
AIM: To study the fundamentals of various types of nucleation processes during vapour growth process

To learn the optimum conditions for the growth of technologically important materials from vapor phase and the methods of epitaxial growth techniques.

OBJECTIVES: On completion of the course the student would be in position

- To do independent work on the growth of crystals from vapour phase
- To design the various reactors for the growth of crystals using CVT, PVT, CVD, PVD techniques

UNIT I

Methods of vapour phase growth – Physical Vapor Transport (PVT) – Physical Vapor Deposition (PVD) – Chemical Vapor Deposition (CVD) – Chemical Vapour Transport (CVT) – reaction types - thermodynamics, kinetics - transport processes - Thermodynamics of Chemical vapor deposition process – physical, thermo – chemical factors affecting growth process.

UNIT II


UNIT III


UNIT IV

Advantages and Limitations of Chemical Vapor Transport (CVT) – stationary temperature profile (STP) – linearly time varying temperature profile (LTVTP) – oscillating temperature profile (OTP) – the role of chemical and geometrical parameters on CVT – determination of thermodynamic values – LPCVD – VPE – MOVPE.

UNIT V

The transport of solid substances and its special applications – metal transport with vapor, hydrogen halides and volatile halides – oxides transport with water vapor, hydrogen halides, oxygen and volatile halides – introduction of impurities by transport-Growth of II-VI and I-III-VI_{2} compounds from vapour phase.

TOTAL PERIODS = 45
REFERENCES:
AIM: To disseminate the knowledge of semiconductor device processing and to deliver the functional devices.

OBJECTIVES:
At the end of the course the student should be in a position to meet the following objectives.
- Preparation of semiconductor structures for processing
- Deposition of oxides, masking and etching
- Applications and limitations of optical lithography and electron lithography
- Metallization, liftoff and annealing
- Dicing, bonding and packing of devices.

UNIT I (9)
Wafer Preparation: Bulk Crystal Growth - Cutting and Polishing - Surface Cleaning - Etching for oxide layer removal - Controlled dissolution of surfaces - Identification for batch processing.

UNIT II (10)
Deposition: Deposition processes - Silicon dioxide - Silicon nitride - Other materials - Plasma assisted deposition - Plasma Enhanced Chemical Vapour Deposition (PECVD) - Oxidation: Growth mechanism and kinetics - Oxidation techniques and systems - Oxide properties - Redistribution at interface - Oxidation induced defects.

UNIT III (10)

UNIT IV (8)
Metallization: Methods of physical vapour deposition - Selected metals for metal-semiconductor contacts - Problems encountered in metallization - Metallization failure - Silicides for gates and interconnections - Corrosion and bonding.

UNIT V (8)
Assembly Techniques and packaging: Wafer separation and sorting - Die interconnections - Package types and fabrication technology - Special package considerations.

TOTAL PERIODS = 45
REFERENCES:
AIM: To enable the students to study the special characterization Techniques of very high sophistication.

OBJECTIVE:

- To enable the students to study the special characterization techniques with respect to technologically important materials to study the surface features, domain structure and to estimate the composition.

UNIT I

UNIT II

UNIT III
X- ray Diffraction -Powder, Laue and rotating crystal methods – use of X-ray diffraction for the measurement of the lattice parameters – single crystallinity – Xray topography – double circle and four circle diffractometers

UNIT IV
Optical Microscopy - Use of polarized light microscopy, phase contrast microscopy and interference microscopy – hot stage microscopy – surface morphology – Etch pit density – Hardness Measurements

UNIT V

TOTAL PERIODS = 45

REFERENCES:
UNIT I PRINCIPLES OF ORGANIC SYNTHESIS
Basic principles - Convergent and linear synthesis - Concept of retrosynthetic analysis – Synthons and synthetic equivalents - Stereoselectivity, Stereospecificity, Regio selectivity and Chemoselectivity.

UNIT II FUNCTIONAL GROUP PROTECTION
Functional group interconversions – Protection and deprotection – Latent functionality – Reverse polarity (Umpolung) - One group C-X disconnection.

UNIT III FUNCTIONAL GROUP DISCONNECTION
Two group disconnection - 1,2-Difunctional compounds, 1,3-Difunctional compounds and 1,4 - Difunctional compounds.

UNIT IV PERICYCLIC REACTIONS

UNIT V PHOTOCHEMICAL REACTIONS
Olefin metathesis - Heterocyclic ring synthesis - Photochemical reactions in organic synthesis.

TOTAL : 45 PERIODS

REFERENCES:
UNIT I STEREOCHEMISTRY  
Stereoselectivity, enantioselectivity and diastereoselectivity - Cram’s rule and Felkin-Anh model - Addition to carbonyl compounds - Organo magnesium, Organo copper, Organo cadmium, Organo zinc, Organo tin and Organo indium compounds.

UNIT II CHIRAL SYNTHESIS  
Alpha substitution using chiral enolates – chiral auxiliary approach – chiral Auxiliaries derived from amino acids and simple carbohydrates - Asymmetric aldol reactions.

UNIT III ADDITION REACTIONS  
Addition to C-C double bonds – asymmetric Diels - Alder reactions – asymmetric 2,3 cycloaddition reactions - Chirality transfer and pericylic reactions.

UNIT IV ASYMMETRIC SYNTHESIS REACTIONS  
Asymmetric cyclopropanations- asymmetric Michael additions – Asymmetric reduction of ketones by chiral Binap and chiral boranes- Chiral transfer hydrogenations – enzymatic reduction of ketones.

UNIT V ASYMMETRIC OXIDATION  
Asymmetric oxidations asymmetric hydroxylation of enolates Asymmetric dihydroxylation of C-C double bonds – asymmetric epoxidation of allylic alcohols and olefins.

TOTAL: 45 PERIODS

REFERENCES:
UNIT I INTRODUCTION
Concepts and components of a biosensor - principles of operation, integration of biosensor in instrumentation.

UNIT II PREPARATION OF BIOSENSOR
Biomolecules used in biosensors and their properties, general Immobilization techniques for (Optical-detection biosensor, thermal-detection biosensor, electrochemical biosensor etc.,) behaviour of different types of biosensors.

UNIT III TYPES OF BIOSENSOR
Enzyme based biosensor; (glucose biosensor, cholesterol biosensor), microbial immunobiosensor and their characteristics.

UNIT IV APPLICATIONS OF BIOSENSORS
Validation (Specificity, Speed, Simplicity, Capability), application of biosensor in environment, Microbiology: bacterial and viral analysis, Food and beverage production and analysis, Clinical Diagnosis.

UNIT V INSTRUMENTATION OF BIOSENSOR
Transducers: Optical Transducers, Fluorescence transducers, Acoustic transducer. Polarizable and non-polarizable electrodes acoustic, plasmon resonance, holographic and microengineered sensors for monitoring low molecular weight analytes, proteins, DNA and whole cells.

REFERENCES:
FS1914 DOMINATION IN GRAPHS

UNIT I DOMINATING SETS
Dominating sets in graphs – Minimal dominating sets – Hereditary and superhereditary properties – Minimal and Maximal P-sets – Independent sets – Every maximal independent set is a minimal dominating set – Irredundant sets – Domination chain – Bounds involving domination, independence and irredundance numbers.

UNIT II CHANGING AND UNCHANGING DOMINATION

UNIT III CONDITION ON DOMINATING SET
Condition on the dominating set – Independent dominating sets – Total dominating sets – Connected dominating sets – Bounds for connected domination number – External graphs attaining the bounds.

UNIT IV DOMINATING CLIQUES
Dominating cliques – Sufficient condition for existence of a dominating clique – Bounds for the clique domination number – Paired dominating sets – Paired domination number – Bounds for paired domination number – Inequalities connecting paired domination number and other domination parameters

UNIT V VARIETIES OF DOMINATION
Varieties of domination – Multiple domination – Bounds for the multiple domination number – k – dependence number – Inequality connected k-domination number and k – dependence number – Locating domination – Locating domination number – Bounds – Strong and weak domination – Strong and weak domination number – Bounds.

TOTAL : 45 PERIODS

TEXT BOOK:
FS1915  DOMINATION RELATED FUNCTIONS IN GRAPHS  L T P M
3 0 0 100

UNIT I  FRACTIONAL DOMINATION
Fractional domination – Fractional and Upper fractional domination numbers – Fractional packings – Fractional packing number and Upper fractional packing number – Fractional total domination – Fractional total domination number – Fractional irredundance – $k$–domination– $k$–packings and $k$–irredundance

UNIT II  MINIMAL DOMINATING FUNCTIONS
Properties of Minimal dominating functions – Positive sets and boundary sets  Existence of positive minimal dominating functions – Convex combination of dominating functions – Universal Minimal Dominating functions – Graphs having Universal Minimal Dominating functions

UNIT III  VERTICES OF TREES
Convexity of Minimal Dominating functions of trees – Cool vertices of trees – Characterization of cool vertices – Loose vertices – Characterization of loose vertices– Universal Minimal Dominating Functions in Trees – Algorithm for 0–1 Universal Minimal Dominating functions in trees

UNIT IV  TOTAL DOMINATING FUNCTIONS
Universal Minimal Total dominating functions in Graphs – Basic results – Graphs having a unique Minimal Total Dominating Function – Short vertices and Hot vertices – Existence and Non existence of Universal Minimal Total Dominating Functions in trees

UNIT V  SIGNED DOMINATION
Minus domination – Signed domination – Signed domination number – Upper signed domination number – Trees with minus domination number 1 – Bounds for signed domination number of trees

TOTAL: 45 PERIODS

REFERENCES:
1. T. W. Haynes, S. T. Hedetniemi and P. J. Slater, Domination in Graphs – Advanced Topics, Marcel Dekker, Inc., New York, 1998. (Sections 3.1, 3.2.1, 3.2.2, 3.3.1)
UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

REFERENCES:
<table>
<thead>
<tr>
<th>UNIT I</th>
<th>CATCHMENT PROCESSES</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3 0 0 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT II</th>
<th>RESERVOIR EUTROPHICATION</th>
<th>10</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT III</th>
<th>SEDIMENTS</th>
<th>12</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT IV</th>
<th>SEDIMENT SAMPLING AND ANALYSIS</th>
<th>8</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT V</th>
<th>SEDIMENT CONTROL AND MANAGEMENT</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control of reservoir sedimentation– sediment removal and disposal – environmental, social and economical impacts.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL : 45 PERIODS**

**REFERENCES:**
UNIT I  SALIENT FEATURES OF CLONING VECTORS  9
Types of cloning vectors viz. Plasmids, Cosmids, ssDNA Phages, Yeast cloning vectors, Animal viruses, Ti Plasmids and cauliflower Mosaic Virus.

UNIT II  PLASMID BIOLOGY  8
Structural and Functional Organization of Plasmids, Plasmid Replication, Stringent and Relaxed Plasmids, Incompatibility of Plasmid Maintenance.

UNIT III  ENZYMES IN GENETIC ENGINEERING  8
DNA polymerase, Polynucleotide kinase, T4 DNA ligase, Nick translation System, Terminal deoxynucleotide transferase, Reverse transcriptase Restriction Endonucleases Type I & II.

UNIT IV  ISOLATION OF GENOMIC AND NUCLEAR DNA  9
DNA digestion and restriction fragment analysis and sequencing by chemical, Enzymatic and big-bye terminator methods.

UNIT V  GENE MODIFICATION & APPLICATION OF RECOMBINANT DNA TECHNOLOGY  11
Mutagenesis-Deletion mutagenesis, Oligonucleotide derived mutagenesis, Site directed mutagenesis- Its applications; Applications of rDNA technology in Diagnostics; Pathogenesis; Genetic diversity; Therapeutic proteins-Vaccines. Molecular probes (production, labeling and uses), P.C.R.

TEXT BOOKS:
2. “Genes VI” by B.Lewin
3. “From Genes to Clones” by E.L. Winnecker.
Faulty of Science and Humanities

ITEM NO. FS 13.01(3)

FS 1919 ANALTICAL TECHNIQUE IN BIOTECHOLOGY

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

UNIT I CHROMATOGRAPHY - TECHNIQUES
Chromatography – adsorption, affinity, partition (GLC, GC, HPLC, TLC, RPC etc.) Immobilized cells.

UNIT II MICROSCOPY - TECHNIQUES
Microscopic identification of various microorganisms: phase contrast and confocal microscopy: SEM-TEM microscopy.

UNIT III SPECTROSCOPIC TECHNIQUES
Introduction to principles and applications of Spectroscopic methods UV, Vis, IR, Fluorescence, ORD, CD, PAS, NMR, ESR and mass spectrometry.

UNIT IV NUCLEOTIDE AND DNA ANALYSIS
DNA purification, PCR – based analysis; DNA fingerprinting; DNA sequencing.

UNIT V IMMUNO-TECHNIQUES

TEXT BOOK:
FS 1920  KEY COMPONENTS FOR ALL-OPTICAL NETWORKS  L T P C
3 0 0 3

UNIT I  DWDM & ALL OPTICAL NETWORKS  9
ITU grid frequencies – Basic network elements of a point to point DWDM system – Issues in DWDM networks- wavelength stabilization, chirping, non-linearities – self phase modulation, FWM, dispersion management, DWDM link design (case study) , Evolution of all – optical networks (optical internet)

UNIT II  NETWORK ELEMENTS  9

UNIT III  WAVELENGTH ROUTING ELEMENTS  9
ROADM architectures, OXC’s, Wavelength converters, Adaptation of these components to optical MEMs based systems for dynamic configurability.

UNIT IV  PHOTONIC COMPONENTS & MATERIALS  9
SEED based devices for optical programming logic, photonic bandgap structures, metamaterials, photonic crystal fibers, programmable optical delays

UNIT V  OPTICAL PACKET SWITCHING  9
GMPLS, Key elements of All- optical packet switching nodes, KEOPS test-bed

REFERENCES:
UNIT I BIOCATALYST OXIDATIONS

UNIT II BIOMIMETIC OXIDATIONS OF CYTOCHROME P450MIMIES
Biocatalytic conversion – oxygenases – oxidases – peroxidases – Biomimetic oxidations – cytochrome P450mimies – MMO mimies

UNIT III BIOMIMETIC CHEMISTRY OF MOLYBDENUM
Biomimetic chemistry of Molybdenum – Overview of Biomimetic systems – Oxygen atom transfer reaction – Coupled electron - Proton transfer reaction

UNIT IV DISTINGUISHING BIOMIMETIC OXIDATIONS FROM OXIDATIONS MEDIATED BY FREELY DIFFUSING RADICALS-FREE RADICALS
Distinguishing Biomimetic oxidations from oxidations mediated by freely diffusing radicals-free radicals – Clock-choice of activation source – Effect of additives – competitive Kinetics – Oxygenated Penton chemistry.

UNIT V METAL – OXO AND METAL – PEROXO INTERMEDIATES
Biometric oxygenation related to Cytochrome P450 Metal- Oxo and Metal – Peroxo intermediates – Mechanism of hydroxylation by Cytochrome P450-Decomposition catalysis for Peroxy nitrite by impartan biological oxidants.

REFERENCES:
5. Biomimetic Oxidations Catalyzed by Transition Metal Complex by Bernard Meunier, Imperial College Press.
UNIT I  INTRODUCTION & THE NON-INTERACTING BOSE GAS
Bose-Einstein condensation in atomic clouds - Superfluid helium - Other Condensates - 
The Bose Distribution - Transition temperature and condensate fraction – Density profile 
and Velocity distribution - Thermodynamic quantities (Condensed phase, Normal phase 
and specific heat close to TC) – Effect of finite particle number – Lower dimensional 
systems.

UNIT II  TRAPPING AND COOLING OF ATOMS
Magnetic traps – Influence of laser light on an atom – Laser cooling (the Doppler Process) 
– the magneto-optical trap – Sisyphus cooling – Evaporative cooling – Spin polarized 
hydrogen.

UNIT III  THEORY OF CONDENSED STATE & ITS DYNAMICS
The Gross – Pitaevskii equation – The ground state for trapped bosons – Surface 
structure of clouds – Healing of the condensate wave function – General formulation (The 
Hydrodynamic equations) – Elementary excitations – Collective modes in traps – Surface 
modes – Free expansion of the condensate – Solitons

UNIT IV  SUPER FLUIDITY
The Landau criterion – The two component picture (Momentum carried by excitations and 
Normal fluid density) – Dynamical processes – First and second sound – Interactions 
between excitations (Landau damping)

UNIT V  MIXTURES AND SPINOR CONDENSATES
Mixtures – Equilibrium properties and collective modes, Spinor Condensates – Mean field 
description and Beyond the mean field approximation.

REFERENCES:
AIM
To introduce the students to principles and tools of information and communication technology (ICT), and its applications for development.

OBJECTIVES
- To understand the information and communication technology developments in India and their role in creating social change.
- To know the different tools of ICT.
- To know the benefits of the tools of ICT for development.

UNIT I INTRODUCTION

UNIT II ICT IN HEALTH

UNIT III ICT IN AGRICULTURE

UNIT IV ICT IN HOLISTIC DEVELOPMENT

UNIT V ICT IN SUSTAINABLE DEVELOPMENT
Sustainable Development Definition – economic, environmental, social and human sustainability – Brundtland report – Improving public awareness – Monitoring – Response systems – Facilitating environmental activism – Enabling more efficient resource use through ICT.

TEXT BOOKS:
2. Akhtar Badshah, Sarbuland Khan and Maria Garrido, Connected for Development, UN ICT Task Forces.

REFERENCES:
FS9001  

FINITE VOLUME METHOD  

UNIT I  
CONSERVATION LAWS AND BOUNDARY CONDITIONS  
Governing equation of fluid flow: Mass, Momentum and Energy equations, Equation of state; Navier-Stokes equations for a Newtonian fluid, Conservative form of equations of fluid flow, Differential and integral forms of the transport equation, classification of PDE’s and fluid flow equations, viscous fluid flow equations, transonic and supersonic compressible flows.

UNIT II  
FINITE VOLUME METHOD FOR DIFFUSION & CONVECTION-DIFFUSION PROBLEMS  
FVM for Diffusion Problems: one-dimensional steady state diffusion, two-dimensional diffusion and three-dimensional diffusion problems; FVM for Convection-Diffusion problems one-dimensional steady state convection-diffusion, central differencing schemes for one-dimensional convection-diffusion, upwind differencing scheme, hybrid differencing scheme, Higher-order differencing scheme for convection-diffusion problems, TVD schemes

UNIT III  
SOLUTION ALGORITHMS FOR PRESSURE VELOCITY LINKED EQUATIONS  
Staggered grid, momentum equations, SIMPLE, SIMPLER, SIMPLEC algorithms, PISO algorithms, solution of discretised equation: Multigrid techniques.

UNIT IV  
FINITE VOLUME METHOD FOR UNSTEADY FLOWS  
One-dimensional unsteady heat conduction: Explicit, Crank-Nicolson, fully implicit schemes, implicit method for two- and three- dimensional problems, transient convection – diffusion equation and QUICK differencing scheme, solution procedures for unsteady flow calculations and implementation of boundary conditions.

UNIT V  
METHOD WITH COMPLEX GEOMETRIES  
Body-fitted co-ordinate grids for complex geometries, Cartesian Vs. Curvilinear grids, difficulties in Curvilinear grids, Block-structured grids, Unstructured grids and discretisation in unstructured grids, Discretisation of the diffusion term, Discretisation of convective term, treatment of source terms, Assembly of discretised equations, Pressure-velocity coupling in unstructured meshes, staggered Vs. co-located grid arrangements, face velocity interpolation method to unstructured meshes.

TOTAL: 45 PERIODS

TEST BOOK:

REFERENCES:
UNIT I INTRODUCTION ON TO NEURAL NETWORKS

UNIT II FEED FORWARD NEURAL NETWORKS

UNIT III ASSOCIATIVE MEMORIES

UNIT IV FUZZY LOGIC SYSTEM COMPONENTS

UNIT V GENETIC ALGORITHMS

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES:
FS9003  VIBRATIONAL SPECTROSCOPY  L T P C  4 0 0 4

UNIT I  MOLECULAR VIBRATIONS & INFRARED SPECTROSCOPY  12

UNIT II  RAMAN SPECTROSCOPY  12

UNIT III  GROUP THEORETICAL APPLICATIONS  12

UNIT IV  NORMAL COORDINATE ANALYSIS  12

UNIT V  LATTICE DYNAMICS AND CRYSTAL SPECTRAL  12

TOTAL : 60 PERIODS

REFERENCES:
FS9004 QUANTUM MECHANICAL COMPUTATION OF MOLECULAR MODELS

UNIT I COMPUTATIONAL THEORY, MODELING AND MOLECULAR MECHANICS 12

UNIT II SIMULATIONS OF MOLECULAR ENSEMBLES 12

UNIT III MOLECULAR ORBITAL THEORY 12
Quantum mechanics and wave function – The Hamiltonian operator – Construction of Trial wave function – Huckel theory – Many electron wave function – Extended Huckel Theory.

UNIT IV SEMIEMPIRICAL IMPLEMENTATIONS OF MOLECULAR ORBITAL THEORY 12

UNIT V DENSITY FUNCTIONAL THEORY 12

TOTAL : 60 PERIODS

REFERENCES:
UNIT I  PRELIMINARIES AND THEORY OF SECOND ORDER DIFFERENTIAL SUBORDINATIONS
Basic definitions and results – Subordinations – Hyper geometric functions – Classes of functions – Integral operators.
Introduction – Fundamental lemmas – admissible functions and examples – Open door lemma and integral existence theorem

UNIT II  APPLICATIONS OF FIRST ORDER DIFFERENTIAL SUBORDINATION
First order linear differential subordinations – Briot – Bouquet differential subordination - Analytic integral operators – Subordination preserving integral operators.

UNIT III  APPLICATIONS OF SECOND ORDER DIFFERENTIAL SUBORDINATION
Second order linear differential subordination – integral operators preserving functions with positive real parts – Integral operators preserving bounded functions – Averaging integral operators – Hyper geometric functions – Schwarzian and Starlikeness

UNIT IV  SPECIAL DIFFERENTIAL SUBORDINATION
Conditions for special sub classes of star like functions – Simple Conditions for star likeness and convexity – On a theorem of Robertson – subordination by convex functions – Function with bounded turning and star like functions – star like with respect to symmetric points.

UNIT V  DIFFERENTIAL SUBORDINATION OF SEVERAL COMPLEX VARIABLES AND APPLICATIONS
Preliminary lemmas – extensions of the fundamental lemma – Dominant and admissible functions in $C^n$ - Differential subordination in $C^n$.

TOTAL : 45 PERIODS

TEXT BOOK:

REFERENCES: