DEPARTMENT OF PHYSICS

PROGRAMME SPECIFIC OUTCOME

The students studying the M.Sc course in Physics will be able to develop a strong foundation in Physical Sciences. The course will provide the students with all round knowledge resources, analytical and research skills needed for developing a career in advanced research in science and technology.

In specialized courses students will be made confident to pursue further advanced study and conduct scientific research in the field of materials and nuclear science and technology. That includes material discovery, synthesis, processing, as well as train them with the state of the art computational and analytical tools required for analysing the data related to high energy physics experiments. Students will get ample scope to learn about renewable energies, energy material applications and recent advances in nuclear science as well as identify societal challenges and engage in energy policy decisions.

M. Sc. program is designed covering most of the UGC syllabus in physical sciences enabling the students to prepare effectively for various national level competitive examinations like UGC-CSIR NET, JEST, GATE, SLET, etc.

Students will be able to recognize ethical and professional responsibilities in science and technology and make informed judgments to produce solutions that meet the scientific and socio-economic needs.

COURSE OUTCOME

	SEMESTER-I
PHY-101	Course Outcome of **PHY-101: Mathematical Physics – I**
	Mathematics is an indispensable tool in the study of physics. After learning the course, the learner will be able to (i) get the basic ideas of linear vector space including linear independence, dimensionality, orthogonality, etc. (ii) utilize the knowledge of complex plane and Cauchy's method to solve complicated integral equations (iii) solve higher order differential equations using different polynomial techniques such as Legendre, Bessel, Hermite etc. (iv) get the preliminary idea of probability distribution and curve fitting.
PHY-102	Course Outcome of **PHY-102: Classical Mechanics**
	After learning this course, students will be able to (i) understand the basic principles of classical mechanics system using Lagrange and Hamiltons formalism (ii) apply methods of classical mechanics in solving various problems of like complicated oscillatory system, motion of rigid body, nonlinear dynamics.
PHY-103	Course Outcome of **PHY-103: Quantum Mechanics – I**

	After learning this course, the learners will be able to (a) solve Schrodinger's equation for bound state problems and calculate the tunneling probability through a potential barrier (b) use Dirac's bra-ket algebra to derive generalized uncertainty principle and solve 1D harmonic oscillator problem (c) compare the different pictures in Quantum Mechanics (d) apply various approximation methods such as time-independent perturbation theory, variational principle and WKB approximation to solve quantum mechanical problems which cannot be ose exact solutions are unavailable (e) write KG equation for spinless particles.
PHY-104	Course Outcome of **PHY-104: Electronics**
	After completion of the course, the students will be equipped with required knowledge in electronic devices, circuits and their applications. The students will be able to learn about digital circuits and microprocessors. The students will get to know the basic concept of signal transmission, and the role of modulation and demodulation in signal transmission.
PHY-105P	Course Outcome of **PHY-105P: General Physics Laboratory - I**
	General Physics Laboratory-I offers a number of optical and electronics practicals which enable the learners to understand the basic concept of electronic circuits through action and observation. After completion of this course, the students will have the ability to (i) understand the behaviour and operations of electronic components such as Integrated Circuit (IC), Operational Amplifier (OPAMP), Logic Gates etc. (ii) analysis and design various oscillators and electronic circuits for mathematical operations, (iii) calculate and determine self-inductance of a coil, unknown resistance of a wire etc. (iv) determine the wavelength of monochromatic light, radius of curvature of convex surface.
PHY-106(OE)	Course Outcome of **PHY-106(OE): Nanostructures**
	At the end of the course the students will be able to 1. *Know the promising area of nanomaterials, understand the nature and prospects for the field.* 2. *Learn about the various types of nanomaterials such as semiconducting nanomaterials and carbon based nanomaterials* 3. *Learn about various synthesis and characterization techniques of nanomaterial**ls***
PHY-107(OE)	Course Outcome of **PHY-107(OE): Surface Science**
	This course provides the physics of surfaces and interfaces in an atomic-scale understanding with experimental and theoretical aspects. Students are expected to gain knowledge on physico-chemical properties of a surfaces, surface structure, surface energy states, thin film properties and surface analysis techniques
PHY-108(OE)	Course Outcome of **PHY-108(OE): Basic tools for data visualization & typesetting**
	After learning this course, the learners will be able to (a) use Gnuplot and Origin to plot ASCII files and functions and fit experimental data with suitable function (b) write article, report, letter, book, and beamer presentation using latex.
SEMESTER-II	
PHY-201	Course Outcome of **PHY-201: Classical Electrodynamics**
	This course imparts the concepts of electrodynamics and Maxwell equations and their applications in various situations. After perusing this course, students will be able to (i) use basic mathematical tools to solve problems in electrodynamics, (ii) describe the nature of electromagnetic wave and its propagation through different media and interfaces, (iii) Simplify charged particle dynamics and radiation from moving charge particles, (iv) extend their understanding on relativistic electrodynamics.
PHY-202	Course Outcome of **PHY-202: Quantum Mechanics - II**

	After learning this course, the learners will be able to (a) write matrix representation of angular momentum and calculate eigenfunctions of orbital angular momentum (b) analyze orbital and spin angular momentum matrices and calculate Clebsch-Gordan coefficients, (c) illustrate continuous and discrete symmetries in QM and apply the identical particle QM to the collision of identical particles (d) use time-dependent perturbation theory for constant and harmonic perturbations and derive Fermi's Golden rule (d) derive KG and Dirac equation equation in presence of electromagnetic field.
PHY-203	Course Outcome of **PHY-203: Nuclear Physics - I**
	After learning this course, the students will be able to (i) apply the shell model and collective model to describe some basic nuclear properties, (ii) understand basics of nuclear reactions, optical model, compound nuclear reactions (iii) get familiar with the various particle accelerators and radiation detectors, (iv) understand the role of symmetries in elementary particle interactions, (v) get elementary idea of quark model, quark confinement, asymptotic freedom and standard model of particle physics
PHY-204	Course Outcome of **PHY-204: Condensed Matter Physics - I**
	Condensed Matter Physics is one of the broad branches of physics that deals with fundamental science of solids and liquids. This course provides a foundation for future advanced studies in solids. On successful completion of this course students will be able to learn the fundamental topics in solids such as (i) crystal structure and crystal systems, and lattice dynamics of solids, (ii) energy band theory for electrical conduction, and basic type, materials and properties of semiconductors, and (iii) concept of different phenomena in electric and magnetic substances.
PHY-205P	Course Outcome of **PHY-205P: General Physics Laboratory - II**
	General Physics Laboratory-II is focusing on advanced techniques and experiments drawn from overall physics classes consisting of advanced electronics, solid state physics, nuclear physics and optics. The student will be able to grasp the role of experimental design, data analysis, error analysis, and the use of computers while investigating physical phenomena
PHY-206(OE)	Course Outcome of **PHY-206(OE): Basics of Vacuum Science & Low temperature Physics**
	This course serves as an open elective course. This course provides the complete understanding of vacuum technology, vacuum measurements and low temperature physics. After learning this course students will be able to construct vacuum system to create high vacuum and to do experiments in low temperature physics
PHY-207(OE)	Course Outcome of **PHY-207(OE): Basics of Material Science**
	This course serves as an open elective course. This course provides the complete understanding of the properties of materials, their structures, band theory of solids and different techniques of material preparations and their characterization techniques.
SEMESTER-III	
PHY-301	Course Outcome of **PHY-301: Mathematical Physics - II**
	After learning this course, the students will be able to (i) understand properties of Tensor like Transformation of coordinates, contravariant and covariant tensors, indices rules for combining tensors,Christoffel symbols and their transformation laws, (ii) solve partial differential equations like 1D, 2D wave equations, 1D heat transfer equation, Laplace equation by using separation of variable method, (iii) apply Fourier and Laplace transforms in solving differential equations, (iv) solve the integral equations by Iterative Technique, separable kernels, (v) apply the concepts of Group Theory to solve numerical problems in Physics.
PHY-302	Course Outcome of **PHY-302: Computational Physics**
	After learning this course, the students will be able to (i) solve nonlinear equations such as Bisection method regula, falsi method and Newton raphson method. (ii) solve system of linear equations using both Gauss elimination and Gauss-Jordan method with and without pivoting,

	(iii) perform polynomial interpolation such as Newton-Gregory and lagrange interpolation method and least square curve fitting (iv) compute numerical integration using trapezoidal rule, Simpson's one third rule in Monte Carlo method (v) solve first and second order linear differential equation using Euler method and Runge-kutta method.
PHY-303	Course Outcome of **PHY-303: Advanced Nuclear Physics - I**
	After learning this course, the students will be able to (i) apply the shell model and collective model to describe some basic nuclear properties, (ii) understand basics of nuclear reactions, optical model, compound nuclear reactions (iii) get familiar with the various particle accelerators and radiation detectors, (iv) understand the role of symmetries in elementary particle interactions, (v) get elementary idea of quark model, quark confinement, asymptotic freedom and standard model of particle physics
PHY-303P	Course Outcome of **PHY-303P: Advanced Nuclear Physics – I (Lab)**
	After learning this course, the students will be able to (i) Use GM counter in order to calculate the dead time and efficiency of the counter, (ii) use scintillation counter and analyze various peaks using single and multi channel analyzer, (iii) handle microscope (a) to calculate the average diameter of α-particle tracks, (b) will able to scan nuclear emulsion plates and can calculate mass of pion, scattering cross section, and range of tracks.
PHY-304	Course Outcome of **PHY-304: Advanced Condensed Matter Physics - I**
	The objective of this course is to expand the knowledge of condensed matter physics and to provide a deep understanding of how condensed matter is characterised on the atomic scale. After completing this course, students will be able to (i) comprehend the opto-electronic and scattering phenomena in solids, (ii) analyse the electrical and transport properties as well as device applications of semiconductor materials (ii) understand the critical phenomena in low-dimensional physics at nanoscale and the key role in the technological advances.
PHY-304P	Course Outcome of **PHY-304P: Advanced Condensed Matter Physics - I (Lab)**
	This course offers the advanced hands- on experiments of advanced condensed matter physics. After completion of this course students will have a deeper understanding on the subject and they will be able to understand the phenomena practically.
PHY-305	Course Outcome of **PHY-305: High Energy Physics - I**
	Using this course the learners will be able to (a) get the idea of the role of symmetry in elementary particles physics (b) get the basic concept of quantum fields and field quantization, (d) compute various QED processes such as Rutherford, Bhabha, Moeller, Compton scattering etc.
PHY-306	Course Outcome of **PHY-306: Advanced Mathematical Physics**
	After successful competition of the course, the learner will be able to (i) transform differential equations to integral equations, figure out the various methods of solving integral equations (ii) apply the knowledge of group theory in various branch of physics (iii) use the concept of path integral in various system like free particle and harmonic oscillator.
PHY-307	Course Outcome of **PHY-307: Experimental High Energy Physics**
	After successful competition of the course, the learner will be able to (i) apply the basic principles of Relativistic Kinematics to solve problems in connection with scattering and decay of elementary particles, (b) get the basic knowledge of the Physics of Heavy-ion collisions and the observable, (c) learn the indirect signatures of Quark-Gluon Plasma, (d) to run various MC event generators in computer, (e) get the basic idea of detector simulation and data analysis.
PHY-308	Course Outcome of **PHY-308: Advanced Optics – I**
	At the end of the course, the students will be able to *1. Familiarize with different branches of spectroscopy*

	2. Learn to use spectroscopic methods to apply in various areas *3. Understand theoretical background of laser, its importance*
PHY-308P	Course Outcome of **PHY-308P: Advanced Optics (Lab)**
	At the end of the course the students will be able to 1. *Use and handle spectroscopic instruments in laboratory* 2. *Understand the principles of laser spectroscopy through performance of experiments* 3. *Provide exposure in practical application of spectroscopic instruments.*
	SEMESTER-IV
PHY-401	Course Outcome of **PHY-401: Statistical Mechanics**
	This course gives the insight of postulates of statistical physics and calculating probability for various statistical systems of particles. After completing this course students will be able to (i) distinguish between the types of ensembles and explain the behaviour of classical and quantum statistics, (ii) establish the connection between statistics and thermodynamics, and (iii) understand the concept of the Ising model and phase transitions.
PHY-402	Course Outcome of **PHY-402: Atomic and Molecular Physics**
	At the end of the course the students will be able to: 1. ascertain the atomic and molecular structures 2. learn the interaction of electromagnetic spectra with matter 3. use spectroscopic techniques to identify elements present in a sample 4. familiarize with the mechanism of laser spectroscopy and its importance 5. familiarize with the mechanism of Fibre optics and its importance in various areas
PHY-403	Course Outcome of **PHY-403: Advanced Nuclear Physics– II**
	After learning this course, the students will be able to (i) apply angular momentum and parity selection rules to predict gamma transition, (ii) apply the basic principle of Mossbauer effect to measure the Isomer shift, determination of gravitational red shift. (iii) calculate important nuclear fission reactor parameters such as slowing down power, moderating ratio & diffusion length (iv) derive & solve Fermi Age Equation (v) compute fission and fusion barrier (vi) distinguish between stellar nucleosynthesis and big bang nucleosynthesis and Controlled fusion reaction (vii) apply basic QM to explain the neutrino oscillation (viii) Accumulate some radiological protection knowledge like effective Biological effect (RBE), shielding, Radiation safety in the laboratory for nuclear physics (ix) apply the basic idea of magnetic nuclear resonance (NMR) to determine nuclear spin & chemical shift.
PHY-404	Course Outcome of **PHY-404: Advanced Condensed Matter Physics - II**
	This course aims at giving the students the advances in material science that most directly be confronted with experiments in future. At the end of the course students will be able to (i) perceive the magnetic behaviour, magnetic interactions in bulk as well as at nanoscale, (ii) explain the fascinating phenomenon of superconductivity and its potential applications, (iii) demonstrate the understanding of soft material dynamics and interactions.
PHY-405	Course Outcome of **PHY-405: High Energy Physics - II**
	At the end of this course, the students will be able to (a) learn about the role played by symmetries in studying Quantum Field theories (b) get the preliminary idea of SSB and Higgs mechanism, (c) acquire the in-depth knowledge of the Standard Model of particle Physics (d) grasp the necessity for physics beyond SM, (e) know the solar & Atmospheric neutrino puzzle and realize its solution through a quantum mechanical process called neutrino oscillation.
PHY-406	Course Outcome of **PHY406: Advanced Optics-II**
	At the end of the course, the students will be able to

	1. *Learn the basic principles of non linear spectroscopy* 2. *Familiarize with principles and instrumentations in non linear spectroscopy* 3. *Learn the different techniques of laser Raman spectroscopy and applications* 4. *Familiarize with recent developments in Laser Spectroscopy*
PHY-407	Course Outcome of **PHY-407: Research Methodology & Experimental Techniques in Physics**
	This course will provide a basic understanding about scientific research and various techniques. After completion of the course, students will be able to identify the research gap and various research methodologies to address the contemporary research problems, investigate the data by using different scientific techniques and develop their presentation skills.
PHY-408P	Course Outcome of **PHY-408P: Project/Dissertation/ Advanced Practical**
	The outcome of this course is the completion of a dissertation / project report. The dissertation reports a research project conducted with the guidance of a supervisor. The dissertation / project reports should make a contribution to education knowledge. This course will motivate the students to take up research in their future.