M.SC. PHYSICS

SEMESTER-I (Year 2017-2022)

Subject: Mathematical Physics (H-1027)

Course Outcomes:

After Successful completion of this paper, the students will be able to:

Develop unified theory for various polynomials.

Establish generating functions and recurrence relations for various polynomials.

Understand the physical significance of complex variables.

Study the integral transforms.

Comprehend the different features of Laplace transform.

Recognise the difference between Fourier series and Fourier transform.

Determine FT of delta and Gaussian function.

M.Sc. SEM I: Paper II (H-1028) Classical Mechanics

After completing this paper students will be able to understand and explain:

Preliminaries: Newtonian mechanics of one and many particle systems, Simple Pendulum with rigid support, two connected masses with string passing over a pulley, Virtual work, Rolling mass inside or outside a circular ring, Constraints; their classification, D'Alembert's principle, generalized coordinates. Hamilton's principle: Derivation of Lagrange's equation from Hamilton's principle, advantages of variational principal formulation, Principle of least action. Two body central force problem: Motion in a central force field, The virial theorem, The inverse square law of force, The motion in central force in the Kepler problem.

Hamiltonian equations of motion: Legendre transformations and Hamilton equations of motion, cyclic coordinates and conservation theorem, Canonical transformation generating functions, Properties, Poisson bracket, Poisson theorem, Relation of Poisson brackets. Hamilton Jacobi method. Small oscillations: Concept of small oscillations, Expression of kinetic energy and potential energy for the problem of small oscillations, Frequencies of free vibration, and Normal coordinates.

Name of the Paper Quantum Mechanics-1

Course Code H-1029

Course Outcomes (COs)

After Successful completion of this paper, the students will be benefited in

Distinguishing features of Quantum and Classical Mechanics or Newtonian Mechanics. Wave functions, physical interpretation of wave function and average values.

Difference between the time-dependent and time-independent Schrodinger equation for simple potentials like, the harmonic oscillator and hydrogen like atoms.

Linear Vector Space, Hilbert Space, Operators, Concepts of Bra and Ket notation and tools to calculate eigen values.Space-time symmetries and conservation laws, theory of identical particles. Relation between symmetry and conservation laws, commutation relations, method to calculate components and total angular momentum. Numberof approximate methods utilized in Quantum Mechanics. The idea of angular momentum and spin, orbital angular momentum and Clebsh Gordan Coefficient as well as the

rulesforquantization. Theory of scattering and various cross sections, optical theorem, Born approximation, partial wave analysis etc.

Name of the Paper Electronic Devices
Course Code H-1030
Course Outcomes (COs)
After Successful completion of this paper, the students will be benefited in:

Execute the conduction mechanism in metals and semiconductors.
Understand the characteristics of various diodes and transistors.
Design electronic circuits for various BJTs and FETs.
Determine h-parameters.
Construct various electronic devices.

Semester II
Name of the Paper Quantum Mechanics II
Course Code H-2027
Course Outcomes (COs)
After Successful completion of this paper, the students will be benefited in:

Understand the time dependent perturbation theory.
Construct gas and solid lasers.
Comprehend Quantum Theory of radiation and Plank's radiation law.
Utility of Klein-Gordon equation and Dirac equation of electron in an electromagnetic field.
Execute Dirac equation for central field with spin orbit interaction and covariant form of Dirac equation.

Name of the Paper Statistical Mechanics
Course Code H-2028

Course Outcomes (COs)
After Successful completion of this paper, the students will be able to:

Understand the physical significance of phase and various ensembles. Comprehend the relations between macroscopic and microscopic properties by the partition function. Execute Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distribution laws for various ensembles. Develop unified theory for various states of matter and deduce equation of state.Interpret cluster expansion and virial equation of state.Study the fluctuations and transport phenomena.

Name of the Paper Atomic and molecular physics
Course Code H-2029
Course Outcomes (COs)
After Successful completion of this paper, the students will be able to:

Understand the physical significance of fine spectrum.Execute wavefunctions and energies of multiplets.Comprehend the approximations, molecular spectra and electronic spectra with various principles.Study infrared,Photoelectron and Raman spectroscopy with NMR and ESR etc.Recognise the general description and working of various spectrometers.

Name of the Paper Electrodynamics and Plasma Physics
Course Code H2030
Course Outcomes (COs)
After Successful completion of this paper, the students will be able to:

Execute the various problems of electrostatics.Understand the concepts of magnetic statistics with various equations. Comprehend the various principles of time-varying fields.Recognize plane electromagnetic wave with various phenomena.Interpret the concept of plasma with various equations.

Name of the Paper: Condensed Matter Physics
Course Code:H-3027

After Successful completion of this paper, the students will be benefited in

Elementary idea of Crystallography, Crystalline, poly crystalline and amorphous solids Lattice parameters, Miller indices and closed packed structures.X-Ray Diffraction (XRD) characterization for crustal structure and defects analysis.XRD techniques such as Laue, powder and Rotating Crystal methods, Bragg's law, JCPDS and reciprocal lattice, Atomicscattering and Geometrical structure factor.Imperfections in solid materials such as 1D, 2D and 3D defects, Dislocations, Characterization of defects via XRD and Introduction of Electron Microscopies.Discussion on Electronic properties of solids, specially TBA, Kronig-Penny Model, Bloch theorem. Concept of Effective mass of an electron, Fermi Surfaces and Hall effectin Semiconductors.Superconductivity: Properties of superconductors with discussion on Meissner effect, BCS theory with concept of Cooper pairs. In Magnetic properties of solids, ferromagnetism is discussed and a quantum picture of Heisenberg exchange energy is covered. Concept of Ferri and antiferro-magnetic order.
Discussion on Curie- Weiss law for susceptibility, The Bloch-wall, Introducing basicconcepts via Spin waves and magnons.

After the completion of course, the competency has been developed to the students regarding Elements of band theory with tight binding approximation (TBA) which helps in solving a real-life electron band structure through computation.

Name of the Paper: Nuclear and Particle physics
Course Code: H3028

After Successful completion of this paper, the students will be able to

Understand the concept of nuclei and statistics of nuclear particles with systematic of stable nuclei.Recognise nuclear disintegration theories with internal conversion.Comprehend the properties of inter nucleon forces with meson theory.Interpret various nuclear structure and models with unified model. Study the origin, classification and interaction of elementary particles with Gell-Mann-Okubu mass formula.

Name of the Paper: Electronics I
Course Code:H7027

After Successful completion of this paper, the students will be able to

Understand the applications of operational amplifier.Recognize digital integrated circuits characteristics.Utility of MOSFETs in various digital devices.Design various digital circuits with simplification by Karnaugh map. Construct various digital devices using flip-flop, registers, counters and convertors.

Name of the Paper: Electronics II
Course Code:H7030

After Successful completion of this paper, the students will be able to

Study the microwave devices with principles of operation of magnetrons and klystrons.
Comprehend the various principles of amplitude and frequency modulated system.Determine the physical parameters attached with transmission and radiation of signals. Study various principles of fibre optic communication systems. Recognize the difference between transmission lines and optical fibre.

MSc physics IV Semester

Name of the Paper: Computational Methods and Programming
Course Code: H4027

After Successful completion of this paper, the students will be able to

Solve the linear and non-linear equations and transcendental equations by various methods.

Determine interpolation by various methods.Execute numerical differentiation and integration by various formula.Curve fitting by various methods with cubic spline. Solve differential equations with various methods.Understand digital computer principles with fortran programming.

Name of the Paper: Physics of Nanomaterials.
Course Code: H4028

After Successful completion of this paper, the students will be benefited in

Nanoscience and Nanotechnology are now become the buzz words all over the world. Really 'Small is Big and Beautiful', One cannotimagine material science without nanomaterials in 21st century. Richard Feynman Statement "There is Plenty of Room at the Bottom". Historical Advances of nanotechnology. Background, emergence and challenges in nanoscience, types of materials based on their degrees of freedom. Size dependence of properties, Surface area to volume ratio i.e., Aspect ratio. Concept of Moor's law, Melting point depression of nanoparticles. Introduction of Energy band gaps of intrinsic and compound semiconductors, Concept of Effective masses, Fermi surfaces and Excitons. Discussion on Semiconductor Nanocrystals i.e., Quantum Dots (QDs) and its Fabrication techniques. Concept of Quantum confinement, Quantum well and Quantum wire.Different types of characterization techniques such as X-Ray Diffraction (XRD), Transmission Electron Microscopy (SEM), Transmission ElectronMicroscopy (TEM), Scanning Probe microscopy (SPM), Scanning Tunnelling Electron Microscopy (STEM) and Atomic Force Microscopy (AFM) for the nanomaterials and their interpretations. Nanoscience is related to synthesis of nanomaterials. The use of nanomaterials is gaining impetus in the present century as they possess defined chemical, optical and mechanical properties.Various Top down and Bottom up approaches, Carbon nanotubes (CNT) such as Multiwalled (MWCNTs) Double walled (DWCNTs) and Single walled Carbon nanotubes (SWCNTs) Synthesis and their Properties and Applications.
After the completion of course, the students are competent enough to use the knowledge of Physics of Nanomaterials in the present research areas of nanotechnology

MSc physics IV Semester

Name of the Paper: Electronics III
Course Code: H8027

After Successful completion of this paper, the students will be able to

Understand elements of a digital communication system with various forms of modulation.Comprehend various digital modulation techniques.Interpret the mathematical representation of noise with various features of noise.Recognise the data transmission with matched filter.Study the satellite communication with GPS and system noise.

Name of the Paper: Electronics IV
Course Code: H8030

After Successful completion of this paper, the students will be benefited in:

Introduction and Classification of Integrated Circuits (ICs), Idea of Monolithic ICs and CMOS Process Overview. Different types of Crystal growth techniques such as CZ and Float zone techniques. EGS and MGS, Silicon is the best material of choice for ICs fabrication. Silicon Wafer Preparation.Basic Concept of Oxidation process. Preparation of SiO2 insulating layer in terms of dry and wet oxidation method. Diffusion Process with the Fick's 1st and 2nd Laws and Atomistic theory and Ion Implantation Technology for Diffusion Process, Channelling and Annealing phenomena including Lattice Damage.Vacuum Science and Technology with the various pumps and Gauges to maintain the vacuum. Different Vacuum Profiles.Thin Film Preparation of metals and Nonmetals, Various Thin film deposition techniques such as Evaporation theory and electron beam evaporation, Physical Vapor Deposition (PVD), Chemicals Vapor Deposition (CVD) and Epitaxy methods. Idea of Photolithography in terms of Electron Beam Lithography and X-ray lithography for making the windows at the desired locations. Idea of Photoresist as Negative and Positive. The phenomena of Masking and Etching. Concepts of Interconnections and Contacts Formation of ICs, Packaging Fabrication Process for ICs such as Wire Bonding, Flip-Chip and Tape-Automated-Bonding.

After the completion of course, the students are competent enough to use the knowledge of ICs Fabrication in the microelectronics research areas.