DEPARTMENT OF PHYSICS

Program Specific Outcomes (PSO)

PSO 1: Fundamental Knowledge and Conceptual Understanding

- **Outcome**: Students will have a strong understanding of core physics concepts in classical mechanics, electromagnetism, thermodynamics, quantum mechanics, optics, and relativity. They will be able to apply theoretical principles to solve complex physics problems.

PSO 2: Experimental and Practical Skills

- **Outcome**: Students will gain hands-on experience in laboratory work, including the use of various instruments and apparatus for conducting experiments. They will be able to design and execute experiments to test physical theories and interpret experimental results with precision.

PSO 3: Problem-Solving and Analytical Thinking

- **Outcome**: Students will develop strong analytical skills and the ability to solve physics problems using mathematical techniques. They will be proficient in applying methods such as calculus, linear algebra, and differential equations to model physical systems and interpret results.

PSO 4: Application of Physics to Real-World Systems

- **Outcome**: Students will be able to apply their understanding of physics to practical and real-world systems. This may include fields such as renewable energy, materials science, electronics, and medical physics.

Department of Physics

Course Outcomes

❖ B. Sc. Semester-I (DSC-I) MEASUREMENT, MECHANICS, AND PROPERTIES OF MATTER

CO1: Understanding Measurement in Physics
Students will define fundamental and derived physical quantities, explain the importance of SI and CGS units, and demonstrate the use of measuring instruments. They will analyze measurement errors and apply dimensional analysis in problem-solving.

CO2: Application of Newtonian Mechanics
Students will explain Newton's laws of motion, describe force, momentum, and impulse, and apply the law of conservation of momentum. They will analyze frictional forces and evaluate the effects of centripetal and centrifugal forces in real-world scenarios.

CO3: Analyzing Motion in One and Two Dimensions
Students will interpret motion graphs, apply kinematic equations, and compare uniform and non-uniform motion. They will analyze projectile motion and evaluate relative velocity in practical situations such as moving vehicles and riverboat problems.

CO4: Understanding the Properties of Matter and Fluid Mechanics
Students will describe elasticity, Hooke's law, and material properties, apply Pascal's law and Bernoulli's principle to fluid mechanics, and evaluate the effects of viscosity, surface tension, and capillarity in industrial and natural processes.

❖ B. Sc. Semester-I (DSC-II) KINETIC THEORY OF GASES AND THERMODYNAMICS

CO1: Understanding Kinetic Theory of Gases
Students will explain the assumptions of the kinetic theory of gases and derive expressions for mean free path and Maxwell's velocity distribution. They will analyze molecular collisions, transport properties, and the law of equipartition of energy in gases.

CO2: Analyzing Real Gases and Thermodynamics
Students will compare real gases with ideal gases using Van der Waals' equation and evaluate critical constants. They will describe thermodynamic variables, apply the first law of thermodynamics to various processes, and calculate work done in isothermal and adiabatic changes.

CO3: Evaluating Heat Engines and Entropy
Students will analyze heat engines, describe Carnot's cycle, and determine its efficiency. They will evaluate the second law of thermodynamics, entropy changes in reversible and irreversible processes, and apply the third law of thermodynamics in real-world applications.

CO4: Applying Maxwell's Relations and Advanced Thermodynamics
Students will derive and apply Maxwell's thermodynamic relations to various systems. They will analyze the Clausius-Clapeyron equation, Joule-Thomson effect, and inversion temperature, and evaluate the significance of Boyle's law in thermodynamic processes.

❖ B. Sc. Semester-I (OE-I) SPACE SCIENCE

CO1: Explain the structure of the Solar System, the laws governing planetary motion, and methods of measuring astronomical distances, including the units used for stellar and planetary measurements. (CO1)

CO2: Describe the principles and types of optical and non-optical telescopes, their magnifying and resolving powers, and the applications of various forms of astronomical observation such as UV, X-ray, and radio astronomy. (CO2)

CO3: Evaluate the role of rockets and satellite payloads in space exploration, and demonstrate understanding of the technology behind detectors for optical and infrared regions, as well as the use of CCDs and CMOS in stellar imaging. (CO3)

CO4: Identify and analyze fundamental particles originating from space, and explain the basic forces in nature, such as gravitational, electromagnetic, weak, and strong forces, while gaining an understanding of celestial objects like galaxies, black holes, and neutron stars. (CO4)

❖ B. Sc. Semester-II (DSC-III) ACOUSTICS AND ULTRASONICS

CO1: Students will explain the characteristics of musical sound, including loudness, pitch, and quality, and differentiate between consonance and dissonance. They will analyze musical scales, human audibility limits, and noise hazards while exploring noise control measures.

CO2: Students will apply the concepts of reverberation, absorption coefficient, and acoustic design for better sound quality in buildings. They will compare different transducers, including microphones, loudspeakers, and hearing aids, and evaluate their role in sound recording and reproduction.

CO3: Students will describe the properties of ultrasonic waves and analyze their detection and production methods. They will compare various ultrasonic wave generators, such as piezoelectric and magnetostriction oscillators, and apply techniques for frequency and velocity measurement.

CO4: Students will apply ultrasonic waves in SONAR, depth measurement, and non-destructive testing. They will explore their role in industrial applications like welding and cleaning, as well as in medical diagnostics, including ultrasonography and ultrasonic microscopy.

❖ B. Sc. Semester-II (DSC-IV) OSCILLATIONS AND BLACK BODY RADIATION

CO1: Students will explain the concepts of linear and angular simple harmonic motion (SHM) and derive their differential equations. They will analyze oscillatory motion in systems like spiral springs and torsional pendulums and apply Lissajous figures to study wave interference.

CO2: Students will derive and solve the differential equations for damped and forced oscillations. They will evaluate the effects of damping, power dissipation, resonance, and the quality factor in oscillatory systems and apply these concepts to real-world mechanical and electrical systems.

CO3: Students will describe transverse and longitudinal waves and derive wave equations for different media. They will analyze the speed of waves on stretched strings, compare phase and group velocity, and apply the Doppler effect to real-world scenarios.

CO4: Students will explain the properties of black body radiation and derive Planck’s law. They will apply Wien’s displacement law, Rayleigh-Jeans law, and Stefan-Boltzmann law to analyze thermal radiation and understand the concept of energy density and pressure of radiation.

❖ B. Sc. Semester-II (OE-II) ENERGY SOURCES

CO1: Students will explain the concepts of linear and angular simple harmonic motion (SHM) and derive their differential equations. They will analyze oscillatory motion in systems like spiral springs and torsional pendulums and apply Lissajous figures to study wave interference.

CO2: Students will derive and solve the differential equations for damped and forced oscillations. They will evaluate the effects of damping, power dissipation, resonance, and the quality factor in oscillatory systems and apply these concepts to real-world mechanical and electrical systems.

CO3: Students will describe transverse and longitudinal waves and derive wave equations for different media. They will analyze the speed of waves on stretched strings, compare phase and group velocity, and apply the Doppler effect to real-world scenarios.

CO4: Students will explain the properties of black body radiation and derive Planck's law. They will apply Wien's displacement law, Rayleigh-Jeans law, and Stefan-Boltzmann law to analyze thermal radiation and understand the concept of energy density and pressure of radiation.

❖ B. Sc. Semester-III (Paper-I) SOUND WAVES, APPLIED ACOUSTICS, ULTRASONIC AND POWER SUPPLY

CO1: Define key terms related to sound waves. Explain how sound waves propagate through different materials Demonstrate how resonance affects sound production in musical instruments. Design an experiment to measure the speed of sound in air using a tuning fork.

CO2: Define fundamental acoustics concepts such as sound pressure, intensity. Analyze the impact of architectural design on sound propagation and reverberation Design the selection of acoustic treatments for concert halls, classrooms, or home studio.

CO3: Define different types of ultrasonic waves. transducers and piezoelectric materials. Analyze and compare different ultrasonic transducer types and their applications. Assess the effectiveness of ultrasonic methods in material testing.

CO4: Define key terms related to power supply systems, such as rectifier, regulated and unregulated power supply Describe the operation of rectifiers (half-wave, full-wave, and bridge rectifiers) and their output characteristics. Demonstrate the working of a basic power supply circuit using simulation software.

❖ B. Sc. Semester-III (Paper-II) PHYSICAL OPTICS AND ELECTROMAGNETIC WAVES

CO1: Understand the principles of interference, including thin-film interference, phase changes, and the applications of Newton's rings and interferometers in wavelength determination.

CO2: Analyze the concepts of Fresnel and Fraunhofer diffraction, diffraction due to slits and apertures, and the resolving power of diffraction gratings.

CO3: Explain the phenomenon of polarization, including Brewster's law, double refraction, Nicol prism, and the use of phase retardation plates.

CO4: Comprehend the characteristics of electromagnetic waves, Maxwell's equations, wave propagation in different media, and the significance of the Poynting vector.

❖ B. Sc. Semester-IV (Paper-I) SOLID STATE PHYSICS, X-RAY AND LASER

CO1: Recall the fundamental concepts of crystal structures, lattice dynamics, and bonding in solids. Explain the classification of solids-based crystal structures. Design experiments to study solid-state properties such as electrical conductivity and Hall effect.

CO2: Recall the fundamental principles of X-ray generation, properties, Explain the production of X-rays. Design experiments to study X-ray diffraction and its applications in material science.

CO3: Recall the fundamental concepts of reciprocal lattice. Describe the mechanisms of X-ray diffraction Analyzed the Bragg spectrometer and its applications.

CO4: Recall the fundamental principles of laser operation, including stimulated emission and population inversion. Explain the working principles of different types of lasers. Analyzed the coherence and intensity properties of laser beams for various applications.

❖ B. Sc. Semester-IV (Paper-II) SOLID STATE ELECTRONICS, AND MOLECULAR PHYSICS

CO1: Understand and analyze solid-state electronic devices such as LEDs, solar cells, and photovoltaic cells, along with the construction, working, and characteristics of bipolar junction transistors (BJTs) in CE and CB configurations.

CO2: Compare and evaluate field-effect transistors (FETs) and MOSFETs in terms of construction, working principles, characteristics, and advantages over BJTs, and analyze their behaviour as amplifiers.

CO3: Explain the principles of molecular physics by studying vibrational and rotational energy quantization, diatomic molecular structures, rotational-vibrational spectra, and the Born-Oppenheimer approximation.

CO4: Analyze the fundamentals of Raman spectroscopy and other advanced spectroscopic techniques like NMR and ESR, including their theoretical explanations, experimental setups, and applications in molecular structure analysis.

❖ B. Sc. Semester-V (Paper-I) ATOMIC PHYSICS, FREE ELECTRON THEORY AND STATISTICAL PHYSICS

CO1: To Understand Spectra of Single and Multi-Electron Atoms, Fundamentals of atom and its structure. It's behaviour in electric and magnetic field

CO2: To understand the theory and applications of Free Electron Theory and Band Theory of Solids.

CO3: To understand of the concept of Probability, microstates and macrostates and how the particles are distributed in the system in different states using statistical Physics.

CO4: To understand the Distribution of distinguishable and indistinguishable, to understand the methods of statistical mechanics used to develop statistics for Bose-Einstein Statistics. Photon gases and Fermi-Dirac statistics and Energy distribution law for electron gas in metal.

❖ B. Sc. Semester-V (Paper-II) QUANTUM MECHANICS, NANOMATERIALS & NANOTECHNOLOGY

CO1: Explain the fundamental principles of quantum mechanics, including the failure of classical physics, wave-particle duality, and Heisenberg's uncertainty principle, with supporting experimental evidence.

CO2: Apply Schrödinger's equation to solve quantum mechanical problems, interpret wave functions, and analyze quantum operators, eigenvalues, and eigenfunctions for different potential systems.

CO3: Differentiate between nanomaterials and bulk materials, describe various nanomaterial structures (0D, 1D, 2D, 3D), and explain size-dependent physical properties and synthesis approaches.

CO4: Demonstrate knowledge of nanomaterial synthesis techniques, characterization methods (SEM, TEM), and applications of nanotechnology in diverse fields such as medicine, electronics, and energy.

❖ B. Sc. Semester-VI (Paper-I) RELATIVITY, NUCLEAR PHYSICS AND BIO PHYSICS

CO1: To understand the inertial and non-inertial frame of references and how fictitious forces arise in a non-inertial frame. To understand the importance of Michelson Morley's experiment in reference to special theory of relativity

CO2: To develop concepts in fission, neutron cycle and also explore ideas in fields of particle accelerators. To develop concepts of liquid drop model and shell model.

CO3: To understand fundamental concepts in radioactive decay. To gain preliminary knowledge of nuclear detectors.

CO4: To understand physics in biosensors and its application in ECG, ERG, EMG, EEG. To understand biomedical instrumentation principles in aspects of device design and applications.

❖ B. Sc. Semester-VI (Paper-II) ELECTRONICS, FIBRE OPTICS, COMMUNICATION & DIGITAL ELECTRONICS

CO1: Classify amplifiers, analyze multistage amplifiers, understand operational amplifier parameters and applications, and explore feedback concepts and various oscillators.

CO2: Analyze and evaluate the principles, parameters, and spectrums of AM and FM, including power, current expressions, and their merits and demerits.

CO3: Understand and analyze AM and FM concepts, including spectrums, modulation parameters, power expressions, and assess their merits and demerits.

CO4: Apply and analyze number systems, perform binary arithmetic, use logic gates and Boolean equations, and apply De Morgan's theorem in digital circuits.
