COURSE OUTCOME (CO)

## B. Sc. (HONS.) in PHYSICS

| Semester | Paper Code & Name | | Outcomes |
|---|---|---|---|
| **I** | **CC1 (Mathematical Physics)** **C1T** | CO1 | Understanding of function & its limit continuity, differential equation, calculus of function more than one variable. |
| | | CO2 | Recapitulation of vectors, & their properties, Vector Differentiation, Integration |
| | | CO3 | Introduction of an orthogonal curvilinear coordinate system like Spherical and Cylindrical Coordinate Systems. |
| | | CO4 | Introduction to Probability & its distribution function; binomial, Gaussian, and Poisson. Brief description of the Dirac delta function and its properties. |
| | **C1P** | CO1 | Basics of scientific computing, Errors, and error Analysis, o plotting graphs with Gnuplot, programming in python, program and random no generation. |
| | | CO2 | Numerical method; Bisection, Newton Raphson, and Secant methods. Forward and Backward difference formula, Solution of Ordinary Differential Equations. |
| | **CC2 (Mechanics)** **C2T** | CO1 | Understanding fundamentals of dynamics: reference frames & their transformation, description of motion with respect to it. Understand work & energy, different kinds of forces, and equilibrium. Inelastic and elastic collision of particle & center of mass in the lab frame. |
| | | CO2 | Know the concept of rotational dynamics of a particle and system. Brief description of elasticity |
| | | CO3 | Knowing about motion under central force. Non-inertial frame and introduction of different fictitious forces like Centrifugal force, Coriolis force, and its application. |
| | | CO4 | Description of Kinematics of Moving Fluids. Understand the concept of the Special Theory of Relativity. |
| | **C2P** | CO1 | Discussion on random errors in observations. Measurement of length using Vernier calipers, screw gauge and travelling microscope. |
| | | CO2 | To determine moment of Inertia using Flywheel. To determine the value of g using Bar Pendulum. |
| **II** | **CC3 (Electricity & magnetism)** **C3T** | CO1 | Basic understanding of the electric field and electric potential. Study of dielectric properties of matter. |
| | | CO2 | Understand magnetic field, magnetic dipole, and vector potential. |
| | | CO3 | Study of magnetic properties of matter. |
| | | CO4 | Understanding electromagnetic induction and electrical circuit, network theorem. |
| | **C3T** | CO1 | Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses. |
| | | CO2 | To study RC circuit, LCR circuit (Series & parallel), Verification of Thevenin & Norton theorems. |

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| **II** | **CC4 (Waves and Optics)** **C4T** | CO1 | Knowing about the Superposition of Collinear & two perpendicular Harmonic oscillations |
| | | CO2 | Concept of wave motion as well introduction of the electromagnetic nature of light. |
| | | CO3 | Discussion regarding interference and experimental study of it by Interferometer. |
| | | CO4 | Study of different kinds of diffraction like Fraunhofer, and Fresnel Diffraction. Study of holography. |
| | **C4P** | CO1 | Experimental study of interference & diffraction. |
| | | CO2 | Determine the wavelength of sodium light by using Michelson's interferometer, Fresnel Biprism, and Newton's Rings also using a plane diffraction grating. |
| **III** | **CC5 (Mathematical Physics-II)** **C5T** | CO1 | Know about the Fourier series and study of its properties |
| | | CO2 | Understand Frobenius Method and Special Functions |
| | | CO3 | Know about the concept of Some Special Integrals |
| | | CO4 | Introduction to Variational calculus in physics, Partial Differential Equations for different methods & symmetry. |
| | **C5P** | CO1 | Introduction to Numerical computation using NumPy and SciPy. Basic study of Curve fitting, Least square fit, Goodness of fit, standard deviation. |
| | | CO2 | Solution of a Linear system of equations by Gauss elimination method and Gauss-Seidel method. |
| | | CO3 | Generation of Special functions using User-defined functions |
| | | CO4 | Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second-order methods Second order differential equation Fixed difference method. |
| | **CC6 (Thermal Physics)** **C6T** | CO1 | Introduction to Thermodynamics & its several laws and application. Concept of temperature, entropy & absolute zero. |
| | | CO2 | Thermodynamics potential. Know about the concept of free energy & phase transition of thermo-dynamical system. |
| | | CO3 | Maxwell's Thermodynamic Relations |
| | | CO4 | Study of Kinetic theory of gases & different distribution laws of ideal gases. Also, know about the behavior of real gas. |

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| **III** | **C6P** | CO1 | Determine the Coefficient of Thermal Conductivity by Searle's Apparatus. |
| | | CO2 | Determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT), |
| | | CO3 | Study of Thermo-EMF of a Thermocouple and measure temperature in a specified Range. |
| | | CO4 | To determine the coefficient of thermal conductivity using Lee and Charlton's disc method. |
| | **CC7 (Digital Systems and Applications) C7T** | CO1 | The basic idea of SSI, MSI, LSI, and VLSI, Classification of ICs. Examples of Linear and Digital lCs. |
| | | CO2 | Learning about digital circuits & different logic gates also solves it by Boolean algebra. |
| | | CO3 | Concept of different integrated circuits like Timers, Shift registers, Counters (4 bits). |
| | | CO4 | Know about the concept of memory storage, RAM, ROM, etc. |
| | **C7P** | CO1 | Learning the use of CRO & design the different gates. |
| | | CO2 | Use of adder and subtractor, counter, shift register, 555 Timer. To verify and design AND, OR, NOT & XOR gates using NAND gates. |
| | **SEC-1 (Electrical Circuits and Network Skills) SEC1T** | CO1 | Understand basic electricity Principles, ohm's law. Understanding Electrical Circuits. |
| | | CO2 | Know the concept of Generators and Transformers. Knowledge about electric motors, solid state devices & wirings. |
| **IV** | **CC8 (Mathematical Physics III) C8T** | CO1 | Study of Complex analysis of complex numbers. |
| | | CO2 | Introduction of Fourier transforms & application in case of differential equations. |
| | | CO3 | Know about the concept of Matrices & their several properties. |
| | | CO4 | Concept of eigenvalue & eigenvector. |
| | **C8P** | CO1 | Solve differential equations. Frobenius method & Plot of special functions. |
| | | CO2 | Calculation of least square fitting manually and error analysis. |

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| **IV** | **CC9 (Elements of Modern Physics)**<br><br>**C9T** | **CO1** | Concept of quantization through plank law & black body radiation also a brief study of wave-particle duality. |
| | | **CO2** | Study of Heisenberg uncertainty via two-slit interference experiment with photons, atoms, and particles. |
| | | **CO3** | Study of the rigid box-energy eigenvalues and eigenfunctions. |
| | | **CO4** | Study of radioactivity, fusion & fission method. |
| | **C9P** | **CO1** | Determination of plank constant, work function, the wavelength of H-alpha emission line of a Hydrogen atom, absorption lines in the rotational spectrum of Iodine vapour. |
| | | **CO2** | Determination of the wavelength of laser source using diffraction of single slits & double slit experiment. |
| | **CC10 (Analog Systems and Applications)**<br><br>**C10T** | **CO1** | To study semiconductor diodes and know the Conductivity and Mobility, |
| | | **CO2** | Two-terminal Devices and their Applications |
| | | **CO3** | Understand Bipolar Junction transistors, Field Effect transistors. |
| | | **CO4** | Basic principle amplifier. |
| | **C10P** | **CO1** | V-I characteristics of PN junction diode, Light emitting diode, Zener diode, solar cells. Bipolar junction transistor. |
| | | **CO2** | Use of op-amp as an Integrator, Differentiator. |
| | **SEC2 (Renewable Energy & Energy Harvesting)**<br><br>**SEC2T** | **CO1** | Fossil fuels as a source of alternate energy.<br>Different kinds of alternate energy i.e.- solar energy, wind energy, ocean energy, Hydro energy, piezoelectric energy & harvesting of electromagnetic energy. |
| | **SEC2P** | **CO1** | Demonstration of Training module on solar energy, wind energy, etc. Conversion of vibration and thermal energy to voltage using piezoelectric materials and thermoelectric modules respectively. |
| **V** | **CC11 (Quantum Mechanics and Applications)**<br><br>**C11T** | **CO1** | Discussion about time-dependent and independent Schrodinger equation. General discussion of bound states in an arbitrary potential. |
| | | **CO2** | Solution of Hydrogen atom & wave function by Frobenius method. |
| | | **CO3** | Study of Atoms in Electric & Magnetic Fields i. e., Paschen-Back and Stark Effect, Normal and Anomalous Zeeman Effect. |
| | | **CO4** | To study Spin-orbit coupling in atoms - L- S and J-J couplings, also to discuss Pauli exclusion principle, and Hund's rule. |

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| **V** | **C11P** | **CO1** | Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom. |
| | | **CO2** | Solve the s-wave radial Schrodinger equation for an atom. |
| | **CC12** (Solid State Physics) | **CO1** | Basic idea about crystal structure. Elementary Lattice Dynamics ie, vibration & concepts of phonons. |
| | | **CO2** | Know the concept of Dielectric Properties of Materials. Discussion about Ferroelectric Properties of Materials. |
| | **C12T** | **CO3** | Understand the magnetic properties of matter. |
| | | **CO4** | Discussion about elementary band theory and Superconductivity. |
| | **C12P** | **CO1** | To measure the Magnetic susceptibility of Solids, the Dielectric Constant of dielectric Materials with frequency, the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to $150^{o}C$) and to determine its band gap. |
| | | **CO2** | To determine the Hall coefficient of a semiconductor sample. |
| | **DSE - 1** (Classical Dynamics) | **CO1** | Know the concept of Classical Mechanics of Point Particles, Recap of Lagrangian and Hamiltonian mechanics. |
| | | **CO2** | Study of Small Amplitude Oscillations. |
| | | **CO3** | Understanding of Special Theory of Relativity. |
| | **DSE1T** | **CO4** | A study on Fluid Dynamics |
| | **DSE - 2** (Nuclear and Particle Physics) | **CO1** | Understand the General Properties of Nuclei and the nuclei model. |
| | | **CO2** | Know the concept of Radioactivity decay & nuclear reaction. |
| | | **CO3** | Interaction of Nuclear Radiation with matter & different detectors to measure it. |
| | **DSE2T** | **CO4** | Introduction to particle physics & particle accelerator. |
| **VI** | **CC 13T** (Electromagnetic Theory) | **CO1** | Study of Maxwell's equations |
| | | **CO2** | Study of propagation of the electromagnetic wave in bound & unbound medium. |
| | | **CO3** | To understand the polarization of electromagnetic waves. |
| | | **CO4** | To Study waveguides & optical fiber. |
| | **C 13P** | **CO1** | To verify the law of Malus for plane-polarized light |
| | | **CO2** | To determine the specific rotation of sugar solution using Polarimeter. |
| | **CC 14T** (Statistical Mechanics) | **CO1** | Know the concept of Classical Statistical Mechanics: phase space, micro & microstate & also the introduction of three ensembles. |
| | | **CO2** | Understanding the classical theory of radiation. |
| | | **CO3** | Understanding quantum theory of radiation. |
| | | **CO4** | Study about Bose-Einstein, and Fermi Dirac statistics. |
| | **C 14P** | **CO1** | Verify Beers law and determine the strength of the solution |
| | | **CO2** | Determine surface tension of the liquid. |
| | **DSE -3** (Communication electronics) | **CO1** | Introduction to communication. |
| | | **CO2** | Know the concept of Analog Modulation. |
| | | **CO3** | Know the concept of analog Pulse Modulation. Know the concept of digital Pulse Modulation. |
| | **DSE 3T** | **CO4** | Understanding Satellite Communication & Mobile Telephony System. |

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| **VI** | **DSE 3P** | CO1 | To design an Amplitude Modulator using Transistor. To study envelope detector. |
| | | CO2 | To study Division Multiplexing (TDM), pulse Amplitude Modulation (PAM), pulse Width Modulation (PWM), and Pulse Position Modulation (PPM). |
| | **DSE – 4 (Experimental technique)** **DSE4T** | CO1 | Knowing the concept of measurements, Signals, and Systems. |
| | | CO2 | Knowing the method of Shielding and Grounding. |
| | | CO3 | Understanding Transducers &industrial instrumentation (working principle, efficiency, applications). |
| | | CO4 | Digital Multimeter, Impedance Bridges, and Q-meter. Understanding of Vacuum Systems. |
| | **DSE 4P** | CO1 | Determine output characteristics of LVDT & measure displacement using LVDT |
| | | CO2 | To measure Q of a coil and influence of frequency using a Q-meter. |
| | | CO3 | Understanding quantum theory of radiation. |
| | | CO4 | Study about Bose-Einstein, and Fermi Dirac statistics. |