ASANSOL GIRLS' COLLEGE

Department of Physics

Programme Specific Outcome (PSO) and Course Outcome (CO)

Programme Specific Outcome (PSO):

The Programme enables the students

PSO1: To acquire basic knowledge in physics, including the major premises of classical mechanics, quantum mechanics, electromagnetic theory, electronics, optics, special theory of relativity and modern physics.

PSO2: To analyze physical problems and develop correct solutions using natural laws.

PSO3: To design and conduct experiments demonstrating their understanding of the scientific method and processes.

PSO4: To discover the concepts of physics in other disciplines such as mathematics, computer science, engineering, and chemistry.

PSO5: To realize and develop an understanding of the impact of physics and science on society.

Course Outcome (CO)

Semester	Module and Topic	Module specific CO
Semester – I (Major) Mechanics & General Properties of Matter	Module: I a) Vector Calculus b) Mechanics of Single Particle	Students will CO1: Understand vector algebra and vector calculus and apply the concepts in classical mechanics CO2: understand the classical mechanics of single particles within the scope of the Newtonian formulation and apply them to physical systems.
	Module: II a) Oscillations b) Gravitation c) System of Particles	CO3: Understand and analyse various aspects of oscillatory motion, including simple harmonic motion properties, energy considerations, damped oscillations, forced oscillations, resonance phenomena,concepts of resonance and quality factors in a driven system and examples of oscillators across different branches of physics CO4: Learn and apply Kepler's laws and Newton's gravitational law to describe the motion of planets and satellites in circular orbit.
	Module: III a) Rigid Body Dynamics b) General Properties of Matter	CO5: Understand rigid body dynamics, including moment of inertia calculations and conservation of rotational energy, and apply these concepts to analyse the dynamics of various rigid bodies. CO6: Study the properties of matter, the response of the classical systems to external forces, and their elastic deformation and its applications and comprehend the dynamics of Fluid and concept of viscosity and surface tension, along with its applications.

Semester	Module and Topic	Module specific CO
Semester – II (Major) Electricity and Magnetism	Module: I a) Electric Field for a pointcharge. b) Electrostatic potential for apoint charge. c) Multipole expansion ofpotential. d) Gauss law in Electrostatics.	Students will CO1: Understand the fundamentals of electric charge, Coulomb's law, electric fields, and potentials, including their relations and apply Poisson's and Laplace's equations to physical problems. CO2: Analyse the electric field and potential generated by multipoles, including dipoles, and apply Gauss's Law to calculate the electric field for various charge distributions
	Module: II a) Concept of Voltage andcurrent Sources. b) Electrostatics in Conductorsand Dielectrics. c) DC steady currents. d) Magnetostatics.	CO3: Explain the behaviours of electric currents, current density, and conductors (metals and semiconductors) under the influence of electric fields and apply Ohm's Law, Kirchhoff's Laws, and network theorems to analyse circuits. CO4: Understand the behaviours of electric fields and charges in conductors and dielectrics, understand capacitor configurations, and be able to calculate the electrostatic energy stored in capacitors. CO5: Understand the fundamental concepts of magnetic fields, including their relation to electric currents, using Ampere's Law and Biot-Savart Law.

	Module: III a) Magnetic materials b) Electromagnetic Induction. c) AC circuits. d) Electromagnetic waves.	CO6: Understand magnetic intensity, induction, magnetisation, susceptibility, and permeability, as well as various types of magnetic materials, including diamagnetic, paramagnetic, and ferromagnetic materials. CO7: Understand electromagnetic induction, including the effects on a conducting rod moving within a magnetic field and apply Faraday's laws of induction and Lenz's Law. CO8: Understand the concepts of RMS and average values of AC signals and analyse the response of RL, RC, LC, and LCR circuits using the j-operator method. CO9: Understand Maxwell's equations, including a brief reference to Magnetic Monopole and an introduction to Gauge transformation andunderstand the concept of electromagnetic waves, including their propagation, transverse nature, and energy transport via the Poynting vector.

Semester	Module and Topic	Module specific CO
Semester – III Classical Mechanics and Special Theory of Relativity	Module: I a) Rotational Motion b) Central force Motion	Students will CO1: Understand the rigid body and rotational motion and apply it to physical systems. CO2: Understand central force motion dynamics, including the two-body problem and Kepler's Laws.
	Module: II a) Lagrangian Formulation b) Hamiltonian Formulation	CO3: Understand Lagrangian mechanics,including concepts like generalised coordinates and conservation principles to analyse the motion of simple systems. CO4: Understand Hamiltonian mechanics,including concepts likePoisson's bracket,Jacobi identity, canonical transformation
	Module: III a) Special Theory of Relativity	CO5: Understand the foundations of the Special Theory of Relativityand its implications for particles moving with velocity close to the value of c (light velocity in vacuum).

Semester	Module and Topic	Module specific CO
Semester – III Thermal Physics I	Module: I a) Kinetic Theory of Gases. b) Transportation Phenomenon c) Brownian Motion and its applications	Students will CO1: Obtain a thorough understanding of the kinetic theory of gases, ideal gas laws, and Maxwell's distribution of molecular velocities. CO2: Understand fundamental transport phenomena in gases: viscosity, thermal conduction, and diffusion.
	Module: II c) Real Gases d) Conduction of Heat e) Radiation	CO3: Understand and analyse the behaviour of real gases beyond the ideal gas model. CO4: Gain in-depth knowledge of various heat transfer processes, particularly conduction and radiation.

Semester	Module and Topic	Module specific CO
Semester – III Analog Systems and Applications	Module: I a) Semiconductor Diodes b) Two-terminal Devices and their Applications	Students will CO1: understand the principles of semiconductor diodes, doping, P-N junction diode and their characteristics. CO2: analyse two-terminal diode devices and their applications as rectifiers as well as principles and structures of LEDs, photodiodes, and solar cells.
	Module: II a) Bipolar Junction transistors b) Field Effect transistors c) Amplifiers	CO3: Understand, analyse and design basic electronic circuits using bipolar junction transistors (BJTs) and field-effect transistors (FETs). CO4: Apply operational amplifiers (Op-Amps) to design and analyse linear and non-linear circuits and perform mathematical operations.

Semester	Module and Topic	Module specific CO
Semester – IV Electromagnetic Theory	Module: I Electromagnetic Theory	Students will CO1: Analyse the propagation of electromagnetic waves using Maxwell's equations. CO2: Explain the behaviour of electromagnetic waves in various media, including reflection, refraction, and transmission at dielectric interfaces. CO3: apply electromagnetic theory to understand modern-day communication systems such as optical fibres and waveguides.
	Module: II a) Dispersion b) Scattering c) Electro-and Magneto-optic Effects	CO4: apply electromagnetic principles to explain various phenomena like dispersion, scattering, etc.

Semester	Module and Topic	Module specific CO
Semester – IV Wave Optics	Module: I a) Oscillation and wave motion. b) Interference	Students will CO1:Understandthe results of the linear superposition of two or more collinear and perpendicular simple harmonic oscillations and wave motion. CO2: Understand and analyse wave phenomena like interference and its applications.
	Module: II a) Diffraction b) Polarisation	CO3: Understand the principles of diffraction of light waves, including Fresnel and Fraunhofer classes. CO4: Gain proficiency in the principles of polarisation, including different states of polarisation, double refraction, andprinciples of optical activity.

Semester	Module and Topic	Module specific CO
Semester – IV Digital Systems and Applications	Module: I a) Integrated Circuits b) Digital Circuits c) Boolean algebra	Students will CO1:understand integrated circuits (ICs), including active and passive components, discrete components, wafers, and chips. CO2: learn about basic digital gates and binary logic and apply it to real-life problems
	Module: II d) Data processing circuits e) Circuits f) Computer Organisation	CO3: Analyse and design basic digital circuits using combinational logic (multiplexers, demultiplexers, decoders, encoders) and sequential logic (SR, D, JK flip-flops). CO4: Explain the fundamental components and organisation of a computer system.

Semester	Module and Topic	Module specific CO
Semester – V Quantum Mechanics	Module: I a) Old quantum theory b) Basic quantum mechanics c) Basic postulates of quantum mechanics	**Students will** CO1:Learn about the foundations of the old quantum theory. CO2: Understand and apply the fundamental principles of quantum mechanics. CO3: grasp the fundamental postulates of quantum mechanics, including Hermitian operators, eigenvalue equations, measurement, and expectation values.
	Module: II d) Time dependent and time independent Schrodinger equation e) Simple applications of Quantum Mechanics f) Schrodinger equation in spherical polar coordinates	CO4: Apply the time-dependent and time-independent Schrodinger equation to solve for wave functions and energy levels in simple quantum systems. CO5: Analyse particle behaviour in one-dimensional potential problems like potential wells, barriers, and the free particle in a box. CO6: understand the Schrödinger equation in spherical polar coordinates, including angular momentum operators, eigenvalues, and eigenfunctions, as well as the hydrogen atom problem.

Semester	Module and Topic	Module specific CO
Semester – V THERMAL PHYSICS II	Module: I a) First Law of Thermodynamics b) Second Law of Thermodynamics c) Thermodynamic Functions	Students will CO1:thoroughly understand the First Law of Thermodynamics and Apply it to various processes. CO2: Comprehend the Second Law of Thermodynamics, reversible and irreversible processes, Carnot's cycle and theorem, entropy and Clausius theorem. CO3: Understand thermodynamic functions such as enthalpy, Helmholtz and Gibbs free energies, Legendre transformations, Maxwell's relations,

	Module: II d) Heat Engines e) Refrigerators f) Thermodynamics of Reversible cells g) Change of State h) Multicomponent Systems i) Radiation	CO4: Analyse heat engines and refrigeration cycles based on thermodynamic principles. CO5:. Understand phase transitions, multicomponent systems, and the Nernst heat theorem (third law). CO6: Explain radiation properties using Kirchhoff's law, blackbody radiation, and radiation pressure. Explore key radiation laws and their implications.

Semester	Module and Topic	Module specific CO
Semester – VI STATISTICAL MECHANICS	Module: I a) Microstates and macro states b) Classical statistical mechanics	Students will CO1:comprehend the concepts of microstates and macrostates, equilibrium, the hypothesis of equal a priori probability and statistical definitions of temperature, pressure, entropy, and chemical potential. CO2: be proficient in classical statistical mechanics, including the Maxwell-Boltzmann distribution law and the calculation of thermodynamic quantities for ideal monoatomic gases.
	Module: II a) Motivations for quantum statistics b) Quantum statistical mechanics	CO3: Explain the limitations of classical statistics and the need for quantum statistics and derive Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics as the most probable distributions. CO4: Apply Bose-Einstein statistics to explain blackbody radiation and Planck's law, Bose-Einstein condensation and specific heat model. Analyse the Fermi-Dirac distribution at various temperatures and its connection to the Fermi energy,degenerate and non-degenerate Fermi gases, and its applications in electron specific heat of metals and Saha's equation for thermal ionisation.

Semester	Module and Topic	Module specific CO
Semester – VI CONDENSED MATTER PHYSICS	Module: I a) Crystal Structure b) Elementary Lattice Dynamics c) Magnetic Properties of Matter	Students will CO1:Understand the structure of solids, grasp elementary lattice dynamics, and understand theories of specific heat, such as Einstein's and Debye's theories. CO2: comprehend the magnetic properties of matter, including dia-, para-, ferri-, and ferromagnetic materials, and the classical Langevin theory of dia- and paramagnetic domains.They will also understand the quantum mechanical treatment of paramagnetism, Curie's law, Weiss's theory of ferromagnetism,
	Module: II d) Dielectric Properties of Materials e) Elementary band theory f) Superconductivity	CO3: Gain an understanding of dielectric properties of materials, including polarisation, comprehend classical and complex theories of electric polarizability, normal and anomalous dispersion, Cauchy and Sellmeir relations, Langevin-Debye equation, and optical phenomena. CO4: Proficient in elementary band theory, including the Kronig-Penny model and band gap concepts. They will understand the classification of materials as conductors, semiconductors (P and N-type), and insulators. In addition, they will gain an elementary understanding of superconductivity.

Course Outcome for GE/Program

Department of Physics

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Semester	Module and Topic	Module specific CO
Semester – III Thermal Physics and Statistical Mechanics	Module: I d) Kinetic Theory of Gases. e) Transportation Phenomenon f) Heat Transfer	Students will CO1: obtain a thorough understanding of the kinetic theory of gases, ideal gas laws, and Maxwell's distribution and transport phenomena in gases CO2: Gain in-depth knowledge of various heat transfer processes, particularly conduction and radiation.
	Module: II j) First Law of Thermodynamics k) Second Law of Thermodynamics l) Thermodynamic functions	CO3: Thoroughly understand the First Law of Thermodynamics and Apply it to various processes. C4: Comprehend the Second Law of Thermodynamics and various thermodynamics functions.

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Semester – IV Wave and Optics	Module: I c) Oscillation and wave motion. d) Interference	Students will CO1:Understandthe results of the linear superposition of two or more collinear and perpendicular simple harmonic oscillations and wave motion. CO2: Understand and analyse wave phenomena like interference and its applications.
	Module: II c) Diffraction d) Polarisation	CO3: Understand the principles of diffraction of light waves, including Fresnel and Fraunhofer classes. CO4: Gain proficiency in the principles of polarisation, including different states of polarisation, double refraction, andprinciples of optical activity.

Semester	Module and Topic	Module specific CO
Semester – V Modern Physics	Module: I g) Old quantum theory h) Quantum Mechanics	Students will CO1:Learn about the foundations of the old quantum theory. CO2: Understand and apply the fundamental principles of quantum mechanics.
	Module: II i) Nuclear Physics j) Atomic Physics	CO3: Learn about fundamentals of nuclear physics CO4: Understand the fundamentals of atomic physics and apply it to physical problems.

Semester	Module and Topic	Module specific CO
Semester – VI Basic Electronics	Module: I c) Semiconductor Diodes d) Two-terminal Devices and their Applications e) Bipolar Junction transistors f) Field Effect transistors	Students will CO1: understand the principles of semiconductor diodes, doping, P-N junction diode and their characteristics. CO2: Understand, analyse and design basic electronic circuits using bipolar junction transistors (BJTs) and field-effect transistors (FETs).
	Module: II d) Amplifiers e) Digital Circuits f) Boolean algebra	CO3: Learn about basic digital gates and binary logic and apply it to real-life problems. CO4: Analyse and design basic digital circuits using combinational logic (multiplexers, demultiplexers, decoders, encoders) and sequential logic (SR, D, JK flip-flops).