DEPARTMENT OF PHYSICS
COURSE OUTCOME
UNDER CBCS

PHYSICS HONOURS(PHSA)

Semester-I

PHSA-CC-1-1-TH : Mathematical Physics-I (Theory)

CO1: Basic concepts of calculus like limits, functions, differentiation, and convergence of infinite series.

CO2: Students will be able to solve first and second order differential equations.

CO3: Calculus of functions of more than one variable, partial derivatives, exact and inexact differentials, maxima minima and Taylor series.

CO4: Basics of vector algebra, Scalar and vector products and their physical significance, scalar and vector fields. Vector differentiation. Gradient, divergence, curl, del and Laplacian operators and their applications in different areas of Physics.

CO5: Vector integration, line, surface and volume integration, Gauss's divergence, Stoke's and Green's theorems and their application.

CO6: Learn about vector operations in cylindrical and spherical coordinates.

CO7: Fundamentals of matrices and some special matrices. Eigen values and eigen vectors, Caley-Hamilton theorem, diagonalization of a matrix and solution of coupled differential equations by matrix method.

PHSA-CC-1-1-P : Mathematical Physics-I (Practical)

CO1: Plotting of 2D graphs using Gnuplot, an open source graph plotting software.

CO2: Basics of programming with Python, a universally accepted open source programming language.

CO3: Variables and data type, basic mathematical operations, compound statements and I/O operations in Python.

CO4: Iterables data type, string and tuples in Python.

CO5 : Writing scripts in Python to solve some simple problems and Matrix operations.

PHSA-CC-1-2-TH : Mechanics (Theory)

CO1: Newtonian Mechanics and Dynamics of system of particles. Conservation of linear and angular momentum, concept of centre of mass and two body problem.

CO2: Work-energy theorem, conservative force and conservation of energy

CO3: Gravitation and central force motion.

CO4 : Centrifugal and coriolis forces in non-inertial frame.

CO5 : Rotational motion of a rigid body

CO6 : Kinematics of moving fluid, equation of continuity, Euler's equation, Bernoulli's theorem and applications.

PHSA-CC-1-2-P : Mechanics (Practical)

CO1 : Familiar with some basic apparatus used in physics laboratory.

CO2 : Learn how to make systematic experimental observation, data collection, recording of data and other basic laboratory practices.

CO3 : Analysis of data, plotting of graphs and determination of different parameters from the graph.

CO4 : Error estimation of experimental results.

CO5 : Perform some experiments to verify different laws and to determine different physical quantities related to mechanics and

general properties of matter like moment of inertia, acceleration due to gravity and elastic coefficients

Semester-II

PHSA-CC-2-3-TH : Electricity & Magnetism (Theory)

CO1: Dirac delta function and its properties.

CO2: Fundamental properties of charged particles, electrostatic field and potential.

CO3: Divergence and curl of electrostatic field, and Gauss theorem in electrostatics.

CO4: Dielectric properties of matter.

CO5 : Laplace and Poisson's equations, and solution of electrostatic problem by the method of images.

CO6 : Electrostatic energy of system of charges.

CO7 : Magnetic properties of matter, magnetic dipole moment, magnetic field, intensity, magnetization and relation between them.

CO8 : Electromagnetic induction, Faraday's and Lenze's law and their various applications.

CO9 : Solve different problems related to AC circuits.

PHSA-CC-2-3-P : Electricity & Magnetism (Practical)

CO1: Learn potentiometric measurement techniques of voltage and determination of low resistance by potentiometer

CO2 : Use of multimeters in different modes

CO3: Able to determine unknown low resistance by Carey-Foster's bridge

CO4 : Study frequency response of LCR circuit

CO5: Study ac characteristics of series RC circuits and its use as low and high pass filters.

CO6: Able to use ballistic galvanometer and study of variation of mutual inductance between two coils for different angles between the primary and secondary.

CO7: Use of magnetometer to determine horizontal component of earth's magnetic field.
CO8: Learn how to find out different sources of error and techniques of removing them while performing an experiment.

PHSA-CC-2-4-TH : Waves and Optics (Theory)

CO1: Simple harmonic motion, damped oscillation, forced oscillation and resonance.
CO2: Superposition of simple harmonic motions and Lissajous figures.
CO3: Wave motion of plane and spherical waves. .
CO4: Superposition of harmonic waves, wave velocity, group velocity and vibration of strings
CO5: Wave theory of light. Interference of waves. Young's double slit, Loyd's mirror, Fresnel's biprism and Newton's ring experiment to demonstrate interference of waves.
CO6: Working principle of Michaelson and Febry-Perot interferometers.
CO7 : Diffraction of waves, Fraunhoffer diffraction of single slit, double slit & grating, Fresnel diffraction, half period zone & zone plates.

PHSA-CC-2-4-P : Waves and Optics (Practical)

CO1: Determine the frequency of a tuning fork by Melde's method.
CO2: Learn how to perform experiments with a spectrometer, its optical leveling and Schuster's method of adjusting it for parallel rays.
CO3: Study the variation of refractive index of a prism with wavelength.
CO4: Determine wavelength of sodium light by Fsrenel's biprism. □
CO5: Determine wavelength of sodium light/radius of plano convex lens using Newton's Rings.
CO6 : Determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped film.

CO7 : Measurement of the spacing between the adjacent slits in a grating

Semester-III

PHSA-CC-3-5-TH : Mathematical Physics-II (Theory)

CO1: Fourier series, expansion of non periodic functions and Fourier analysis.
CO2: Frobenius method and some important special functions such as Legendre, Hermite and Bessel functions.
CO3: Beta and gamma functions and some special integrals.
CO4: Integral transforms.
CO5: Introduction to theory of probability.
CO6: Partial differential equations and their applications in different branches of physics

PHSA-CC-3-5-P : Mathematical Physics-II (Practical)

CO1: Basic concepts and syntax of the modules numpy and scipy for scientific computing using Python.
CO2: Use of numpy array for matrix operations.
CO3: Use of numpy, scipy for different scientific applications such as interpolation, numerical integration, solution of ODE and curve fitting
CO4: Use of matplotlib as a sub module of Python for drawing graphs.

PHSA-CC-3-6-TH : Thermal Physics (Theory)

CO1: Basics of thermodynamics, zeroth law, concept of thermal equilibrium and temperature.
CO2: Concept of work, heat, internal energy. First law of thermodynamics, different thermodynamic processes and equivalence of work and heat.
CO3: Second law of thermodynamics, concept of reversibility, conversion of work into heat and vice-versa, working of heat engines.

CO4: Important concept of entropy, its applications and entropy principle

CO5: Different thermodynamic potentials, thermodynamic relations and their applications. Maxwell's relations, T-dS equations and their applications.

CO6: Phase Transition, third law of thermodynamics, liquefaction of gas by Joule-Thomson throttling expansion and un attainability of absolute zero.

CO7 : Kinetic Theory of gas and behaviour of real gas.

CO8: Transport phenomena like viscosity, conduction and diffusion.

CO8 : Conduction of heat and application of Fourier equation of heat flow.

PHSA-CC-3-6-P : Thermal Physics (Practical)

CO1 : Different experiments on heat and thermodynamics viz. coefficient of thermal expansion of solid, calibration of a thermocouple by potentiometer, thermal conductivity of bad conductor, determination of boiling point of a liquid using platinum resistance thermometer & determination of temperature coefficient of resistance using Carey Foster bridge. This laboratory course will enrich their theoretical concepts and experimental skill .

PHSA-CC-3-7-TH : Modern Physics (Theory)

CO1: The basic concepts of quantum mechanics, particle nature of radiation and the quantum theory of black body radiation.

CO2: Wave particle duality, Schrodinger equation and its solution. Application of Schrodinger equation in different physical problems.

CO3: The important concept of angular momentum and their commutation relations.

CO4: The students will be introduced to the world of nuclear physics. They will learn the details of nuclear structure and different models.

CO5 : Features of nuclear interaction, radioactivity, fission and fusion.

CO6 : Theoretical understanding of LASER and its applications.

PHSA-CC-3-7-P : Modern Physics (Practical)

CO1: Determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of e/m of electron and I-V characteristics of tunnel diode

Semester-IV PHSA-CC-4-8-TH : Mathematical Physics-III (Theory)

CO1: Complex analysis and its applications in solving definite integrals.

CO2: Variational calculus and its application which results in the famous Lagrangian and Hamiltonian formulation of classical mechanics.

CO3: The students will be acquainted with the revolutionary concept of special theory of relativity which is extremely essential for understanding the physical world beyond Newtonian mechanics.

CO4: Students will learn about mass energy equivalence, time dilation, length contraction and variation of mass with velocity .

CO5: The students will be acquainted with four vector formulation of mechanics and electrodynamics.

PHSA-CC-4-8-P : Mathematical Physics-III (Practical)

CO1 : Handle Gaussian integration, delta function, numerical solution of first and second order differential equation, some special functions, solution of some basic partial differential equations and evaluation of Fourier coefficients. This course will prepare the students for higher studies and research in theoretical and computational physics.

PHSA-CC-4-9-TH : Analog Electronics (Theory)

CO1: The basic concepts of semiconductor physics and its application. They will learn about the operation, characteristics and various applications of different type of diodes, transistors and field effect transistors.

CO2: They will have an idea about working of amplifiers and regulated power supply.
CO3: They will learn important concept of feedback amplifier, oscillator and multivibrator.
CO4: Characteristics of OPAMP and its various applications in modern analog electronics.

PHSA-CC-4-9-P : Analog Electronics (Practical)

CO1: Some essential laboratory equipments like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for higher studies or research in experimental Physics.

PHSA-CC-4-10-TH : Quantum Mechanics (Theory)

CO1: Wavepacket description of particles and general discussions of bound states in arbitrary potentials.
CO2: Solution of Schrodinger equation for harmonic oscillator and hydrogen like atom problems.
CO3: Important concepts of generalized angular momenta and spin.
CO4: Atomic spectra of hydrogen atom and its fine structure.
CO5: Behaviour of atoms in electric and magnetic field
CO6: Symmetric and ant symmetric wave function for identical partcles.
CO7: L-S and J-J coupling and fine structure splitting of spectra of many electron atoms

PHSA-CC-4-10-P : Quantum Mechanics (Practical)

CO 1: The student will learn some advanced computational techniques and applying them to solve various problems related to quantum mechanics using Python in this course.

Semester-V PHSA-CC-5-11-TH : Electromagnetic Theory (Theory)

CO1: Maxwell's equations of electromagnetism, Poynting vector, energy of the electromagnetic field etc.

CO2: Electro-magnetic wave propagation in bounded and unbounded media, laws of reflection and refraction and metallic reflection.

CO3 : Polarization of electromagnetic waves, propagation of electromagnetic waves in uniaxial and biaxial crystals, double refraction, rotatory dispersion and optical activity.

PHSA-CC-5-11-P : Electromagnetic Theory (Practical)

CC 11 (theory). The behavior of electromagnetic wave after refraction as established through well known laws can be verified in the laboratory. Also the theoretical predictions on polarization of electromagnetic waves find verification through the experiments referred in this course. The students also learn to investigate the variation of intensity of e. m. wave using polaroids, determination of specific rotation of optically active substance. The dispersive power & resolving power of plane transmission grating are also studied in this course.

PHSA-CC-5-12-TH : Statistical Physics (Theory)

CO1: Basic concepts of classical statistical mechanics.

CO2: Ideas of microcanonical, canonical and grand canonical ensembles, partition function and their application in simple systems.

CO3: Concepts of quantum statistics, behaviour of system of identical particles, bosons and fermions.

CO4 : Bose-Einstein and Fermi-Dirac statistics.

CO5: Classical and quantum aspects of black body radiation.

CO6: Electron gas and electronic specific heat of metal by FD statistics.

PHSA-CC-5-12-P : Statistical Physics (Practical)

CO1 : The students will use Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers including Monte Carlo integration. The approach is extended also to the study of different distributions in statistical mechanics.

Semester-VI PHSA-CC-6-13-TH : Digital Electronics (Theory)

CO1: Design and fabrication of integrated circuits.

CO2: Different number systems such as decimal, binary, octal, hexadecimal and their inter conversions. Binary addition and subtraction using 1 and 2's complement method. .

CO3: Digital circuits using different kind of logic gates and their implementation using DTL. TTL and MOS logic.

CO4: SOP and POS representation of logic expressions. Simplification of logical expressions using Karnaugh map. Implementation of different combinational logic circuits.

CO5 : Data processing circuits, sequential circuits (different types of flip-flops, registers and counters)

CO6: A/D and D/A data conversions

CO7: Basics of computer organization, idea of ROM, RAM, memory addressing and interfacing.

PHSA-CC-6-13-TH : Digital Electronics (Practical)

CO1: This course will give the students hands on training of fabrication of the basic electronic circuits like different logic gates, Flip-Flops, Shift Registers, Multiplexers using discrete components and standard ICs.

PHSA-CC-6-14-TH : Solid State Physics (Theory)

CO1: Crystal structure, X-ray diffraction and elementary lattice dynamics.

CO2: Magnetic properties of matter.

CO3: Dielectric properties of materials.

CO4: Free electron gas in metals.
CO5: Elementary band theory, explanation of metallic and semiconducting properties, effective mass and Hall effect.
CO6: Basic concepts of superconductivity.

PHSA-CC-6-14-P : Solid State Physics (Practical)

CO: All the experiments of this course are related to investigation of fundamental, and electrical & magnetic properties of solids. The determinations of BH loop area of ferromagnetic substance, dielectric constant of a material, study and verification of temperature dependence of resistance of semiconductor, study of Hall effect in intrinsic semiconductor etc by experiments will boost up the interest of the students.

B. DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSE Semester-V PHSA-DSE-A1(b)-TH : Laser and Fiber Optics (Theory & Tutorial)

CO1: Principles of stimulated emission and population inversion.
CO2: Basic properties of and different kinds of LASER systems.
CO3: Application of LASER and holography.
CO4: Fibre optics and application of optical fibres in communication.
CO5: Introductory non-linear optics.

PHSA-DSA-B1(b)-TH : Nuclear and Particle Physics (Theory & Tutorial)

CO1: Properties of nuclei and nuclear reactions.
CO2: Interaction of nuclear radiation with matter, particle accelerators and detectors.
CO3: Fundamentals of Particle Physics.

Semester-VI PHSA-DSE-A2(a)-TH : Nano Materials and Applications (Theory & Tutorial)

CO1: Basic ideas of nano scale physics, 1D, 2D and 3D nano structures, band structures and density of states

CO2: Different synthesis techniques of nano structured materials like vacuum deposition, physical vapour deposition, chemical vapour deposition etc..
CO3: Students will learn different characterization techniques such as x-ray diffration, optical and electron microscopy (SEM and TEM), atomic force microscopy (AFM), scanning tunneling microscopy (STM).
CO4: Optical properties of heterostructure and nano structure, quasi particles and excitons.
CO5: Electron transport in nano structures.
CO6: Application of nano materials in electronics, medicine and different fields.

PHSA-DSE-B2(b)-TH : Advanced Statistical Mechanics (Theory & Tutorial)

CO1 : Density matrix formulation of quantum statistical mechanics
CO2: Properties of ideal Bose and Fermi systems, Bose-Einstein condensation, white dwarf star, and Pauli paramagnetism
CO3: One dimensional Ising model
CO4: Basic concepts of non-equilibrium statistical mechanics.

SKILL ENHANCEMENT COURSE (SEC) Semester-III PHSA-SEC-A1-TH (Technical Skill) : Scientific Writing (Theory)

CO1: This course is a technical skill enhancement course. The students will learn how to prepare a scientific article containing figures, tables and mathematical equations in a presentable form through open source scientific writing software LaTex. This course will be beneficial for the students in the job market.

PHSA-SEC-A1-TH (Technical Skill) : Scientific Writing (Project)

CO1: In this course the students will learn how to prepare different kind of projects in real world using the scientific writing software LaTex and knowledge acquired in the theory portion of this paper.

Semester-IV PHSA-SEC-B1-TH (Technical Skill) : Arduino (Theory)

CO1: Basic ideas and programming using ARDUINO.
CO2: Hardware software interfacing techniques through open source software package Arduino IDE. PHSA-SEC-B1-PR (Technical Skill) : Arduino (Project)
CO: The students will be able to demonstrate real life applications using Arduino IDE and Arduino UNO R3 Board. This course will help the students to gain hands on training on software-hardware interfacing techniques. The students will get better opportunity in job market after completion of this course.

Physics Generic Elective (GE) Course

Semester-I

PHS-G- CC-1-1-TH : Mechanics (Theory)

CO1 : Basic mathematical tools like vectors analysis, calculus of vectors, differential equations etc.
CO2: Newtonian Mechanics, laws of mechanics, conservative force, work energy theorem, conservation of energy and momentum, rotational motion.
CO3: Central force and Gravitation; orbits of the planets, gravitational potential and forces, calculation in simple cases.
CO4: Oscillations and simple harmonic motion
CO5: Elasticity; Hooke's law, elastic coefficients and their relations, Cantilever.
CO6: Surface tension, surface energy, surface films and capillary rise.

PHS-G-CC-1-1-P : Mechanics (Practical)

CO1: Familiar with some basic apparatus used in physics laboratory.
CO2: Learn how to make systematic experimental observation, data collection, recording of data and other basic laboratory practices.

CO3: Analysis of data, Plotting of graphs and determination of different parameters from the graph.

CO4: Perform some experiments to verify different laws and to determine different physical quantities related to mechanics and general properties of matter like moment of inertia, acceleration due to gravity and elastic coefficients

Semester-II

PHS-G-CC-2-2-TH : Electricity and Magnetism (Theory)

CO1: Basic ideas of Electrostatics, Coulomb's Law, Electric Dipole Moment, Electric Polarization, Electric Field in Dielectrics, Susceptibility & Permittivity.

CO2: Properties of Electrostatic Field, Divergence & Curl of Electrostatic Field, Electric Potential & Field calculations in simple cases.

CO3: Magnetic Induction, application of Biot-Savart's Law, Magnetic Fiels calculation, Properties of magnetic field, Magnetic Dipoles.

CO4: Electromagnetic Induction, Maxwell's equations, Displacement current, Electromagnetic waves & Poynting vector.

PHS-G-CC-2-2-P : Electricity and Magnetism (Practical)

CO1: Determination of unknown low resistance by Carey-Foster's bridge

CO2: Determination of unknown current passing through a resistance using potentiometer

CO3: Determination of Horizontal component of earth's magnetic field

CO4: Conversion of Ammeter to Voltmeter & vice versa.

Semester-III PHS-G-CC-3-3-TH : Thermal Physics and Statistical Mechanics (Theory)

CO1: Basics of thermodynamics, zeroth law, concept of thermal equilibrium and temperature.

CO2: Concept of work, heat, internal energy. First law of thermodynamics, different thermodynamic processes and equivalence of work and heat.
CO3: Second law of thermodynamics, concept of reversibility, conversion of work into heat and vice-versa, working of heat engines.
CO4: Important concept of entropy, its applications and entropy principle
CO5: Different thermodynamic potentials, thermodynamic relations and their applications. Maxwell's relations, T-dS equations and their applications.
CO6: Phase Transition, third law of thermodynamics, liquefaction of gas by Joule-Thomson throttling expansion and unattainability of absolute zero.
CO7: Kinetic Theory of gas and behaviour of real gas.
CO8 Theory of Radiation
CO9: Basic ideas of Statistical Mechanics

PHS-G- CC-3-3-P : Thermal Physics and Statistical Mechanics (Practical)

CO: Thermal expansion coefficient solid, Thermal coefficient of Resistance, Thermal conductivity of bad conductor, Pressure coefficient of air & verification of Stefan's law.

Semester-IV PHS-G- CC-4-4-TH : Waves and Optics (Theory)

CO1: SHM, Superposition of vibration, Intensity & Loudness of sound
CO2: Wave Equation in stretched string and its solution, Young's law.
CO3: Wave optics, Huygens' principle, interference of waves.
CO4: Interference of waves. Young's double slit, Loyd's mirror, Fresnel's biprism and Newton's ring experiment to demonstrate interference of waves.
CO5: Diffraction of waves, Fraunhoffer diffraction of single slit, double slit & grating, Fresnel diffraction, half period zone & zone plates.

CO6: Transverse nature of light, Polarization: Plane, Circular & Elliptical polarized light.

PHS-G- CC-4-4-P : Waves and Optics (Practical)

CO1: Frequency of a Tuning fork by sonometer
CO2: Focal length of concave lens.
CO3: Radius of curvature of a plano-convex lens using Newton's ring,
CO4: Measurement of thickness of a paper by wedge shaped film.
CO5: Optical rotation of an active solution using polar meter.
