DEPARTMENT OF PHYSICS
ANNA UNIVERSITY, CHENNAI

VISION:

Department of Physics, at Anna University shall

- Strive towards the world class centre by producing students with higher technical knowledge, professional skills and other values.
- Provide an outstanding experience in teaching, research and consultancy.
- Perform frontier research and create knowledge base in pure and applied physics, materials science, laser engineering and areas of technological importance.

MISSION:

Department of Physics, Anna University shall

- Provide high quality physics education, producing well prepared students who are intellectually and technically equipped in their abilities and understanding of physics and in particular materials science.
- Promotes high quality academic and research programmes and providing extension services in cutting edge technologies in materials science and laser engineering.
- Ensures the supportive campus climate in academic and research activities by meeting the need of the students, faculty and staff.
1. **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

I. To make the students in mastering in the field of materials science and prepare them for research.

II. To provide students with a solid foundation in mathematical, scientific and fundamentals of Physics and Materials Science and to impart knowledge on preparation, processing, characterization and applications of various kinds of Materials.

III. To train students with good scientific and sound knowledge of Materials Science so as to comprehend, design, analyze, and provide solutions for the real life problems.

IV. To inculcate the students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Materials Science aspects to broader social context.

V. To provide students an academic environment to develop excellence in leadership qualities, practice ethical codes and guidelines, and achieve life-long learning needed for a successful professional career.

2. **PROGRAMME OUTCOMES (POs):**

After going through the two years of study, our Materials Science Post-Graduates will exhibit ability to:

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<th>PO #</th>
<th>Graduate</th>
<th>Programme Outcome</th>
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<td>1.</td>
<td>Research aptitude</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<td>Technical documentation</td>
<td>An ability to write and present a substantial technical report/document</td>
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<td>3.</td>
<td>Technical competence</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<td>Modern Tool Usage</td>
<td>Students will develop and demonstrate an ability to work in laboratory, conduct experiments, visualize data and interpret the results.</td>
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<td>5.</td>
<td>Impact in society</td>
<td>Students will show the understanding of impact of materials in the society and also will be aware of contemporary issues.</td>
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<td>6.</td>
<td>Ethical responsibilities</td>
<td>Students will demonstrate knowledge of professional and ethical responsibilities.</td>
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3. **PEO / PO Mapping:**

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# ANNA UNIVERSITY, CHENNAI
## UNIVERSITY DEPARTMENTS
### M.Sc. MATERIALS SCIENCE (2 YEARS)
#### REGULATIONS 2023
##### CHOICE BASED CREDIT SYSTEM
##### CURRICULA AND SYLLABI

## SEMESTER I

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**Total Credits**: 43

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**Total Credits:** 16

### SUMMARY

#### M.Sc. MATERIALS SCIENCE (FT)

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**Total Credit** 20 24 20 21 85
MC3101 MATHEMATICAL PHYSICS L T P C
4 0 0 4

OBJECTIVES:
- To introduce the students to understand the vector calculus and matrices.
- To make the students to understand the special functions.
- To make the student to study the complex variables.
- To involve the student to learn the integral transform.
- To educate the students to develop the understanding partial differential equation and group theory.

UNIT I VECTOR CALCULUS AND MATRICES 12
Laplacian-Vector operators in curvilinear coordinates Gauss, Green and Stokes theorems-Applications - Vector spaces - Linear dependence and independence - Eigenvalue problem - Diagonalization - Similarity transformation.

UNIT II SPECIAL FUNCTIONS 12
Beta and Gamma functions - Bessel, Legendre, Hermite, Chebyshev and Laguerre functions and their properties-Series solutions - Recurrence relations-Rodrique's formulae, Orthogonality, Generating functions – Applications - Dirac delta function.

UNIT III THEORY OF COMPLEX VARIABLES 12
Functions of complex variables - Cauchy Riemann conditions - Analytic functions - Conformal mapping - Simple and Bilinear transformations - Applications-Cauchy's Integral Theorem and Integral Formula-Taylor's and Laurent's series - Singularities-Zeros, Poles and Residues-Residue theorem - Contour integration with circular and semicircular contours.

UNIT IV INTEGRAL TRANSFORMS 12

UNIT V PARTIAL DIFFERENTIAL EQUATIONS AND GROUP THEORY 12

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, the student should be able to
CO1: Apply ideas of vector calculus and matrices to physics problems.
CO2: Crack the physics problems with special formula.
CO3: Make use of complex variable to solve integrals.
CO4: Use integral transform in physics and optics.
CO5: Utilize the partial differential equation to boundary value problems.

REFERENCES
MC3102  CLASSICAL MECHANICS  L T P C
3 0 0 3

OBJECTIVES:
- To illustrate the students about the Lagrangian formulation of mechanics of a systems of particles
- To introduce the students to Hamiltonian formulations and conservation theorems
- To make students familiar with independent coordinates, rigid body kinematics and moment of inertia
- To introduce the concepts of small oscillations, Legendre transformations and Hamilton's equation
- To educate the students with the concept of Hamilton-Jacobi theory and Poisson bracket

UNIT I  LAGRANGIAN FORMULATION  9

UNIT II  HAMILTONIAN FORMULATION  9
Conservation theorems and symmetry Properties – Two body central force problem: Reduction to the equivalent one body problem - Hamilton's Principle - Basic techniques of calculus of Variations – Derivation of Lagrange’s equations from Hamilton’s principle

UNIT III  RIGID BODY DYNAMICS  9
The kinematics of rigid body motion – The independent coordinates of a rigid body - The Euler Angles - Euler’s theorem on the motion of a rigid Body - Finite and infinitesimal Rotation - Angular momentum and kinetic energy of motion about a fixed Point - Moment of inertia-Equation of Torque

UNIT IV  THEORY OF SMALL OSCILLATIONS  9
Small oscillations - Formulation of the Problem - Eigenvalue equation and the principle axes Transformation - Legendre transformation and Hamilton's equations of motion Cyclic coordinates and conservation theorems - Derivation of Hamilton’s equation from a variational principle
UNIT V HAMILTON JACOBI THEORY

The equations of canonical transformation – Examples - Poisson brackets and other canonical invariants – Equations of motion – Infinitesimal canonical transformations and conservation theorems - Poisson bracket – formulation – Hamilton - Jacobi equation and its application to the harmonic oscillator problem

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completing the course, the student should be

CO1: Familiar with the Lagrangian formulation of mechanics for a system of particles and will apply the equations to solve problems

CO2: Efficient in understanding Hamiltonian formulations and conservation theorems

CO3: Competent with the knowledge of rigid body kinematics and moment of inertia

CO4: Thorough with the concepts of small oscillations, Legendre transformations and Hamilton’s equation

CO5: Familiar with the concept of Hamilton Jacobi theory and Poisson bracket

REFERENCES
1. L.D. Laudau and E.M. Lifshitz, Mechanics

CO-PO MAPPING

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High – 3, Medium-2, Low -1

MC3103 ELECTRONICS AND INSTRUMENTATION L T P C

OBJECTIVES:
• To make the students understand the importance of op-amp.
• To introduce the advanced concepts of op-amp circuits.
• To educate the students on the concepts of digital electronics.
• To equip the students for designing electronic instruments.
• To familiarize the students with the importance of nano and nonlinear electronics.
UNIT I OPERATIONAL AMPLIFIER
Introduction, Classification of IC’s, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit, differential amplifiers, op-amp parameters - Op-Amp Characteristics and importance of negative feedback.

UNIT II APPLICATOINS OF OP-AMP

UNIT III DIGITAL ELECTRONICS
CMOS logic: CMOS logic levels, Basic CMOS Inverter, NAND and NOR gates, CMOS direct and inverter logic gates. Combinational circuits: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, IC 74154), BCD to 7-segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154). Sequential circuits: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493).

UNIT IV ELECTRONIC INSTRUMENTATION

UNIT V NONLINEAR ELECTRONICS
MOSFETs - `channel length scale, new Ohm’s law, electron transport in nanostructures - resonant tunneling diodes – single electron transfer devices – nano-electromechanical systems - quantum dot cellular automata. Effect and importance of nonlinearity in electronic devices and circuits – chaos and soliton dynamics – applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completing this course, the students should be able to
CO1: Understand the working principles of op-amps.
CO2: Design various op-amp circuits.
CO3: Design digital electronic circuits.
CO4: Design electronic instruments.
CO5: Gain knowledge on nonlinear electronic devices.

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High – 3, Medium-2, Low -1

MC3104 SOLID STATE PHYSICS

OBJECTIVES:
- To understand the basic crystal structures, bonding of solids and the lattice energy calculations.
- To discuss how our understanding of lattice dynamics is formulated in terms of travelling waves, together with the role of the interatomic forces.
- To explain electrical and thermal conduction in metals and Fermi distribution function.
- To understand the electrons in solid move under the influence of a periodic potential due to ions arranged along a periodic lattice and the theory developed on the basis of this model.
- To study the properties of magnetic materials and superconducting materials and their applications.

UNIT I CRYSTAL STRUCTURE AND BONDING
Crystalline solids - crystal systems - Bravais lattices - coordination number - packing factors - cubic, hexagonal, diamond structure, Sodium Chloride Structure - lattice planes and Miller Indices - interplanar spacing - directions. Types of bonding - lattice energy - Madelung constants - Born Haber cycle - cohesive energy.

UNIT II LATTICE DYNAMICS

UNIT III FREE ELECTRON THEORY
Drude theory - Wiedemann-Franz Law and Lorentz number - Quantum state and degeneracy - density of states, concentration - free electron statistics (Fermi-Dirac), Fermi energy and electronic Specific heat, Electrical resistivity and conductivity of metals - Boltzmann transport theory - electrical and thermal conductivity of electrons.
UNIT IV PERIODIC POTENTIALS AND ENERGY BANDS


UNIT V MAGNETIC PROPERTIES AND SUPERCONDUCTIVITY


TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students should be able to:

CO1: Make use of fundamental concepts of various crystal systems, types of bonding and calculate the cohesive energy.

CO2: Understand the basics concepts of free electron theory and Boltzmann transport theory.

CO3: To gain knowledge on atomic lattice vibrations, phonon-phonon interactions and Einstein and Debye models.

CO4: The students would have gained knowledge on periodic potentials and Fermi surface studies.

CO5: Would have known the applications and various properties of semiconductors and superconductive materials.

REFERENCES

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High – 3, Medium-2, Low -1
OBJECTIVES:
- To impart knowledge on the concepts of electrostatics and magnetostatics.
- To impart knowledge on the fundamentals of Maxwell’s equation and applications.
- To provide understanding in the theory of generation and propagation of electromagnetic waves in vacuum and different media.
- An overview on various optical activities and their applications in material characterization.
- To understand the importance of LASER and non-linear optical effects.

UNIT I ELECTRO AND MAGNETOSTATICS 12
Electrostatics: Coulomb’s law – Electric field - Gauss law - electric potential and electrostatic energy – Laplace and Poisson Equations –Boundary value Problems-multipole expansion

UNIT II ELECTRODYNAMICS 12

UNIT III ELECTROMAGNETIC WAVE PROPAGATION 12
Plane electromagnetic waves in free surface - characteristic impedance - wave equation in an isotropic medium - wave equation in insulators and conductors - reflection by a perfect conductor- Reflection and refraction of electromagnetic waves - TM and TE modes - Propagation in Rectangular waveguides - Cavity Resonator - Radiation from a localized source - Oscillating electric dipole

UNIT IV POLARIZATION AND CRYSTAL OPTICS 12

UNIT V LASERS AND NONLINEAR OPTICS 12

TOTAL: 60 PERIODS

COURSE OUTCOMES:
After completion of this paper the students will understand the effect of light propagation in materials and how materials change the nature of electromagnetic wave. Specifically, they will be able to:
CO1: Learn the fundamentals of electrostatics and magnetostatics.
CO2: Derive Maxwell’s equations and apply them to study the electrostatics and magnetostatics.
CO3: Analyze and solve simple problems related to generation and propagation electromagnetic waves in various media.
CO4: Elucidate how optical activities occur in anisotropic materials and how they can be used to further characterize materials.
CO5: Apprehend the fundamentals of Laser and Non-linear optical effects and their applications.
REFERENCES
2. Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, 2019

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High – 3, Medium-2, Low -1

MC3111 MATERIALS SCIENCE LAB – I L T P C 0 0 6 3

OBJECTIVES:
- To familiarize the students with band gap determination and dielectric behavior of materials
- To make the students to acquire knowledge on the determination of elastic constants
- The make the students to have basic knowledge on the different crystal structures and also on the velocity of ultrasonic waves in liquid medium
- To enable the students to perform experiments related to electronics and apply them.
- To enable the students to gain knowledge on microprocessor and its applications

LIST OF EXPERIMENTS

Any Fifteen experiments
1. Determination of elastic constants – Hyperbolic fringes
2. Determination of elastic constants – Elliptical fringes
3. Ultrasonic diffractometer - Ultrasonic velocity in liquids
4. Viscosity of liquid - Meyer’s disc
5. Magnetostriction measurements
6. Study of crystal lattices
7. Strain gauge meter – Determination of Young’s modulus of a metallic wire
8. Conductivity of ionic crystals
9. Instrumentation Amplifier
10. Regulated power supply
11. 555 Timer – A stable multivibrator
12. Operational amplifier - characteristics and applications.
13. Active filter
14. RC Phase Shift Oscillator (FET)
15. AD/DA convertor
17. Code conversion (BCD to Binary and Binary to BCD).
18. Temperature Conversions (F to C & C to F).
19. Temperature controller measurements (Digital thermometer).
20. Stepper motor interfacing.

TOTAL: 90 PERIODS

COURSE OUTCOMES:
CO1: The students will familiarize with band gap determination and dielectric behavior of materials.
CO2: The students will acquire knowledge on the determination of elastic constants.
CO3: The students will acquire basic knowledge on the different crystal structures and experimental determination of velocity of ultrasonic waves in liquid medium.
CO4: The students will gain knowledge and perform experiments related to electronics and apply them.
CO5: The students will gain knowledge on microprocessor and its applications.

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High – 3, Medium-2, Low -1

MC3201 NUMERICAL METHODS FOR MATERIALS SCIENCE  L T P C  4 0 0 4

OBJECTIVES:
• To improve and enhance the analytical ability in problem solving skills of students using numerical methods and MatLab Program.
• To solve the large system of linear equations and find the roots of non-linear equations.
• To familiarize interpolation and curve fitting using numerical methods.
• To understand and use the appropriate method of numerical differentiation and integration when the function is too complicated and difficult to solve.
• To demonstrate the use of different methods to find the solution of ordinary differential equation and get exposed to basic statistics
• To demonstrate the understanding of numerical methods to solve problems using MatLab.
UNIT I  SYSTEM OF EQUATIONS  
12

UNIT II  INTERPOLATION & CURVE FITTING AND ERROR ANALYSIS  
12

UNIT III  NUMERICAL DIFFERENTIATION AND INTEGRATION  
12

UNIT IV  DIFFERENTIAL EQUATIONS SOLVING AND STATISTICS  
12

UNIT V  MATLAB/SCILAB PROGRAMMING  
12
Overview of Matlab – data types and variables, comments, Matlab workspace, simple math, complex numbers, mathematical function, operation on vectors and matrices, Logical arrays, control structure: For loops, while loops, If-else end- writing and running programs – plotting – overview of simulink environment.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to
• Acquire knowledge and apply it to solve large system of linear equations and find the roots of non-linear equations.
• Familiarize interpolation and curve fitting using numerical methods.
• Understand and use the appropriate method of numerical differentiation and integration to solve complicated problems in Physics.
• Demonstrate the methods to solve differential equations and solve problems related to boundary value and get exposed to statistics
• Write efficient mat lab code for various problems , analyze and interpret numerical results.

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High – 3, Medium-2, Low -1

MC3202 THERMODYNAMICS AND STATISTICAL MECHANICS  L T P C
3 0 0 3

OBJECTIVES:
- To introduce the students to laws of thermodynamics, Maxwell's relations and relevant concepts
- To facilitate the students to know about phase transitions and critical exponents
- To develop deep knowledge about fundamentals of statistical mechanics and ensembles
- To enable the students familiar with the applications of quantum statistical mechanics.
- To equip the students understanding the concepts of heat and mass transfer and its applications

UNIT I THERMODYNAMICS 9

UNIT II PHASE TRANSITIONS 9
Basic introduction to phase transitions: first order and continuous; Critical phenomena: critical exponents and scaling hypothesis; Ising model: exact solution in one dimension, mean-field approximation and calculation of critical exponents, Landau theory.

UNIT III CLASSICAL AND QUANTUM STATISTICS 9
Objectives of statistical mechanics; Microstates and macrostates; Phase space and concept of an ensemble; Liouville’s theorem and concept of equilibrium; Microcanonical, canonical and grand canonical ensembles -Maxwell –Boltzmann, Bose-Einstein and Fermi-Dirac statistics– Comparison of MB, BE, and FD statistics.

UNIT IV APPLICATION OF QUANTUM STATISTICAL MECHANICS 9

UNIT V HEAT AND MASS TRANSFER 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
- The students will gain knowledge about the laws of thermodynamics, Maxwell’s relations.
- The students will understand about phase transitions and critical exponents and will apply this knowledge in designing new materials.
- The students will obtain deep knowledge about fundamentals of statistical mechanics and ensembles and derive the distribution laws.
- The students will be familiar with the statistics and will apply the statistical mechanics to solve problems.
- The students will understand the concepts of heat and mass transfer and will apply his knowledge in finding solutions to hydrodynamics.

REFERENCES
3. H.B.Callen. Thermodynamics and an Introduction to Thermostatistics, Wiley India Pvt.Ltd. 2014.

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High – 3, Medium-2, Low -1

MC3203 CHARACTERISATON OF MATERIALS

OBJECTIVES:
To introduce the important characterization techniques to the students
- To make the students understand some important thermal analysis techniques.
- To make the students familiarize with image formation in an optical microscope and learn other specialized microscopic techniques.
- To make the students learn the principle of working of electron microscopes and scanning probe microscopes.
- To make the students understand some important semiconductor characterization techniques.
- To introduce the students the basics of some important spectroscopic techniques

UNIT I THERMAL ANALYSIS
UNIT II  MICROSCOPIC METHODS  9

UNIT III  ELECTRON MICROSCOPY AND SCANNING PROBE MICROSCOPY  9

UNIT IV  ELECTRICAL METHODS AND OPTICAL CHARACTERISATION  9

UNIT V  SPECTROSCOPY  9
Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, NMR, ESCA and SIMS- proton-induced X-ray Emission spectroscopy (PIXE) – applications.

TOTAL: 45 PERIODS

CHARACTERIZATION LAB

Any FIVE experiments:
1. Photoluminescence measurement.
2. TGA – Measurement and interpretation of results
3. FTIR studies - sample preparation, recording and analysis
4. Identification of phases using a metallurgical microscope
5. Optical absorption –spectrophotometer
6. Four Probe - Electrical resistivity measurement.
7. Thermomechanical analysis

TOTAL: 30 PERIODS

COURSE OUTCOMES:
- Students will be able to describe TGA, DTA, DSC and TMA, its applications and interpretation of results.
- Students have understood the concept of image formation in Optical microscope and other specialized microscopes.
- Students have learned the working principle and operation of SEM, TEM, STM and AFM.
- Students have understood the necessary theory of Hall measurement, four–probe resistivity measurement, C-V, I-V, Photoluminescence and electroluminescence techniques.
- Students have learned basics and necessary theory of some important spectroscopic techniques and its applications.

REFERENCES
MC3204 QUANTUM MECHANICS

OBJECTIVES:
- To expose the students to the basic formulation of quantum mechanics.
- To impart knowledge to the students about potential problems.
- To introduce knowledge on angular momentum to the students.
- To explore the ideas on approximation methods to the students.
- To inspire the students with knowledge of scattering theory.

UNIT I BASIC FORMULATION

UNIT II POTENTIAL PROBLEMS
Free particle in three dimensions, particle in a box-one dimension and three dimension-potential step, potential barrier, tunnel effect, square well potential, periodic potential, linear harmonic oscillator, rigid rotator, the hydrogen atom, atomic orbitals.

UNIT III ANGULAR MOMENTUM
Rotation operators, angular momentum operators, commutation rules. Eigenvalues of angular momentum operator, matrix representations, addition of two angular momenta, Clebsch-Gordon coefficients, properties-Pauli matrices.

UNIT IV APPROXIMATION METHODS
Time-independent perturbation theory, non degenerate and degenerate cases, Examples of Anharmonic oscillator and Stark effect, The variation method, Application to the deuteron and helium atom, Time dependent perturbation theory, Harmonic perturbation.

UNIT V SCATTERING THEORY
Centre of mass and Laboratory systems-Scattering amplitude and cross sections-Scattering of a wave packet-Born approximation-validity-partial wave analysis-phase shifts.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
After end of the course, the students will be able to
- Make use of fundamentals of quantum mechanics to various physics problems.
- Utilize the potential problems to solve real practical problems.
- Gain the understandings of angular momentum and its usefulness in spectroscopy.
- Learn about the approximation methods and its usefulness to various physics problems.
- Understand the basic knowledge about scattering theory and its uses in various physics problems.

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High – 3, Medium-2, Low -1

MC3205 PHYSICS OF MATERIALS

OBJECTIVES:
To impart knowledge on various properties of materials
- To introduce the concepts of mechanical test and plastic deformation the students
- To introduce the students about various dielectric materials and their application.
- to expose the students to different types of semiconducting materials and their properties
- To study the properties of various optical materials, LED and LCD and their applications
- To make the students understand about the various properties of shape memory alloys, CCD, Nanomaterials and NLO materials and their applications

UNIT I MECHANICAL PROPERTIES
Factors affecting mechanical properties - Plastic deformation by slip and twinning - shear strength of perfect and real crystals-work hardening and recovery- mechanical tests- tensile, hardness, impact, creep and fatigue - fracture-Types-Griffith's theory-creep resistant materials - diffusion- Fick’s law.
UNIT II  DIELECTRIC PROPERTIES


UNIT III  SEMICONDUCTORS


UNIT IV  OPTICAL PROPERTIES


UNIT V  ADVANCED MATERIALS

Metallic glasses - preparation, properties and applications - shape memory alloys – CCD device materials and applications - solar cell -Series and shunt Resistance-Solar cell materials Device and efficiencies - surface acoustic wave and sonar transducer materials and applications -

TOTAL: 45 PERIOD

PHYSICS OF MATERIALS LAB

Any FIVE experiments:
1. Hall effect - Determination of Hall co-efficient, charge carrier density and mobility
2. Creep characteristics of a metallic wire.
3. I-V characteristics of Solar cell, Photodiode
4. LED Characteristics.
5. Dielectric constant
6. Seebeck coefficient measurement
7. Electro optic effect

TOTAL: 30 PERIODS

COURSE OUTCOMES:
After completing the course, the students should be able to
• Would have gained knowledge on various mechanical tests and plastic deformation mechanisms
• The students have gained knowledge on various properties of dielectric materials and their applications
• Make use of the fundamentals on semiconducting materials and their applications
• To gain knowledge on the properties of optical materials and their applications.
• Understood the basic knowledge of about advanced materials, preparation methods for nanomaterials and their properties and NLO materials

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High – 3, Medium-2, Low -1

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**MC3211 MATERIALS SCIENCE LAB–II**

**OBJECTIVES:**

- To make the students gain knowledge on the electrical conductivity of metals and alloys
- To make the students understand the semiconducting and magnetic properties of materials
- To make the students aware about the various techniques for growing single crystals.
- To expose the students to various types of mechanical behavior of materials
- To inculcate the students to apply their knowledge on various properties of materials

**LIST OF EXPERIMENTS**

**Any ten experiments:**

1. Magnetic susceptibility - Quincke’s method
2. Crystal Growth – Solution technique
3. Crystal Growth - Gel technique
4. Determination of melt flow index of polymers
5. Particle size determination using laser –
6. Determination of wavelength of He-Ne laser-Diffraction method
7. Ultrasonic interferometer – ultrasonic velocity in liquids
8. Ferromagnetism – Hysteresis loop - coercivity, retentivity and saturation magnetization
9. Fraunhofer diffraction - using laser

**Strength of Materials Laboratory**

1. Tensile test on mild steel rod
2. Compression test on wood
3. Torsion test on mild steel rod
4. Impact test
5. Compression test on helical spring
6. Deflection test on Carriage spring
7. Double shear test
8. Hardness shear test
9. Deflection test on metal beams
10. Tension test on helical spring

TOTAL: 90 PERIODS

COURSE OUTCOMES:

- The students will gain knowledge on the electrical conductivity of metals and alloys
- The students will acquire knowledge on the semiconducting and magnetic properties of materials
- The students will learn to grow single crystals using various techniques
- The students will be exposed to various mechanical behavior of materials
- The students will be able to analyze and apply their knowledge on various properties of materials

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High – 3, Medium-2, Low -1

MC3301 CRystallography and Crystal Growth

OBJECTIVES:

- To introduce the basics of crystal symmetry and important crystal structures.
- To introduce the knowledge of X-ray production, optics, detection and fundamentals of X-ray diffraction.
- To familiarize with the instrumentation and interpretation of single crystal/powder diffractometry.
- To impact knowledge on basic theories of crystal growth.
- To gain knowledge on various crystal growth techniques.

UNIT I CRYSTAL SYMMETRY AND STRUCTURES

Symmetry operations, elements - translational symmetries - point groups - space groups - equivalent positions – close packed structures - voids - important crystal structures – Pauling’s rules - defects in crystals – polymorphism and twinning.

UNIT II X-RAY DIFFRACTION

Generation of X-rays - laboratory sources – X-ray absorption – X-ray monochromators - X-ray detectors (principles only) - diffraction by X-rays - Bragg’s law - reciprocal lattice concept - Laue conditions - Ewald and limiting spheres - atomic scattering factor - anomalous scattering - neutron and electron diffraction (qualitative only)
UNIT III  SINGLE CRYSTAL AND POWDER DIFFRACTION


UNIT IV  CRYSTAL GROWTH THEORY


UNIT V  CRYSTAL GROWTH TECHNIQUES


TOTAL: 60 PERIODS

COURSE OUTCOMES:
- The student can understand the basics of various crystal symmetries and their importance in crystal structures.
- Gain the understandings of phenomenon of X-ray diffraction.
- The students attain basic knowledge in crystallographic techniques and analyzing the data.
- The students gain in-depth knowledge on thermodynamic and other kinetic theories of crystal growth.
- The students can understand basic principles involved in the traditional crystal growth techniques.

REFERENCES

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High – 3, Medium-2, Low -1
OBJECTIVES:
- To introduce polymers, their synthesis and polymerization techniques.
- To impart knowledge on the various properties of polymers.
- To gain knowledge of various polymer processing techniques, and applications.
- To introduce the fundamentals of composites and their mechanical behavior.
- To impart knowledge on the fabrication of different types of composites.

UNIT I  INTRODUCTION TO POLYMERS  9

UNIT II  PROPERTIES OF POLYMERS  9

UNIT III  POLYMER PROCESSING, RHEOLOGY AND APPLICATIONS  9

UNIT IV  INTRODUCTION TO COMPOSITES  9

UNIT V  FABRICATION OF COMPOSITES  9
Polymer matrix composites – liquid resin impregnation routes, pressurized consolidation of resin pre-pregs, consolidation of resin moulding compounds– metal composites – squeeze infiltration, stir casting, spray deposition, powder blending and consolidation, diffusion bonding of foils, physical vapour deposition – ceramic composites – powder based routes, reactive processing, layered ceramic composites, carbon/carbon composites.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students will be able to understand
- the basics properties of polymers, their synthesis and various polymerization techniques
- the conformation, glass transition temperature, crystallinity and mechanical behaviour of polymers
- different polymer processing methods, and various applications of polymers
- classification of composites, matrix and reinforcement, and mechanical behavior of composites
- fabrication techniques of composites and apply them in practice.

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High – 3, Medium-2, Low -1

MC3303 PHYSICAL METALLURGY

OBJECTIVES:
- To introduce the concepts of phase diagrams.
- To impart knowledge about iron carbon phase equilibrium diagram and alloys.
- To expose the students to various heat treatment processes those are employed.
- To make the students to understand about various phase transformations.
- To introduce various engineering alloys and their applications.

UNIT I PHASE DIAGRAMS
The phase rule - Types of Binary Diagrams, – invariant reactions- eutectic, eutectoid, peritectic and peritectoid reactions – Microstructural changes during cooling- Thermodynamics, Solution theory - free energy composition curves for Binary systems – Experimental determination of equilibrium diagram-grain size analysis, grain size measurement - effect of grain size on properties of metals and alloys Iron- Carbon phase equilibrium diagram

UNIT II SOLID SOLUTION AND PHASE TRANSFORMATIONS

UNIT III HEAT TREATMENT

UNIT IV CORROSION AND ITS PREVENTION
UNIT V ENGINEERING ALLOYS


TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students would be able to construct phase diagrams.
- The students would have gained knowledge on Iron-Carbon phase equilibrium diagram.
- Students would be able to apply the various heat treatment processes.
- Students would gain knowledge on phase transformations.
- To analyze the various properties of engineering alloys and apply them.

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High – 3, Medium-2, Low -1

MC3311 MATERIALS SCIENCE LAB - III AND MINI PROJECT

OBJECTIVES:
- To understand the basic property measurements governing fundamental physics.
- To train the students in hands-on experience with various sophisticated materials characterization techniques.
- To make the students to visualize the experimental data and interpretation of results.
- To expose the students about the introductory concepts of computational materials science.
- To train the students to do independent research and ability to write and present the technical report.
LIST OF EXPERIMENTS

Any Ten experiments
1. Density measurements – organic materials and polymers
2. NDT – Ultrasonic flaw detector
3. Faraday effect
4. X-ray powder method – indexing, cell determination and identification of unknown elements
5. Charge density, atomic scattering factor calculations.
6. Laser coherence, divergence measurement.
7. Optical Fibre – Measurement of numerical aperture and bending loss.
8. Preparation of buffer solutions and pH measurements.
9. Laser Raman - sample preparation, recording and analysis
11. MATLAB/SCILAB/MATERIALS STUDIO – simple programs and plots.
14. VESTA – Molecular Structure Tool.

TOTAL: 45+45 = 90 PERIODS

B. MINI PROJECT

COURSE OUTCOMES:
- The students can have familiarity about the basic property measurements governing fundamental physics.
- The students can attain the higher knowledge on hands-on experience with various sophisticated materials characterization techniques.
- The students can have knowledge on visualizing the experimental data and interpretation of results.
- The students can gain knowledge on the computational materials science by utilizing suitable computer suites.
- The students will get insight in doing independent research and consolidating the technical report.

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High – 3, Medium-2, Low -1

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OBJECTIVES:
- To give theoretical fundamental understanding on the Physics of semiconductors
- To make the students to understand transport properties of charge carriers in semiconductors.
- To familiarize the students with the materials used for making semiconductor devices
- To educate the students about making of semiconductor junctions and transistors
- To give an overview on the applications of semiconductors devices in various fields.

UNIT I INTRODUCTION: FORMATION OF ENERGY BANDS & BAND-GAP

UNIT II DOPING AND TRANSPORT PROPERTIES IN SEMICONDUCTORS
Direct and indirect band gaps – Electron and holes –Types of defects – Doping - Influence of intrinsic defects and dopants on the electrical properties –Temperature-dependent carrier concentration profile in extrinsic semiconductors- High doping effects and incomplete ionization – Types of recombination- Carrier scattering and mobility - Low-field and high-field transport, drift and diffusion - Current continuity equation–Characterizing defects: Hall-effect measurement.

UNIT III SEMICONDUCTOR MATERIALS

UNIT IV SEMICONDUCTOR JUNCTIONS AND TRANSISTORS
Introduction to p-n Junction – p-n junction under bias –Formation of diodes -Schottky junction under equilibrium and bias – Ohmic contacts- p-n, n+p, p+n, p++p junctions – Transistors: Bipolar Junction transistors (BJT) - Working of Junction Field-Effect Transistors (JFET) - Basics and working of Metal-Oxide Semiconductor FET (MOSFET) – Basics and working of Metal-Semiconductor FET – Transistors for power electronics.

UNIT V SEMICONDUCTOR DEVICES

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
- Understand the theoretical background of electronic band formation in semiconductors.
- Appreciate different types of defects and influence of dopants on semiconductors
- Gain knowledge on various types of semiconductor materials.
- Get a fundamental understanding on junctions and various junction devices.
- Understand the different application areas of semiconductors.

Attested

DIRECTOR
REFERENCES:

Additional Books:

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High – 3, Medium-2, Low -1

MC3002 PYTHON PROGRAMMING

OBJECTIVES:
- To introduce the concepts of algorithms and developing them.
- To make the students to understand different types of data, expressions and statements in Python environment.
- To elucidate the aspects of control flow and functions in Python environment.
- To introduce the concepts of lists, tuples and dictionaries in Python environment.
- To make the students to use files, modules and packages.

UNIT I ALGORITHMIC PROBLEM SOLVING
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.
UNIT II DATA, EXPRESSIONS, STATEMENTS
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort.

UNIT V FILES, MODULES, PACKAGES
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completing this course, the students should able to
• Develop algorithms.
• understand different types of data, expressions and statements in Python environment.
• Make use of control flow and functions in Python environment.
• Use lists, tuples and dictionaries in Python environment.
• use files, modules and packages Python programming environment.

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OBJECTIVES:
- To understand the basics of manufacturing processes.
- To impart the knowledge about surface treatment processes.
- Teaching the students about various processes of welding.
- To teach the students about mechanical working of metals.
- To understand the knowledge about powder metallurgical processes.

UNIT I BASIC MANUFACTURING PROCESSES
Fundamental analysis of Manufacturing processes, casting, casting processes, forging, methods of forging, extrusion, rolling, spinning, turning, planning and shaping, milling, grinding.

UNIT II SURFACE TREATMENT PROCESSES
Necessity for surface modification, surface cladding, surface alloying, hard facing, shock hardening, conventional methods, carburising, nitriding, cyaniding, advantages of laser surface treatment over conventional methods, typical laser variables used in surface alloying, laser cladding, experimental setup.

UNIT III WELDING PROCESSES
Various processes of welding, fusion welding, pressure welding, oxyacetelene welding, resistance welding, spot welding, thermit welding, hermetic welding, projection welding, seam welding, butt welding, thermal effects of welding, effects on grain size and microstructure, internal stresses effect, corrosion effect, high energy beam welding, laser beam and electron beam welding, key hole effect.

UNIT IV MECHANICAL WORKING OF METALS
Hot working, cold working, normalising, full annealing, tempering, theory of tempering, effect of tempering temperature on mechanical properties of carbon steels, different tempering process, deformation of metals, elastic deformation, plastic deformation, slip, twinning – assessment of processed materials.

UNIT V POWDER METALLURGICAL PROCESS
Production of powders, powder mixing, compacting, types of presses, sintering, soaking, finishing process, limitations and advantages of powder metallurgy, applications, production of cemented carbide cutting tools, self lubricating bearings, magnets, cermets, ultrasonic ceramic transducers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students will gain the knowledge about the basics of various manufacturing processes.
- The students will learn the various surface treatment processes.
- The students will understand the different welding techniques.
- The students will have better knowledge with mechanical working of metals.
- The students will get clear understanding of powder metallurgical process.

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**MC3004 LASER AND APPLICATIONS**

**OBJECTIVES:**
- To introduce knowledge on basics of lasers and its application
- To make the students understand about theoretical studies on laser systems.
- To impact the basic knowledge on laser system compound.
- To introduce the knowledge about various laser systems.
- The students will be able to know about laser system used for materials processing.
- To impact knowledge on the laser applications.

**UNIT I PRINCIPLES OF LASERS**
- Spontaneous emission, Stimulated emission, Einstein coefficients, ratio of rates of stimulated and spontaneous emission – Threshold condition for laser action – Rate equations – Population inversion in three level and four level systems.

**UNIT II OPTICAL RESONATORS**
- Resonant cavities, Gaussian beam characteristics, resonator modes, spot size – Types of resonators, geometries, quality factor of an optical resonator – Q-switching and Mode locking concepts and techniques.

**UNIT III LASER SYSTEMS**

**UNIT IV MATERIALS PROCESSING**
UNIT V APPLICATIONS
Metrology - interferometric techniques - Laser ranging and tracking - Laser Doppler velocimetry - Ring laser and rotation sensing - Pollution monitoring - Holography and speckle in displacement and deformation measurements – ions – Medical applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After the completion of course, the students should be able to
- Understood the principle involved in Einstein coefficient and laser action.
- Gained knowledge on laser compound and Q switching mode focusing concepts.
- Understand the basic knowledge about various laser systems working methods.
- The students have gained knowledge on various laser processing methods and advantages.
- The students would have known the laser applications on industrial and medical fields.

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MC3005 NON-DESTRUCTIVE TESTING L T P C

- To introduce the students to liquid penetrant and magnetic particle inspection.
- To make the students understand the principle, working and uses of radiographic testing.
- To impart knowledge about the ultrasonic testing.
- To make the students understand the principle, working and application of eddy current technique.
- To expose the thermal and optical methods used in NDT.

UNIT I INTRODUCTION AND SURFACE NDT METHODS
UNIT II RADIOPHGRAPHIC TESTING

UNIT III ULTRASONIC TESTING

UNIT IV EDDY CURRENT TESTING

UNIT V THERMAL AND OPTICAL METHODS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students will learn about liquid penetrant and magnetic particle inspection.
- The students will understand the principle, working and uses of radiographic testing.
- The students will gain knowledge on ultrasonic testing.
- The students will be able to apply their knowledge on eddy current technique.
- The students would be able to analyse the thermal and optical methods used in NDT.

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High – 3, Medium-2, Low -1
OBJECTIVES:
- To introduce the response of biomaterials to host environment, and host response to biomaterials
- To introduce various materials used in bone and joint replacement
- To gain knowledge about materials used in cardiovascular implants
- To know about dental materials and dental implants
- To impart knowledge on soft tissue and drug delivery materials.

UNIT I  BIOLOGICAL PERFORMANCE OF MATERIALS  9
Biocompatibility - introduction to the biological environment – material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – host response: the inflammatory process - coagulation and hemolysis - approaches to thrombo- resistant materials development

UNIT II  ORTHOPAEDIC MATERIALS  9

UNIT III  CARDIOVASCULAR MATERIALS  9

UNIT IV  DENTAL MATERIALS  9

UNIT V  SOFT TISSUE MATERIALS  9

COURSE OUTCOMES:
After completion of this course, the students should able to
- understand the response of biomaterials to host environment, and host response to biomaterials
- know and prepare various materials used in bone and joint replacement
- gain knowledge on materials used in synthetic blood vessels, pacemakers and in other cardiovascular implants
- to prepare impression materials and dental cements, and know about dental implants
- to gain knowledge on soft tissue replacement and drug delivery materials.

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High – 3, Medium-2, Low -1

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**MC3007 NONLINEAR OPTICAL MATERIALS**

**OBJECTIVES:**
- To make the students aware of the various characterization techniques based on non-linear optics
- To educate the students about the important properties of Non-linear optical materials
- To make the students aware of the various Inorganic Non-linear materials
- To educate the students about various Organic Non-linear materials
- To make the students aware of the various applications of Non-linear Materials

**UNIT I** INTRODUCTION TO NON-LINEAR MATERIALS


**UNIT II** INORGANIC NON-LINEAR MATERIALS

Potassium di hydrogen phosphate (KDP) - Potassium titany1 phosphate (KTP) - Ammonium dihydrogen phosphate (NH4H2PO4) 3-4, potassium dihydrogen phosphate (KH2PO4), Lithium formate monohydrate, potassium niobate (K NbO3) and barium titanate (Ba TiO3) potassium pentaborate (KB5O84H2O) and ammonium pentaborate (NH4B54H2O) urea, potassium titanyl phosphate, beta barium borate and lithium borate

**UNIT III** ORGANIC NON-LINEAR MATERIALS

Nonlinear optical (NLO) response in organic molecules - Semiorganic Non-linear materials - Alkynes - Heterocycles - Dyes - Ferrocenes - Spiranes - Porphyrins - Nonlinear optical fullerenes

**UNIT IV** NLO CHARACTERIZATION TECHNIQUES

Raman/Brillouin gain measurement techniques - Second-order wave mixing - Third-order parametric wave mixing - Third-order polarization rotation - Beam distortion/absorption - Nonlinear interferometry - Third-order nonlinear imaging
UNIT V
APPLICATIONS OF NON-LINEAR MATERIALS

Harmonic generation and up-conversion-optical parametric oscillator - frequency conversion of ultrashort pulses - frequency conversion of high average power sources - frequency conversion of low average power sources - laser fusion - Fibre Interferometers - Fibre Gratings - organic photovoltaics (OPVs) and organic thin-film transistors (OTFTs)

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Students will gain knowledge about the various characterization techniques based on non-linear optics like Nonlinear interferometry - Third-order nonlinear imaging etc.
- Students will be educated about the important properties of Non-linear optical materials Like Velocity Dispersion-Non linear wave propagation-Non linear refraction-Fibre Modes-Soliton characteristics etc.
- Students will be aware of the various Inorganic Non-linear materials.
- Students will learn about various Organic Non-linear materials.
- Students will acquire knowledge of the applications of Non-linear Materials in Fibre Gratings - organic photovoltaics (OPVs) and organic thin-film transistors (OTFTs) etc.

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High – 3, Medium-2, Low -1

MC3008 SUPERCONDUCTING MATERIALS AND APPLICATIONS

OBJECTIVES:
- To introduce the basic experimental aspects of the superconductivity.
- To know about superconducting materials and its alloys.
- To make the students to understand the experimental studies of superconducting materials.
- To inspire the theoretical aspects of superconductivity.
- To progress the students with various application in superconductivity.
UNIT I INTRODUCTION TO SUPERCONDUCTIVITY 9

UNIT II SUPER CONDUCTING MATERIALS 9
Elemental superconductors – superconducting compounds and its alloys – A-I5 compounds – chevral phase compounds

UNIT III THEORY OF SUPERCONDUCTIVITY 9
Isotope effect – BCS theory – Role of electrons and phonons – applications of electron band structure results to calculate electron-phonon coupling constant McMillan’s formula – GLAG theory-recent theories on high Tc materials, Coherence length, expression for critical temperature Tc, critical field Hc, critical current Jc – heavy fermion superconductivity.

UNIT IV HIGH TEMPERATURE SUPERCONDUCTORS 9

UNIT V APPLICATIONS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
• The students will understand the basic concepts of superconductivity.
• Gain knowledge in superconducting materials.
• Crack the experimental studies of superconducting materials.
• Apply the theoretical aspects of superconductivity.
• The students will be able to understand various technological application of the superconductivity.

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High – 3, Medium-2, Low -1
OBJECTIVES:
- To explain principles behind elasticity, viscoelasticity and rubber elasticity.
- To provide insights into plastic deformation under tension and compression, and hardness testing methods.
- To explain macroscopic aspects of fracture in the context of microscopic mechanisms, and various fracture testing methods.
- To explain the mechanisms of creep and development of heat resistant materials.
- To impart understanding of fatigue mechanisms and fatigue tests.

UNIT I  ELASTICITY AND VISCOELASTICITY

UNIT II  PLASTICITY
Plastic deformation in tension: tensile curve parameters, necking, strain rate effects - plastic deformation in compression testing - the Bauschunger effect - plastic deformation of polymers: stress - strain curves, glassy polymers, semicrystalline polymers, viscous flow-plastic deformation of glasses: microscopic deformation mechanism - temperature dependence and viscosity - flow, yield, and failure criteria – hardness: macroindentation tests - microindentation tests - nanoindentation.

UNIT III  FRACTURE
Macroscopic aspects: theoretical tensile strength, stress concentration and Griffith criterion of fracture, crack propagation with plasticity, linear elastic fracture mechanics, fracture toughness - microscopic aspects: fracture in metals, fracture in ceramics, fracture in polymers - fracture testing: impact testing, plane-strain fracture toughness test, crack opening displacement testing, J-integral testing, flexure test (three-point bend test, four-point bending), fracture toughness testing of brittle materials (Chevron notch test, indentation methods for determining toughness).

UNIT IV  CREEP

UNIT V  FATIGUE

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of the subject, the student should be able to:
- understand elastic and viscoelastic behavior of materials.
- understand the mechanism of plastic deformation and origin of materials strength.
- design and select engineering components based on the principles of fracture mechanics.
- understand high temperature mechanical behavior of materials and be able to select the materials for high temperature applications.
- improve materials resistance to fatigue fracture.
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High – 3, Medium-2, Low -1

MC3010 INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY

OBJECTIVES:
- To make the students understand the structure and properties of nanomaterials.
- To educate students about the various synthesis methods of nanomaterials.
- To introduce the students about quantum dots.
- To give awareness about characterization of materials like crystallite size analysis, scanning etc.,
- To inspire the nanotechnology applications.

UNIT I NANO SCALE SYSTEMS
Length, energy, and time scales - Quantum confinement in 3D, 2D, 1D and zero dimensional structures - Quantum confinement of electrons in semiconductor nanostructures - Size effect and properties of nanostructures - Top down and Bottom-up approach.

UNIT II SYNTHESIS OF NANOSTRUCTURE MATERIALS
Gas phase condensation - Vacuum deposition - Physical vapor deposition (PVD) - chemical vapor deposition (CVD) - laser ablation - Sol-Gel - Ball milling - Electro deposition - Electroless deposition - spray pyrolysis - plasma-based synthesis process (PSP) - hydrothermal synthesis - carbon nanotubes and graphene synthesis.

UNIT III QUANTUM DOTS
Excitons and excitonic Bohr radius - nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods - MOCVD and MBE growth of quantum dots - Absorption and emission spectra - photo luminescence spectrum - optical spectroscopy - linear and nonlinear optical spectroscopy.
UNIT IV CHARACTERIZATION
Crystallite size analysis using Scherrer formula - Particle size measurement using DLS and HRTEM - Atomic Force Microscopy (AFM) and Scanning tunneling microscopy (STM) - applications to nanostructures – Nanomechanical characterization – Nanoindentation – femtosecond laser.

UNIT V NANOTECHNOLOGY APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Plan and develop the application of semiconductor nanomaterials
- Familiar with various synthesizing methods.
- Workout various quantum dot synthesis.
- Advance the applications of nanostructures and nanomechanical characterization.
- The students can understand the importance of nanoscience and technology with the fundamental concepts behind size reduction.

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High – 3, Medium-2, Low -1

MC3011 CORROSION SCIENCE AND ENGINEERING

OBJECTIVES:
- To introduce the students to corrosion process and corrosion control.
- To make the students understand the methods used for testing corrosion.
- To introduce the different methods used for coating.
- To impart knowledge on various types of corrosion with respect to corrosion.
- To expose the students to various application of coating.

Attested

DIRECTOR

Centre for Academic Courses
Anna University, Chennai-600 025
UNIT I CORROSION PROCESSES
Basic principles of electrochemistry and aqueous corrosion processes - Electrochemical Thermodynamics and Electrode Potential - Electrochemical Kinetics of Corrosion Cathodic and anodic behavior - Faraday's Law - Nernst equation; standard potentials Pourbaix diagram - Tafel equations, corrosion rate - Evans diagram - pitting, crevice and exfoliation corrosion; influence of deposits and anaerobic conditions; corrosion control; high temperature oxidation and hot corrosion; corrosion/mechanical property interactions.

UNIT II CORROSION TESTING

UNIT III COATING MANUFACTURE
Electrodeposition; flame and plasma spraying; thermal, HV of detonation gun, physical vapour deposition; chemical vapour deposition; HIP surface treatments.

UNIT IV CORROSION IN SELECTED ENVIRONMENTS

UNIT V COATING APPLICATIONS
Abrasive, erosive and sliding wear. The interaction between wear and corrosion. Coating systems for corrosion and wear protection; new coating concepts including multi-layer structures, functionally gradient materials, intermetallic barrier coatings and thermal barrier coatings.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students would have learnt various corrosion process and corrosion control.
- The students would have understood the methods used for testing corrosion.
- They analyze and apply the different methods for coating.
- The students would have gained knowledge on corrosion type with respect to environment.
- The students would have learnt about the various concepts and applications of coating.

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OBJECTIVES:
- To expose the students to the introductory concepts of nanoelectronics and nanophotonics.
- To explain the electron transport in semiconductors & nanostructures.
- To make the students recognize the concept of electromigration.
- To make the students acquire the knowledge in the theory of low-dimensional structures and nanodevices science of molecular electronic devices.
- To accomplish nanophotonics and basic properties of electromagnetic effects in periodic media.

UNIT I MATERIALS FOR NANOELECTRONICS

UNIT II ELECTRON TRANSPORT IN SEMICONDUCTORS & NANOSTRUCTURES
Introduction — time and length scales of the electron in solids — statistics of the electrons in solids and nanostructures — density of states of electrons in nanostructures — electron transport in nanostructures.

UNIT III ELECTROMIGRATION

UNIT IV LOW-DIMENSIONAL STRUCTURES AND NANODEVICES

UNIT V NANOPHOTONICS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Utilize the ideas with materials for nanoelectronics carbon nanomaterials: graphene, nanotubes, and fullerenes.
- Gain knowledge on the density of states of electrons in nanostructures and electron transport in nanostructures.
- Apply ideas of electromigration consequences for nanoelectronics.
- Design the Molecular electronic devices.
- The students will gain knowledge on the basics of nanoelectronics, nanoelectronic devices and nanophotonics.

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MC3013 CARBON MATERIALS L T P C

OBJECTIVES:
- To introduce the different types of Carbon materials
- To impart knowledge about the various processing methods
- To expose the students to various applications of Carbon materials
- To make the students to understand carbon and graphite fibers
- To make the students understand about carbon composites

UNIT I INTRODUCTION

UNIT II PROCESSING OF CARBON MATERIALS

UNIT III APPLICATIONS

UNIT IV CARBON AND GRAPHITE FIBRES
UNIT V  CARBON COMPOSITES


TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course the students will be able to
• Gain Knowledge on the basics and types of carbon structures
• Have knowledge about the preparation of various carbon related materials
• Know various fields and applications of carbon-based materials.
• Better understanding about carbon and graphite fibers
• Have gained knowledge about various carbon composites with their applications

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MC3014  THIN FILM SCIENCE AND TECHNOLOGY

OBJECTIVES:
• To introduce about mechanical pumps, production of high vacuum and thin film coating unit
• To expose the various methods for preparation of thin films.
• To make the students understand the characterization methods used for thickness measurement.
• To make the students gain knowledge on the nucleation theories and thin films structures.
• To impact knowledge on the various properties of thin films.
UNIT I HIGH VACUUM PRODUCTION 9
Mechanical pumps - Diffusion pump - measurement of vacuum - gauges - production of ultra high vacuum - thin film vacuum coating unit.

UNIT II PREPARATION METHODS 9
Physical methods: thermal evaporation - vapour sources - Wire, crucible and electron beam gun - sputtering mechanism and methods - Pulsed laser deposition (PLD), photochemical deposition (PCD) - Chemical methods: chemical vapour deposition and chemical solution deposition techniques - spray pyrolysis - laser ablation.

UNIT III THICKNESS MEASUREMENT AND MONITORING 9
Multiple beam interference - quartz crystal - ellipsometric - stylus techniques. Characterization: X-ray diffraction - electron microscopy - high and low energy electron diffraction.

UNIT IV GROWTH AND STRUCTURE OF FILMS 9

UNIT V PROPERTIES OF THIN FILMS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students would have gained knowledge on production of high vacuum and thin film coating unit.
- The students would apply the various methods for the preparation of thin films.
- The students know the methods of characterization of thin films and thickness measurement.
- Gained knowledge on nucleation theories and thin film structures.
- Gained knowledge on properties of thin films.

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High – 3, Medium-2, Low -1
MC3015  ADVANCES IN CRYSTAL GROWTH  L T P C  3 0 0 3

OBJECTIVES:
- To introduce the concepts of nucleation and types of nucleation.
- To explain about the theories related to crystal growth.
- To expose the various methods of melt growth.
- To impact knowledge on the growth of crystals by solution growth.
- To make the students understand various methods of growing crystals from vapour phase.

UNIT I  NUCLEATION  9

UNIT II  THEORIES OF CRYSTAL GROWTH  9

UNIT III  MELT GROWTH  9

UNIT IV  SOLUTION GROWTH  9

UNIT V  VAPOUR GROWTH  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students will understand the concepts of nucleation and types of nucleation.
- The students would have learnt the theories related to crystal growth.
- Students would have known the various methods of melt growth.
- Students would have gained knowledge on solution growth.
- Students would have gained knowledge on growth of crystals from vapour phase.

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High – 3, Medium-2, Low -1
OBJECTIVES:
- To introduce the aspects of High pressure science and technology.
- To expertise the measurements of high pressure.
- To familiarize high pressure devices for various properties and applications.
- To inspire physical properties of high pressure and spectroscopy studies.
- To insight mechanical properties under pressure.

UNIT I  METHODS OF PRODUCING HIGH PRESSURE

UNIT II  MEASUREMENT OF HIGH PRESSURE

UNIT III  HIGH PRESSURE DEVICES FOR VARIOUS APPLICATIONS

UNIT IV  HIGH PRESSURE PHYSICAL PROPERTIES

UNIT V  MECHANICAL PROPERTIES UNDER PRESSURE

COURSE OUTCOMES:
- Establish the operation of anvil and Multi-anvil devices.
- Crack the gauge operations.
- Design various anvil device applications.
- Apply ideas of Electronic structure of metals and semiconductors.
- After completing this course the students will be able to understand the basic concepts of the high pressure and various technological applications of high pressure.

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High – 3, Medium-2, Low -1
OBJECTIVES:
- To introduce the students to structural ceramics and familiarize them with their properties.
- To impact knowledge to the students on various electronic ceramics, magnetic ceramics, superconducting materials and fuel cells.
- To expose the students to various processing techniques used for ceramic materials.
- To introduce the students about various types of refractories.
- To make the students understand about various glass forming processes, types of glass and their applications.

UNIT I  STRUCTURAL CERAMICS
Oxide ceramics – zirconia, alumina, silica, mullite, magnesia and titania – carbides – silicon carbide, boron carbide, tungsten carbide, titanium carbide – nitrides – silicon nitride, boron nitride, titanium nitride, borides, silicides, - sialon – bio ceramics

UNIT II  ELECTRONIC CERAMICS

UNIT III  CERAMIC PROCESSING

UNIT IV  REFRACTORY CERAMICS
Refractories – types of refractories - special refractories - silica, alumina, mullite, zirconia, cordierite - carbide based and nitride-based refractories – Fusion cast refractories – ceramic fibers – high temperature applications.

UNIT V  GLASS CERAMICS
Glass forming processes – Glass transition – Glass transformation range - Heat treatment schedule, crystal nucleation in glass, nucleation agent – high purity silica glass, laser glasses, fiber glasses, optical glasses and non-oxide glasses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completing the course, the students
- would have gained knowledge on various structural ceramic materials and their applications.
- would have known the applications of electronic ceramics and magnetic ceramics and also
- will analyze and apply the various processing techniques they have studied.
- they would know about the functioning of varistors and fuel cells.
- would have gained knowledge on refractories and their applications.
- would be familiar with various glass forming methods, types of glasses and their applications.

REFERENCES
MC3018 SMART MATERIALS AND APPLICATIONS

OBJECTIVES:
- To provide fundamental understanding on smart and intelligent materials.
- To provide the students with knowledge about multifunctional smart materials.
- To expose the students to electro-rheological smart materials.
- To enhance students’ understanding on the structure-property relationship.
- To enable students, appreciate novel materials and their usage in current cutting-edge technologies.

UNIT I BASICS OF SMART MATERIALS AND STRUCTURES

UNIT II MULTI FUNCTIONAL SMART MATERIALS

UNIT III ELECTRO-RHEOLOGICAL (FLUIDS) SMART MATERIALS

UNIT IV SHAPE – MEMORY SMART MATERIALS
Introduction to structure types, Structure-property relationships, Shape memory effect (SME), One way and two-way SME, Shape memory alloys (SMAs), Intelligence in the form of SMA - Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – Martensitic transformations – Austenitic transformations – Thermoelectric martensitic transformations – Cu based SMA, chiral materials – Applications of SMA in Thermal-storage, and aerospace materials. Shape-memory polymers, and their applications.
UNIT V  MULTIFERROIC AND SMART OPTICAL MATERIALS


TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
- understand the working principle of smart materials
- get an overview on various types of smart materials and their application areas.
- Gain knowledge in electro-rheological smart materials
- get motivated to find novel applications of these multifunctional materials in new technologies.
- understand the importance and structure of smart materials.

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High – 3, Medium-2, Low -1

MC3019  ADVANCES IN X-RAY ANALYSIS  L T P C
3 0 0 3

OBJECTIVES:
- To introduce the knowledge on X-ray sources, optics and detection.
- To impact the basics of single crystal X-ray methods with their physical concepts.
- The students will be able to understand traditional and advanced methods for crystal structure determination from powder crystal techniques.
- To familiarize various applications of X-ray in determining physical parameters.
- To expose the other characterization techniques using X-rays.
UNIT I EXPERIMENTAL METHODS

UNIT II SINGLE CRYSTAL METHODS

UNIT III POWDER METHODS

UNIT IV APPLICATIONS

UNIT V OTHER STUDIES

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students can have basic idea on how the X-rays are produced and detected.
- The students attain knowledge on prediction of crystal structure from single crystal methods.
- The students can understand the advances in powder diffraction analysis.
- Get insight knowledge on utilizing X-ray as a tool for determining physical parameters.
- The students will understand the qualitative study on other X-ray characterization techniques.

REFERENCES
**MC3020**  
**COMPUTATIONAL MATERIAL SCIENCE**  
**L T P C**  
**3 0 0 3**

**OBJECTIVES:**
- To make the students understand theoretical background of condensed media.
- To teach students to the density functional theory methods.
- To teach the students exchange correlation functionals.
- To introduce students to plane wave methods.
- To introduce the students augmented plane wave methods.

**UNIT I**  
**INTRODUCTION AND OVERVIEW**  
9
Introduction and Basic concepts, Theoretical Background, Basic equations for interacting electrons and nuclei, Coulomb interaction in condensed matter, independent electron approximations, Exchange and correlation, Periodic solids and electron bands, Structures of crystals: lattice + basis, The reciprocal lattice and Brillouin zone, Excitations and the Bloch theorem

**UNIT II**  
**INTRODUCTION TO QUANTUM MECHANICAL MODELING**  
9

**UNIT III**  
**FUNCTIONALS FOR EXCHANGE AND COORELATION**  
9

**UNIT IV**  
**DETERMINATION OF ELECTRONIC STRUCTURE**  
9
UNIT V  
AUGMENTED PLANE WAVES AND MUFFIN-TINS  
Augmented plane waves (APW's) and 'muffin-tins' – Solving APW equations: examples Muffin-tin orbitals (MTOs). Linearized augmented plane waves (LAPWs) - Applications of the LAPW method - Linear muffin-tin orbital (LMTO) method - Applications of the LMTO method - Full potential in augmented methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students will be able to
- understand the underlying interactions in condensed matter
- apply suitable approximations and methods to model the materials and obtain energy values.
- Apply suitable exchange correlation functional for the materials of interest.
- Determine electronic structures of the materials.
- perform theoretical studies, analyses and calculations with applications in materials science

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High – 3, Medium-2, Low -1

MC3021  
SOLID STATE IONICS  
L T P C  
3 0 0 3

OBJECTIVES:
- To introduce the basic aspects of solid state physics.
- To impart knowledge on solid state ionics, hydrogen storage and nano-ionic materials.
- To introduce the students to micro batteries, fuel cells, super capacitors and their applications.
- To familiarize the students to various characterization techniques for new cathode materials.
- To expose the students to the various application of ionic materials.

UNIT I  
BASIC ASPECTS OF SOLID STATE PHYSICS  
UNIT II SOLID STATE IONICS
Concept of solid state ionics- Importance of super-ionic materials and structures-Classification of Superionic solids- crystalline anionic and cationic conductors, mixed ionic and electronic conductors-structural factors responsible for high ionic conductivity - Experimental probes pertaining to solid state ionics- Theoretical models of fast ion transport- Applications of fast ionic solids-Nano-ionic materials.

UNIT III MICRO BATTERIES AND APPLICATION
Concept of a thin film solid state battery- electrolyte thin films- flash evaporation technique-pulsed laser deposition technique-applications-electromotive force-reversible cells-free energy changes-capacity of a cell-power and energy density of a cell-polymer electrolytes-application of polymer electrolytes in micro batteries, Fuel cells-solid state battery-super capacitors.

UNIT IV CHARACTERIZATION OF NEW CATHODE MATERIALS

UNIT V APPLICATIONS OF IONIC MATERIALS
Primary lithium batteries- thermodynamics and mass transport in solid state batteries, battery performance and electrode kinetics-Secondary lithium batteries-Li-ion electrode materials-preparation and fabrication- -characterization of Li-ion cells- Comparison of Li-iodine and NiCd cells in CMOS-RAM applications. Applications of Lithium batteries in electronic devices, electric vehicle, fuel cells, sensors -Solar energy conversion devices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students would have learnt the basic aspects of solid state physics.
- Gained knowledge on solid state ionics, hydrogen storage.
- Learnt about micro batteries, fuel cells, super capacitors.
- Learnt about the various characterization techniques available for cathode materials.
- The students are familiar with various applications of ionic materials

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High – 3, Medium-2, Low -1
MC3022  PREPARATION AND FABRICATION OF NANOSCALE MATERIALS  L T P C 3 0 0 3

OBJECTIVES:
- To introduce the basic aspects of preparation of nanomaterials and nanoscale fabrication related characterization techniques.
- To expose the different types of clean room and its importance.
- To study the synthesis and purification Single walled and Multi walled Nanotubes (SWNT and MWNT) and impart the concepts behind one dimensional nanowires and nanofibers.
- To inculcate characterization of materials with various techniques and to progress the nano-fabrication for biomedical applications.
- To inspire the knowledge of nanodevices for magnetic storage and know about applications and devices for micro- and nano-systems.

UNIT I  PROPERTIES OF NANOPARTICLES AND NANOSCALING LAWS 9

UNIT II  CLEAN ROOM 9
Clean room and its importance – Types of clean rooms – maintenance of different types of cleanrooms – standardization – peripherals - oxidization and metallization- masking and patterning.

UNIT III  PREPARATION OF NANOTUBES, NANOWIRES AND NANOFIBERS 9

UNIT IV  CHARACTERIZATION AND NANO-FABRICATION 9
Absorption and emission spectra – PL spectrum - single nanoparticle characterization –Scanning capacitance microscopy – capillary electrophoresis- laser induced fluorescence (CE-LIF)-Etching technologies - wet and dry etching - photolithography – Drawbacks of optical lithography for nanofabrication - electron beam lithography – ion beam lithography - strain-induced self-assembly for Nanofabrication of quantum dots and molecular architectures - Polymer processing for biomedical applications

UNIT V  NANODEVICES APPLICATIONS 9
Mechanics for micro- and nano-systems: fluid flow in submicron and nanoscale, MEMS, field emission display devices, nano diodes, nano switches, molecular switches, nano-logic elements-Super hard nanocomposite coatings and applications in tooling-high density quantized magnetic disks - magnetic super lattices – MRAMS - MTJs using nano scale tunneling junctions - Millipede for storage – nano-material sensors

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Familiarize the properties of nanoparticles and Grow up and promote scaling laws.
- The students should be able to utilize types of clean rooms.
- The students apply ideas on enlightenment of Nanowires and gain the idea of one dimensional nanostructure.
- The students will be able to gain the keen idea of biomedical applications and its characterization.
- The students will understand the principle involved in preparation and characterization of nanostructures and fabrication of nanodevices and characterization techniques.
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High – 3, Medium-2, Low -1

MC3023 ENERGY CONVERSION AND ENERGY STORAGE DEVICES

OBJECTIVES:
- To familiarize the students about the energy conversion devices (Thermoelectric application)
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Super capacitors and the materials used.

UNIT I THERMOELECTRIC
Basics of thermoelectricity - Seebeck effect- Peltier effect-Thomson effect - Analysis of Electrical Conductivity, Seebeck Coefficient, Thermal Conductivity, Electronic Thermal Conductivity, Lattice Thermal Conductivity-Wiedmann Franz law- Figure of Merit- Two Probe and Four Probe Method of Measuring Electrical Resistivity,- Hall measurements- Laser pulse method- Thermal conductivity - Nanostructuring of Thermoelectric material- Charge Impurity Scattering, Grain Boundary Scattering, Point Defect- Applications – Exhaust of Automobiles, Refrigerators, Industries, Space Programs (RTG)

UNIT II ELECTROCHEMICAL DEVICES
Electrochemical Energy – Cells & Batteries - direct and rechargeable - Electrochemical sensors-Mass Transfer- Electric and Hybrid Vehicles - Linear Kinetics and Tafel equation - Gibbs Energy and Equilibrium - Battery V-I - Types of Batteries - Primary battery (Alkaline battery, Zinc-Carbon battery) - Secondary battery (Li-ion battery, Sodium-ion battery) —, LiFePO4, LiMn2O4 – Electrolytes for Lithium-ion battery.

UNIT III FUEL CELLS
Principle of operation of fuel cells – electrochemical kinetics of fuel cells - mass transfer effects - Fuel cell performance characteristics - voltage efficiency and power density -types of fuel cells

UNIT IV PHOTOVOLTAICS


UNIT V SUPERCAPACITORS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the materials used.
- The students gain knowledge on different types of supercapacitors and the performance of various materials.

REFERENCES

5. Materials for Supercapacitor applications; B. Viswanathan, M. AuliceScibioh

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High – 3, Medium-2, Low -1
OBJECTIVES:
- To introduce the students to nuclear structure and radioactivity.
- To expose the students about nuclear models, exchange forces and elementary particles.
- To make the students understand about nuclear fission, fusion and controlled thermo nuclear reaction.
- To make the students understand about neutron and reactor physics.
- To impart knowledge on the reactor design, materials and radioactive waste disposal.

UNIT I NUCLEAR STRUCTURE AND RADIOACTIVITY

UNIT II NUCLEAR MODELS, FORCES AND ELEMENTARY PARTICLES

UNIT III NUCLEAR FISSION AND FUSION

UNIT IV NEUTRON AND REACTOR PHYSICS

UNIT V REACTOR DESIGN AND MATERIALS

COURSE OUTCOMES:
- The students will learn about nuclear structure and radioactivity.
- The students would have gained knowledge about nuclear models exchange forces and elementary particles.
- The students would have understood about nuclear fission, fusion and controlled thermo nuclear reaction.
- The students would have understood about neutron and reactor physics.
- The students would learn about reactor design, materials and radioactive waste disposal.

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High – 3, Medium-2, Low -1

MC3025

NON-LINEAR ELECTRONICS

OBJECTIVES:
- To prepare the students for understanding the concepts of nonlinear circuits
- To introduce the concept of nonlinear network theory and its importance
- To equip the students for designing chaotic circuits
- To apply the knowledge of nonlinear dynamics in power electronic systems
- To understand the implication of nonlinear transmission line in the generation of electrical solitons

UNIT I LINEAR AND NONLINEAR CIRCUITS

UNIT II NONLINEAR NETWORKS

UNIT III CHAOTIC CIRCUITS

UNIT IV POWER ELECTRONIC SYSTEMS
Overview – switching power converters – voltage mode control, current mode control, complexity of operation – modeling strategies of switching converters – bifurcation behavior in switching power converters – nonlinear dynamics of Cuk Boost, and Buck converters – Intermittent chaotic operations.
UNIT V ELECTRICAL SOLITONS


COURSE OUTCOMES:
After completion of this course, the students should able to
- Understand the importance of nonlinearity in electronic circuit design.
- Apply the knowledge of nonlinear network theory in circuit design.
- Design different types of chaotic circuits.
- Apply the knowledge of nonlinear dynamics in power electronic systems.
- Design electrical soliton generators.

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High – 3, Medium-2, Low -1

MC3026 COMPOSITE MATERIALS AND STRUCTURES L T P C 3 0 0 3

OBJECTIVES:
- To introduce about the properties of fibers and matrices.
- To make the students to understand the interface region and their testing.
- To impart knowledge on the fabrication techniques of composites.
- To expose the students to various micro and macro mechanics involved.
- To impart knowledge on the various mechanical properties of composites.

UNIT I FIBERS AND MATRICES
UNIT II INTERFACE REGION
Bonding mechanisms – adsorption and wetting, interdiffusion and chemical reaction, electrostatic attraction, mechanical keying – experimental measurements of bond strength – single fiber pull out, push-out and push-down tests – three-point bend test - control of bond strength – coupling agents, toughness reducing coatings, diffusion barrier coatings, interfacial chemical reaction, the interphase region.

UNIT III FABRICATION
Polymer matrix composites – liquid resin impregnation routes, pressurized consolidation of resin pre-pregs, consolidation of resin moulding compounds, injection moulding of thermoplastics, hot press moulding of thermoplastics – metal composites – squeeze infiltration, stir casting, spray deposition, powder blending and consolidation, diffusion bonding of foils, physical vapour deposition – ceramic composites – powder based routes, reactive processing, layered ceramic composites, carbon/carbon composites.

UNIT IV MICROMECHANICS AND MACROMECHANICS

UNIT V STRENGTH AND TOUGHNESS OF COMPOSITES

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students would have gained knowledge about various fibers and matrices.
- The students would gain knowledge about the interface region and chemical reactions.
- To apply the fabrication methods they have learnt.
- Understood the micromechanics and macro mechanics involved.
- Learnt the various mechanical properties and applications of composites.

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