# Department of Physics

# Programme: Three years BSc Physics Major

# Programme outcome, programme specific outcome and course outcome

## Programme Outcome (PO):

The three years BSc Physics major programme is intended to the students who are enthusiastic in learning the essence of physics. Students graduating BSc in physics would be able to

**PO1.** ***Content:*** Cherish the mystical beauty of physics in explaining physical world and culture the mind to comprehend physics principles and theories.

**PO2.** ***Organized knowledge:*** Understand the fundamental concepts and building blocks of the theories involved and the experiments designed as the subject is unfolded. Develop the mathematical concepts involved in the analysis and formulation of the core courses including mechanics, thermodynamics, classical and quantum mechanics, and statistical mechanics. Foster ability to formulate, conduct, analyse, and interpret experiments in physics. Explore the nature of the physical world from microscopic scale to macroscopic scale.

**PO3.** ***Problem solving strategy****:* Develop the ability to represent the key aspects of physics through graphs and diagrams, and use geometric arguments in problem solving. Develop analytical skills and utilize them in solving problems with increasing level of difficulties.

**PO4.** ***Communication:*** Nurture the artistry of presenting information in a clear, concise, and logical manner. Develop some positive attitude and values including perception about the impact of physical sciences in various social, economical, and environmental issues. Capable of understanding their professional and ethical responsibility to society; accumulate capacity and desire for life-long learning to improve themselves as good citizens.

**PO5.** ***Research:*** Complete an experimental research project under the guidance of faculty and report on this project in writing and orally to an audience of peers and faculty.

## Programme Specific Outcome (PSO)

**PSO1:** Develop an appropriate knowledge of the foundations of physics.

**PSO2:** Foster ability to theoretically model and experimentally explore physical systems.

**PSO3:** To develop competency in applying various mathematical as well as graphical methods to analyse and solve problems.

**PSO4:** Demonstrate the ability to do simple laboratory experiments, to collect and analyse the experimental data and to interpret their results.

**PSO5:** To develop competency for research project and develop an ability to communicate scientific work and findings.

**PSO6:** Students are intended to develop an advanced level on all fronts, suitable for entry to a higher-level of courses.

## Course outcome (CO):

The three years undergraduate BSc Physics major programme involves fundamental and core courses of physics as mentioned bellow. All of these courses have different outcomes (as mentioned bellow separately) which will ultimately enhance the depth of knowledge about physics.

***Course title: Mathematical methods***

**CO1:** To learn the fundamental mathematical methods that are frequently used to formulate and analyse the problems involved in core physics courses.

**CO2:** To learn elegant techniques coordinate transformation, Eigen value problem, methods of solving various second-order differential equations, method of solving partial differential equations using separation of variables, methods of complex integrations, etc.

**CO3:** Understand basic statistical methods and concepts like probability, random variables, variance, and probability distribution functions.

**CO4:** To develop the capacity of formulating physical laws in terms of tensors and their simplification using coordinate transformation.

**CO5:** Able to apply the methods in solving various physical problems.

***Course title: Mechanics, Properties of Matter, Waves and oscillations, and Special Theory of Relativity***

**CO1:** To develop the understanding of laws of mechanics and their applications in analysing various physical problems.

**CO2:** Able to classify and understand various physical properties of matter.

**CO3:** To understand the role of the wave equation and appreciate the universal nature of wave motion in a range of physical systems.

**CO4:** Able to understand the nature of waves and oscillations and their analysis via Fourier series.

**CO5:** To grasp the foundation of special theory of relativity; the application of Lorentz transformation in describing the relativistic motion.

***Course title: Optics***

**CO1:** to understand various optical phenomena such as diffraction, interference, polarization in terms of the wave model.

**CO2:** Find the location and magnification of images in single- and multiple-lens/mirror systems by calculation and by ray tracing.

**CO3:** Capable of explaining the working principle behind various optical instruments including human eye.

**CO4:** Able to learn the various techniques involved in analysing the ray and wave optics together with some parts of modern optics such as construction of laser, holography, optical fibres etc.

***Course title: Heat and Thermodynamics***

**CO1:** To learn the fundamental laws of thermodynamics and associated thermodynamic variables

**CO2:** To explain various thermodynamic processes and their quantitative analysis.

**CO3:** To learn kinetic theory of gases and the concepts involved in designing heat engines and their uses.

***Course title: Electrostatics and Magnetostatics***

**CO1:** Have a deep understanding of the theoretical foundations of electromagnetic phenomena.

**CO2:** Able to understand the relationship between electric charge, electric field, electric potential, and magnetism.

**CO3:** Able to explain various phenomena of electrostatics and magnetostatics.

***Course title: Electricity and Magnetism***

**CO1:** Learn about the significance of various electrical components and devices and how they operate in an electrical circuit.

***Course title: Introduction to Computer and Computer Programming***

**CO1:** Familiar with the logical development of algorithms and object oriented programming.

***Course title: Classical Mechanics***

**CO1:** Able to develop an idea how Lagrangian and Hamiltonian formulations can be used effectively as a sophisticated tool to analyse the problems of mechanics.

**CO2:** Learn how these formulations are applicable in explaining the Keplar's law for planetary motion and other central force problem.

***Course title: Atomic Physics***

**CO1:** Able to describe theories explaining the structure of atoms and the origin of observed spectra.

**CO2:** Able to explain the observed dependence of atomic spectral lines on externally applied electric and magnetic field and, thereby able to identify atomic effects such as Zeeman effects, Stark effects etc.

***Course title: Solid state Physics***

**CO1:** Have a basic knowledge of various crystal structure and spatial symmetries.

**CO2:** Able to account for how crystalline materials are studied using diffraction.

**CO3:** Able to calculate thermal and electrical properties in the free-electron model.

**CO4:** Able to differentiate metal, insulator, and semiconductor in terms of energy band.

**CO5:** Have a flavour of superconductivity and different types of superconductors.

**CO6:** Capable of explaining magnetic properties through classical theories of magnetism.

***Course title: Nuclear Physics***

**CO1:** Able to understand the importance of models in describing the properties of nuclei and nuclear collisions and able to make quantitative estimates of phenomena involving nuclei.

**CO2:** Able to understand how various types of accelerators work; functioning of nuclear reactors etc.

***Course title: Electronics***

**CO1:** Acquire knowledge about the basic design principles of various electronic components and their characteristics.

**CO2:** Analyse and design various electronic circuits including rectifiers, amplifiers, and oscillators.

**CO3:** Capable of solving numerical problems related to circuit design.

**CO3:** Acquire knowledge about the basics of digital electronics and solving problems related to number systems and Boolean algebra.

***Course title: Quantum Mechanics***

**CO1:** Able to realize the difference between macroscopic and microscopic world and the historical development of quantum mechanics.

**CO2:** Have a deep understanding about the mathematical foundations of quantum mechanics.

**CO3:** Learn how to solve Schrodinger equation for simple potentials.

***Course title: Statistical Mechanics***

**CO1:** Able to understand the fundamental concepts involved in statistical mechanics including phase space, ensembles, density of states, etc.

**CO2:** Acquire knowledge about the classification of statistics for classical and quantum particles.

**CO3:** Capable of applying the statistics to some classic problems of physics including blackbody radiation, electronic specific heat, and Bose-Einstein condensation.

***Course title: Introduction to Astrophysics***

**CO1:** Able to understand the formation, evolution, and classification of stars.

**CO2:** Familiar with various physical quantities and parameters involved in describing celestial objects.

***Course title: Laboratory Experiments***

**CO1:** Able to perform various basic experiments in physics.

**CO2:** Able to perform a statistical and systematic analysis of the observed data.

**CO3:** To engage students for preparing projects based on syllabus.

**CO4:** To enhance their theoretical understanding through lab experiments.

**CO5:** To develop basic lab skill for application of various lab experiments.