M.Sc PHYSICS PROGRAMME

Programme Specific Outcomes (PSOs)

PSOs	Program Specific Outcomes
PSO1	Acquire a comprehensive knowledge in physics.
PSO2	Will develop a broad understanding of the physical principles of the universe
PSO3	Acquire laboratory skills to design advanced experiments and high precision measurements
PSO4	Be proficient in computing and interfacing techniques
PSO5	Be empowered for critical thinking and innovation in dealing with scientific problems and experiments.
PSO6	Develop advanced laboratory techniques and instrumentation skills for a career in research
PSO7	Develop independent research skills through projects
PSO8	Be provided with opportunities to further their knowledge in frontier areas through elective courses
PSO9	Be empowered for planning career in physical sciences and also in taking up jobs in other fields in the contemporary society
PSO10	Be able to communicate effectively and participate actively in team work.

COURSE OUTCOMES (COs):

CORE COURSE OUTCOMES (COs)

THEORY

SEMESTER 1

PAPER CODE & NAME: PHY1C01- CLASSICAL MECHANICS

COs	Course Outcome Statements
CO1	Explain the fundamental concepts in Lagrangian and Hamiltonian formulation in mechanics.
CO2	Apply the concepts of Lagrangian, Hamiltonian, Action, Poisson brackets, canonical transformations and their subsequent development to Heisenberg's matrix mechanics and Schrodinger's wave mechanics, to carry out numerical problems
CO3	Develop the analytical and mathematical skills for describing the dynamics of rigid bodies. It could be applied to practical situations. This can be applied spectroscopic analysis of samples
CO4	Explain the theory of small oscillations. Small oscillations are part and parcel of all bound physical systems

CO5	Elucidate the concepts in nonlinear dynamics and chaos. These techniques can be directly applied in nonlinear physics and also to verify various experimental results.

PAPER CODE & NAME: PHY1C02- MATHEMATICAL PHYSICS – I

COs	Course Outcome Statements
CO1	Describe coordinate systems appropriate for different physical problems. Applies it to solve Laplace's equation in different coordinate systems.
CO2	Perform transformation operations and get the corresponding transformation matrices. Learns procedures for matrix diagonalisation
CO3	Distinguish the class of objects called tensors, their classifications and use. Understand differential equations of special nature and the ways to solve them
CO4	Identify differential equations of special nature and the ways to solve them.
CO5	Illustrate special functions as solutions to problems in atomic, molecular nuclear, and solid state physics etc. and will put them in use.
CO6	Distinguish Fourier series and integral transforms of different types and their properties. This will enable him/her to analyse or solve different mathematical problems in physical sciences

PAPER CODE & NAME: PHY1C03- ELECTRODYNAMICS AND PLASMA PHYSICS

COs	Course Outcome Statements
CO1	Explain the significance of displacement current and Maxwell's equations and general electromagnetic wave equations, their solutions in terms of potentials and fields. Another basic concept of physics called gauge transformation will be understood. Multipole expansion of the potentials, fields and multipole moments of different orders will be learned.
CO2	Describe the propagation of electromagnetic waves through free space and the consequences of reflection from different types of boundaries. These have important consequences in wave propagation
CO3	Discusses propagation of electromagnetic waves through confined media like wave guides and cavity resonators
CO4	Enables to appreciate the magnificent results of the blending of relativity and electrodynamics and motivates to take up a course on quantum field theory, the study of fields, interactions and symmetries

CO5	Understand the criteria for a medium to be called plasma and the various properties of it.

PAPER CODE & NAME: PHY1C04- ELECTRONICS

COs	Course Outcome Statements
CO1	Analyse characteristics of JFET and MOSFET and their specific applications
CO2	Distinguish the basic characteristics of light emitting and light sensing devices and illustrate the basic concepts behind integrating electronic and photonic devices suitably for microwave communication
CO3	Classify characteristics of op-amps and their implementation in various elementary level applications
CO4	Identify the basics of logic gates, flip flops and registers and the designing of counters, satisfying specific conditions. Understands RAM and D/A converter and basic features of specific microprocessors

SEMESTER II

PAPER CODE & NAME: PHY2C05- QUANTUM MECHANICS-I

COs	Course Outcome Statements
CO1	Appreciate the importance and implication of vector spaces. Will be able to use Dirac ket and bra notations. Use operators and will be able to solve eigen value problems. Understand generalized uncertainty principle in quantum mechanics and the need for quantum mechanical formalism and its basic principles
CO2	Explain time evolution of quantum mechanical systems and learn different time evolution approaches -Schrodinger picture and Heisenberg picture. Apply different approaches in quantum dynamics to various fundamental problems
CO3	Develop a better understanding of the mathematical foundations of spin and angular momentum. Make use of spherical harmonics to compute Clebsch - Gordon coefficients
CO4	Apply Schrodinger's equation to central potentials problems, to solve various quantum mechanical problems
CO5	Understand invariance principles based on symmetry of the system and establish the associated conservation laws. These quantum mechanical concepts will be applied to analyse the ground state of Helium atom. Here it will be understood that all symmetry elements possess the mathematical property of groups.

PAPER CODE & NAME: PHY2C06- MATHEMATICAL PHYSICS-II

COs	Course Outcome Statements
CO1	In general, physical phenomena are expressed in equations involving complex quantities. Some times we get complex solutions to equations. Solving such problems requires special procedures. On completing this module he/she will be gain the skill for solving and interpreting such problems.
CO2	Acquire a preliminary training in group theory. All symmetry elements possess the mathematical property of groups. Concepts of group theory will help to solve problems in quantum mechanics. It is quantum mechanics that gives more stress on symmetry than classical mechanics.
CO3	Apply the techniques of calculus of variation to diverse problems in physics.
CO4	Apply the Greens function technique to solve problems showing causality relationships

PAPER CODE & NAME: PHY2C07- STATISTICAL MECHANICS

COs	Course Outcome Statements
CO1	Understand macroscopic and the microscopic states, thermodynamic potentials, basic concepts of entropy, Liouville"s theorem and its consequences. Also the students will have an understanding of the connection between statistics and thermodynamics
CO2	Have a detailed understanding different canonical ensembles
CO3	Develop an understanding of the statistical behavior of Bose-Einstein and Fermi-Dirac systems

PAPER CODE & NAME: PHY2C08: COMPUTATIONAL PHYSICS

COs	Course Outcome Statements
CO1	Write computer programs using core python
CO2	Use advanced mathematical modules like Numpy and Pylab in python program for solving mathematical and physical problems and also to present the result visually using graphs and charts
CO3	Solve numerically mathematical problems like interpolation, curve fitting, integration etc. and to write python programs for these
CO4	Solve numerically mathematical problems like differential equations, Fourier transforms etc. and also to write python program for these.
CO5	Analyse by simulating simple physical problems in physics like one-dimensional and two-dimensional motion, harmonic oscillator, radio active disintegration, chaos, solution of Schrodinger equation etc., using python programs by applying the knowledge acquired for the course.

PRACTICAL PAPERS

PRACTICAL PAPER 1:PHY1L01 & PHY2L03 (GENERAL PHYSICS)

PRACTICAL PAPER II: PHY1L02 & PHY2L04 (ELECTRONICS)

SEMESTER III

PAPER CODE & NAME: PHY3C09 - QUANTUM MECHANICS –II

COs	Course Outcome Statements
CO1	Understand time independent perturbation theory and to apply it to harmonic and anharmonic oscillators, and learn the fine structure and hyperfine splitting of Hydrogen atom in the presence of external magnetic and electric fields.
CO2	Apply methods like Ritz variational technique and WKB approximation to quantum mechanical systems
CO3	Interpret time dependent perturbation theory and apply it to describe radiative transitions in atoms. Understand Fermi's Golden rule and learn Born approximation
CO4	Explain the theory of scattering and apply the method of partial waves to scattering by central potential and square well potential
CO5	Identify the principles of relativistic quantum mechanics and apply to Dirac particles, Klein-Gordon equation. Also understand the concept of spinors and the non-relativistic limit and Hole theory.

PAPER CODE & NAME: PHY3C10-NUCLEAR AND PARTICLE PHYSICS

COs	Course Outcome Statements
CO1	Interpret the properties of nucleus, binding energy, angular momentum, two nucleon scattering, spin dependence, tensor force, partial wave concept and the theory of deuteron structure
CO2	Elucidate the theory of various types of nuclear decay, selection rules of transition, concept of parity and multipole moments
CO3	Compare various nuclear models and nuclear processes like fission and fusion. Will be able to apply it to various nuclear systems in the chart of nuclides.
CO4	Demonstrate the working of one or two nuclear radiation detectors of different types and the signal processing and analysing units
CO5	Compare basic interactions and classify the elementary particles. Interactions are linked with the concept of symmetry and conservation laws. Understand Sakata model, Gellmann- Okubo mass formula, Quark mode and their significance.

PAPER CODE & NAME: PHY3C11- SOLID STATE PHYSICS

COs	Course Outcome Statements
CO1	Analyse the structure of materials based on X-ray diffraction and interpret it on the basis of the theory understood
CO2	Distinguish different excitations in crystals. Properties of quasiparticles could be explained. Arrive at proper explanation of for specific heat.

CO3	Explain free electron model and interpret the properties of metals. Gain a deeper understanding of the energy bands based on the properties of carriers
CO4	Interpret properly the thermal, electrical and magnetic properties of materials. Will enable the student to understand the current research going on in the related areas.
CO5	Illustrate using phase diagrams, phase transitions in materials leading to superconductivity and different types of superconductors

ELECTIVE COURSE 1

PAPER CODE & NAME: PHY3E05- EXPERIMENTAL TECHNIQUES

COs	Course Outcome Statements
CO1	Explain vacuum, Gauges to measure vacuum, types of pumps and their utility, cryogenics etc
CO2	Explain and demonstrate different thin film fabrication techniques, thickness measurement and application of thin films
CO3	Explain different types of particle accelerators, their working and specific applications
CO4	Explain methods of materials analysis by different nuclear techniques
CO5	Be trained on defining X-ray techniques to characterise materials

SEMESTER IV

PAPER CODE & NAME: PHY4C12- ATOMIC AND MOLECULAR SPECTROSCOPY

COs	Course Outcome Statements
CO1	Understand the behavior of atoms and molecules and their interactions with electromagnetic waves.
CO2	Apply the behaviour of nonrigid rotor and understand the microwave spectroscopy
CO3	Distinguish between Raman and IR spectroscopy and elucidate on the features of Raman spectrum
CO4	Explain electronic spectroscopy and applications
CO5	Identify the structure of the sample from spin resonance and Mossbauer spectra

ELECTIVE II

PAPER CODE & NAME: PHY4E12- MATERIALS SCIENCE

COs	Course Outcome Statements
CO1	Aquire a basic understanding of the concept of formation of lattice defects in solids
CO2	Analyse the phase diagrams of single component, binary and ternary systems and diffusion in solids.
CO3	Identify the cause of plastic deformation in crystals.
CO4	Distinguish polymers and ceramics in terms of , their classifications, structure and properties.

CO5	Apply the ideas of synthetic approaches of nanomaterials and their characterization methods
CO6	Understand the structure of buckminster fullerene, carbon nanotube, its classification and its applications

ELECTIVE III

PAPER CODE & NAME: PHY4E23- MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS

COs	Course Outcome Statements
CO1	To be equipped with essential knowledge on design and programming of simple microprocessor based systems
CO2	Develop basic skills in design of simple AVR microcontroller based embedded systems

PRACTICAL PAPERS

PRACTICAL PAPER 1: PAPER CODE & NAME - PHY3L05 & PHY4L06 (MODERN PHYSICS)

PRACTICAL PAPER II- PHY4L07: COMPUTATIONAL PHYSICS PRACTICAL

PROJECT

PAPER CODE & NAME : (PHY4P01) Project

VIVA: (PHY4V01) Comprehensive Viva voce