Course: B. Sc. Physics
Programme Outcomes:

Core Papers:

DSC1: Mechanics: The students would learn about the behaviour of physical bodies it provides the basic concepts related to the motion of all the objects around us in our daily life. The course builds a foundation of various applied field in science and technology; especially in the field of mechanical engineering. The course comprises of the study vectors, laws of motion, momentum, energy, rotational motion, gravitation, fluids, elasticity and special relativity.

DSC1 LAB: Students would perform basic experiments related to mechanics and also get familiar with various measuring instruments would learn the importance of accuracy of measurements.

DSC2: Electricity and Magnetism: It gives an opportunity for the students to learn about one of the fundamental interactions of electricity and magnetism, both as separate phenomena and as a singular electromagnetic force. The course contains vector analysis, electrostatics, magnetism, electromagnetic induction and Maxwell's equations. The course is very useful for the students in almost every branch of science and engineering.

DSC2 LAB: Students would gain practical knowledge about electricity and magnetism and measurements such as: Resistance, Voltage, current etc.

DSC3: Thermal Physics and Statistical Mechanics: The course makes the students able to understand the basic physics of heat and temperature and their relation with energy, work, radiation and matter. The students also learn how laws of thermodynamics are used in a heat engine to transform heat into work. The course contains the study of laws of thermodynamics, thermodynamic description of systems, thermodynamic potentials, kinetic theory of gases, theory of radiation and statistical mechanics.

DSC3 LAB: Students would gain practical knowledge about heat and radiation, thermodynamics, thermo emf , RTD etc. and perform various experiments.

DSC4: Wave and Optics: The course comprises of the study of superposition of harmonic oscillations, waves motion (general), oscillators, sound, wave optics, interference, diffraction, polarization. The course is important for the students to make their career in various branches of science and engineering, especially in the field of photonic engineering.

DSC4 LAB: The practical knowledge of wave motion doing experiments: Tuning fork, electric vibrations. They would also learn optical phenomena such as interference, diffraction and dispersion and do experiments related to optical devices: Prism, grating, spectrometers

Discipline Specific Elective papers(any two):

DSE1: Elements of Modern Physics: Students would know about the basic principles in the development of modern physics. The topics covered in the course build a basic foundation of undergraduate physics students to study the advance branches: quantum physics, nuclear physics, particle physics and high energy physics. The course contains the study of Planck's hypothesis, photoelectric effect, Compton effect, matter waves, atomic models, Schrodinger wave equations, and brief idea of nuclear physics.

DSE1 LAB-Elements of Modern Physics: In this course students would be able to understand Basic experiments of modern physics such as: Determination of Plank's and Boltzmann's constants, Determination of ionization potential, Wavelength of H-spectrum, Single and double slit diffraction, Photo electric effect and determination of e/m

DSE1: Solid State Physics: Students would be able to understand various types of crystal structures and symmetries and understand the relationship between the real and reciprocal space and learn the Bragg's X-ray diffraction in crystals. Would also learn about phonons and lattice.

DSE1 LAB- Solid State Physics: The course Provides practical knowledge of various physical phenomena such as: magnetism, dielectrics, ferroelectrics and semiconductors. Students would gain a hands-on learning experience by performing experiments on these properties of materials.

DSE2: Quantum Mechanics: Quantum mechanics provides a platform for the physicists to describe the behaviour of matter and energy at atomic and subatomic level. The course plays a fundamental role in explaining how things happen beyond our normal observations. The course includes the study of Schrodinger equations, particle in one dimension potential, quantum theory of H like atoms, atoms/molecules in electric and magnetic fields.

DSE2 LAB- Quantum Mechanics: Various practical problems solving methods related to Quantum Mechanics would be learned by students.

DSE2: Mathematical Physics: Would learn mathematical methods to solve the various problems in physics. The topics include the calculus of functions, Fourier transform, special functions and special integrals, partial differential equations, complex analysis and variables.

DSE2 LAB- Mathematical Physics: Various practical problems related to applications of mathematical tools to solve the problems in physics would be learned by students

Skill Enhancement Courses (any two):

SEC1 - Electronics –I: The students would gain the knowledge of Basic Electronics circuits, network theorems and measuring instruments: They would know about common solid state devices: Semiconductor diodes and transistors. The topics also include the Rectifiers, Filters and their applications, number systems and logic gates which are foundation blocks of digital electronics.

SEC2- Computational Physics: This course would introduce students with the basic knowledge of computers their applications in solving common and scientific problems, the course include scientific programming languages, scientific word processing and graphical analysis.

SEC3-Electronics II: Students would learn about electronic circuits such as Amplifiers and Oscillators. Various types of Amplifier and Oscillator circuits their working and applications in in domestic, industrial and scientific devices/equipments.

SEC4: Radiation and Safety: The students would gain the knowledge of different types of radiation and its interactions with matter, would also know about the photons, charged particles, neutrons, about radiation detection, monitoring and safety measures, and also learn about the applications of nuclear techniques.

B. Sc. PHYSICS

PROGRAMME SPECIFIC OUTCOMES: This undergraduate course in Physics Would provide the opportunity to the students:

- To understand the basic laws and explore the fundamental concepts of physics
- To understand the concepts and significance of the various physical phenomena.
- To carry out experiments to understand the laws and concepts of Physics.
- To apply the theories learnt and the skills acquired to solve real time problems.
- To acquire a wide range of problem solving skills, both analytical and technical and to apply them.
- To enhance the student's academic abilities, personal qualities and transferable skills this will give them an opportunity to develop as responsible citizens.
- To produce graduates who excel in the competencies and values required for leadership to serve a rapidly evolving global community.
- To motivate the students to pursue PG courses in reputed institutions.
- This course introduces students to the methods of experimental physics. Emphasis will be given on laboratory techniques specially the importance of accuracy of measurements.
- Providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, heat, optics, electricity and electronics.

Course: M Sc. (Physics)

Programme Outcomes (PO)

Phy-C001: Classical Mechanics: In this course students would learn to apply the Newtonian laws using various mathematical formulations to describe the motions of macroscopic objects using generalized coordinates, momentum, forces and energy. The classical mechanics would be helpful in understanding of advanced branches of modern physics.

Phy-C002: Mathematical Physics: Students would be able to understand the mathematical methods essential for solving the advanced problems in physics. It would be helpful in the development of the ability to apply the mathematical concepts and techniques to solve the problems in theoretical and experimental physics. The knowledge of mathematical physics would be beneficial in further research and development as it serve as a tool in almost every branch of science and engineering.

Phy-C003: Electrodynamics & Astrophysics: The study of electromagnetic theory provides basic foundation for the students to understand advanced courses of physics. The astrophysics part of the course opens scope for students seeking research opportunities in space, atmospheric and planetary sciences etc. The course involves the study of electromagnetic theory, Maxwell's equations and electromagnetic waves, radiations from moving charges, solar and stellar systems.

Phy-C004: Electronics: This course comprises of basics understanding of power amplifiers, feedback amplifiers, operational amplifiers and optoelectronic devices. This course is helpful for the students seeking job opportunities in government, corporate and private sectors. It is also helpful for the students to find opportunities research & development (R & D). The in depth understanding of electronics at post graduate level opens scope for the students to work in private and public sector enterprises.

PHY-005&006: Lab Course I&II: Students would gain practical knowledge of basic electronic circuits and components by performing experiments in laboratory the experiments include: LCR, UJT MOSFET, Transistors, Amplifiers, and Oscillators.

Phy-C007: Atomic and Molecular Physics: The course structure includes atomic and molecular spectroscopy. As per the course structure, the students learn basics concepts of spectroscopic principles and rules. Students would learn technique in spectroscopy and know about their applications. The course is helpful for the students to explore R & D opportunities in various areas of science and technology such as biomedical, industrial and environmental fields.

Phy-C008: Solid State Physics: students will be able to develop an understanding of the lattice, different types of crystal structures, symmetries. The student would gain insight about the interior of the substances using X-ray diffraction in crystals. This course also includes elastic waves, phonons, and lattice vibrational properties. The course forms a theoretical basis of experimental material science and technology.

Phy-C009: Statistical Physics: The course includes the study of Basic postulates, application of classical distribution to ideal gases, imperfect gases, quantum statistics and black body radiation. The course is

helpful for the students to understand the dynamics of the bulk material in macroscopic as well as microscopic levels. It is also useful to understand the relation between microscopic and macroscopic systems. Understand how statistics of the microscopic world can be

Phy-C010: Quantum Mechanics: The course provides an understanding of the behaviour of the systems at microscopic (atomic and nuclear) scale and even smaller. Students would learn basic postulates and formulations of quantum Mechanics. The course, in fact, plays an important role in explaining the behaviour of all physical systems in the universe. The course includes the study of a brief review of foundations of quantum mechanics, matrix formulation of quantum mechanics, symmetry in quantum mechanics and approximation methods for bound states.

PHY-C011 & 012: Lab Course I & II: Students would gain practical knowledge by performing various experiments of Electronics, Optics and Radiation.

Phy-C013: Advanced Quantum Mechanics: The course includes the study of scattering theory, identical particles, relativistic wave equations and quantization of wave fields. The course would describe the nature and behaviour of matter and energy at subatomic level. In particular, theory of scattering gives an understanding collision between a quantum mechanical particle and target. The study of relativistic quantum mechanics enables the students to understand the behaviour of objects moving with speeds comparable to that of light.

Phy-C014: Nuclear Physics: In this course students would know about the general properties of nuclei, nuclear forces and detectors, radioactive decay and nuclear reactions. The course expands the knowledge of students especially, the various applications of nuclear physics The course builds a foundation for the students to carry out research in the field of nuclear physics, high energy physics, nuclear astrophysics, nuclear reactions and applied nuclear physics.

Phy-C015: Lab Course I: In This Course students would gain the practical knowledge by performing various experiments related to different field in physics and would also learn to design the experiments themselves under the supervision.

Phy-E001: Condensed Matter Physics A: The course includes the study of defects in crystals, magnetism, energy bands and dielectric and electrical properties of insulators. This course is of immense importance for the students seeking R & D opportunities in the field of theoretical condensed matter physics, material science, device fabrication, nanoscience and nanotechnology etc.

Phy-E002: Electronics A: This course helps the students to gain basic ideas of the construction and working of electronic devices and circuits and to understand the fundamentals of communication systems. The course includes the study of number systems, Boolean algebra, logic gates, combinational circuits, sequential circuits, memory devices and IC technology. The course is of much practical purpose for the students to learn basics of digital electronics. The digital electronics has wide applications in computing, process control, signal processing, communication systems, digital instruments etc.

Phy-E003: Laser Physics A: In This course the students would gain the knowledge basic principles, would study the various types of lasers, Laser spectroscopy and their applications in science and technology.

Phy-E004: High Energy Physics A: Students would be able understand the complex properties and behaviour of high energy particles at the microscopic level. This course would encourage students to peruse higher study and research in particle and high energy Physics.

PHY-E005: Astrophysics A: The Course would be helpful in understanding our composition and universe, the dynamics of stars including our solar system and radiation. Students would also le **PHY-E006: Lab Lab Course II (Circuit design):** Students to would physically experience about various electronic components and learn to design some basic electronic circuits and study their applications.

Phy-C016: Computational Physics: The course provides an opportunity to the students to learn about the fundaments of computer applications in solving the problems in different branches of Physics and Mathematics. They would learn basics of C-programming and FORTRAN-90/95 programming languages and their applications which can useful in their future carrier in the field of research and technology.

Phy-C017: Particle Physics: The course is important for the students to learn about the most fundamental building blocks of matter and radiation, interaction among elementary particles and hence to understand their behaviour. The course provides a platform for the students seeking research opportunities in high energy physics.

Phy-E007: Condensed Matter Physics B: The course gives in depth understanding of condensed matter physics, including Dielectric and Ferroelectric, Piezoelectric properties, superconductivity, nanomaterials and nanoscience and technology. The students have the opportunity to use the basic principles of condensed matter physics in frontier areas of research and development in the field of material science, nanoscience and nanotechnology.

Phy-E008: Electronics B: The course is very important for the students to understand the broadcasting of a message signal from transmitter, its radiation mechanism (how modulated electrical signal is propagated in the form of radio waves) and its detection or demodulation (extraction of original message from modulated signal) at receiver. The course includes the study of modulation, demodulation, transmitters, receivers, TL, antenna, propagation of radio waves, TV, Radar systems. The course is gives the basic science of working of a wireless communications system. The course is also useful for the students to understand the basic function of Television and Radar systems.

PHY-E009: Laser Physics B: The students would learn about various optical sources and devices including lasers photo diodes, LED and applications, they would also have the understanding of optical fiber optics, different types of optical fibers, optical communication systems, digital modulation, optical fibers and importance of fiber optical communication in modern world.

PHY-E010: High Energy Physics B: In this course provide advance knowledge of higher energy physics and particle physics. The topics include the Symmetries and conservation laws, Gauge theory, Gauge fields, Grand Unified theory and basic idea out the quark and Leptons.

PHY-E011: Astrophysics B: This Course provides an opportunity to students to know about various experimental techniques astronomical observations; these include Detectors, Photometry and spectroscopic observational instruments, radio astronomical telescope, interferometer etc. Students would also learn about the Galactic system, extragalactic systems, cosmology and gravitation.

Phy-E012: Project: This course is based on preliminary research oriented topics both in theory and experiments. The students are given particular research problems under the supervision of faculty members of the department. Students have the opportunity to work on theoretical as well as experimental topics in physics. The different research areas in which students can do projects are theoretical condensed matter physics, experimental material science, nuclear radiation detectors, radiation physics and environmental radioactivity. The knowledge gained during their project work play a key role in the students' career to pursue Ph. D degree and start their carrier in research in scientific institutions.

Self Study (Any one of the following):

PHSS-006: **- Environmental Physics:** Students would acquire basic knowledge about essentials of Environmental Physics , Environmental pollution & degradation, Environmental Changes and Remote Sensing, Global and regional Climate, Global warming, Greenhouse effect and methods and techniques to control these effects.

PHSS-002: Physics Of Liquid Crystals: The students would gain the theoretical understanding about the liquid crystals their structure, physical properties and their applications.

PHSS-003: Atmospheric Physics: This course would provide the knowledge of physical processes and physical laws used to discuss these processes and properties of atmosphere. The students would also understand various Mathematical and Statistical Methods, Observational Techniques leading to understanding of the atmosphere, Atmosphere and their role in the wave propagation, and Atmospheric Thermodynamics and radiation budget.

PHSS-004: Bio Physics: Course would provide the applications of physical laws in the understanding of biological processes, various methods in the Biophysical analysis including florescence spectroscopy, Raman spectroscopy and characterization of bio molecules would be studied.

M Sc. Physics

Programme Specific Outcomes (PSO)

- The Master of Science in Physics programme provides the candidate the required knowledge, general competence, and analytical skills on an advanced level, needed in industry, consultancy, education, research, or in public administration.

- The students would gain substantial knowledge in various branches of physics: Electronics, Quantum, classical, statistical mechanics, condensed matter physics, astrophysics, particle, nuclear and high energy Physics.
- Would learn use of mathematical tools in solving complex physical problems and have the solid background and experience required to model, analyze, and solve advanced problems in physics.
- Would able to apply advanced theoretical and/or experimental methods, including the use of numerical methods and simulations.
- This course would empower the student to acquire scientific and engineering skills and the required practical knowledge by performing experiments in general physics and electronics.
- Would also get some research oriented experience by doing theoretical and experimental projects in the last semester under the supervision of faculty.
- The course as a whole opens up several career doors for the students interested in various areas of science and technology in private, public and government sectors.
- Students may get job opportunities in higher education, research organizations, physics consultancy, radiology, radiation oncology and many others. Some of the institutions where physics students can start their carrier are: BARC, DRDO, NPTC, IISc, ISRO, ONGC, BHEL, PRL, NPL, SINP, VECC, IITs, NITs, IIPR etc.