Graduate attributes in Physics

Some of the Graduate attributes of a graduate in Physics are

- **Disciplinary knowledge and skills:** Capable of demonstrating good knowledge and understanding of major concepts, theoretical principles and experimental findings in Physics and its different subfields like Astrophysics and Cosmology, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, Space science and other related fields of study, including broader interdisciplinary subfields like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology etc.
  ability to use modern instrumentation and laboratory techniques to design and perform experiments is highly desirable in almost all the fields of Physics listed above .
- **Skilled communicator:** Ability to transmit complex technical information relating all areas in Physics in a clear and concise manner in writing and oral ability to present complex and technical concepts in a simple language for better understanding.
- **Critical thinker and problem solver:** Ability to employ critical thinking and efficient problem solving skills in all the basic areas of Physics.
- **Sense of inquiry:** Capability for asking relevant/appropriate questions relating to the issuesand problems in the field of Physics, and planning, executing and reporting the results of a theoretical or experimental investigation.
- **Team player/worker**: Capable of working effectively in diverse teams in both classroom, laboratory, Physics workshop and in industry and field-based situations.
- **Skilled project manager:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct; and safety and laboratory hygiene regulations and practices.
- **Digitally Efficient*:*** Capable of using computers for simulation studies in Physics and computation and appropriate software for numerical and statistical analysis of data, and employing modern e-library search tools like Inflibnet, various websites of the renowned Physics labs in countries like the USA, Europe, Japan etc. to locate, retrieve, and evaluate

Physics information.

- **Ethical awareness / reasoning*:*** The graduate should be capable of demonstrating ability to think and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights,and adopting objectives, unbiased and truthful actions in all aspects of work.
- **National and international perspective*:*** The graduates should be able to develop a national as well as international perspective for their career in the chosen field of the academic activities. They should prepare themselves during their most formative years for their appropriate role in contributing towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise.
- **Lifelong learners:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling in all areas of Physics.

Program Learning Outcomes in B.Sc (Honours) Physics

The student graduating with the Degree B.Sc (Honours) Physics should be able to

- Acquire

  (i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics and interdisciplinary areas like Astrophysics, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics,Mathematical Physics, Analytical dynamics, Space science, and its linkages with related disciplinary areas/subjects like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology;

  (ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research anddevelopment, teaching and government/public service;

  (iii) skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.
- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.
- Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevanttheories of Physics.

- Demonstrate relevant generic skills and global competencies such as

  (i) problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary- area boundaries;

  (ii) investigative skills, including skills of independent investigation of Physics-related issues and problems;

  (iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;

  (iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translate them withpopular language when needed;

  (v) ICT skills;

  (vi) personal skills such as the ability to work both independently and in a group.

- Demonstrate professional behavior such as

  (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;

  (ii) the ability to identify the potential ethical issues in work-related situations;

  (iii) appreciation of intellectual property, environmental and sustainability issues, constitutional values, Indian Knowledge system; and

  (iv) promoting safe learning and working environment.

(POs) in B.Sc (Honours) Physics

PO1: Fundamental understanding of the field

PO 2: Application of basic Physics concepts

PO 3: Linkages with relateddisciplines

PO 4: Procedural knowledgefor professional subjects

PO 5: Skills in related fieldof specialization

PO 6: Ability to use in Physics problem

PO 7: Skills in Mathematical modeling

PO 8: Skills in performinganalysis and interpretation of data

PO 9: Develop investigative Skills

PO 10: Skills in problem solving in Physics and related discipline

PO 11: Develop Technical Communication skills

PO 12: Developing analytical skills and popular communication

PO 13: Developing ICT skills

PO 14: Demonstrate Professional behaviour with respect to attribute like objectivity, ethical values, self reading,etc

Course Outcomes (COs)

Discipline Specific Core Courses

DSC1: BASIC PHYSICS-I
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

Students will be able to

CO1 : Revise the knowledge of calculus, SI system, plotting, vectors, vector calculus. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.

CO2 : Learn the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.

CO3 : Learn homogenous differential equations, partial derivatives which have applications in all branches of physics.

CO4 : Understand laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance. She will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.

CO5 : Understand the dynamics of system of particles and idea about center of mass and laboratory frames and their correlation.

CO6 : Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation, central force.

CO7 : Understand simple principles of fluid flow and the equations governing fluid dynamics.

CO8: In the laboratory course, the student shall perform experiments to measure Modulus of Rigidity, moment of inertia, vertical height using Sextant, determining coefficient of viscosity. Know about the basic theory of errors, their analysis, estimation with examples of simple experiments in Physics.

COs - POs Mapping
Course Code : DSC1

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√				√
CO2	√	√	√	√	√	√	√		√	√	√			√
CO3	√	√	√	√	√	√	√		√	√		√		√
CO4	√	√	√	√	√	√	√		√	√	√			√
CO5	√	√	√	√	√	√			√	√		√		√
CO 6	√	√	√	√	√	√			√	√				√
CO7	√	√	√	√	√	√	√		√	√	√			√
CO8	√	√	√	√	√			√	√		√	√		√

Course Outcomes (COs)

DSC2: BASIC PHYSICS-II
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

Students will be able to

CO1 : Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to various systems.

CO2 : Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electriqpotential, electric potential energy) formalisms of electrostatics.

CO3 : Articulate knowledge of electrostatic energy.

CO4 : Basic knowledge of Loretnz force and operational principle of cyclotron.

CO5 : Describe the basics of magnetostatics, Bio-Savart Law.

CO6: Application of Ampere's circuital law, concept of magnetic dipole etc.

CO7: Learn the microscopics and macroscopic description of matter, postulates of kinetic theory of gases, Maxwell-Boltzman distribution law.

CO8: Comprehend the basic concepts of thermodynamics, the zeroth, first and the second law of thermodynamics, the concept of entropy and the associated theorems.

CO9: In the laboratory course the student will get an opportunity to study the conversion of Ammeter to Voltmeter and vice versa. Should be able to determine the unknown resistance using Carey-Foster bridge, measurement of current using potentiometer. Measure the pressure coefficient and coefficient of thermal expansion.

COs - POs Mapping
Course Code : DSC2

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√		√		√
CO2	√	√	√	√	√	√			√	√	√			√
CO3	√	√	√	√	√	√			√	√				√
CO4	√	√	√	√	√	√			√	√				√
CO5	√	√	√	√	√	√			√	√				√
CO 6	√	√	√	√	√	√	√		√	√		√		√
CO7	√	√	√	√	√	√	√		√	√	√	√		√
CO8	√	√	√	√	√	√	√		√	√		√		√
CO9	√	√	√	√	√			√				√		

Course Outcomes (COs)

DSC 3: Waves and Optics
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

CO1: Learn about the different types of mathematical oscillators and acquire a knowledge about the superposition of harmonic oscillations at different conditions both graphically and analytically.
CO2: Learn about the wave motions and superposition of harmonic waves.
CO3: Gain an understanding about wave motions through strings at different conditions and be able to explain several phenomena observed in everyday life.
CO4: Learn about the reflection and refraction of light.
CO5: Interpret the wave nature of light by studying its interference and diffraction properties alongside recognize light as an electromagnetic wave by studying its polarization property and understand the working principles of several optical instruments namely interferometer, biprism, diffraction grating.
CO6: In the laboratory course, students will gain hand on experience toperform several experiments like

(i) Determination of frequency of an electric tuning fork by Melde's experiment and the verification of the theory.
(ii) Measurement of wavelength of light using Fresnel's biprism and Newton's ring experiments.
(iii) Verification of theory using diffraction grating experiment.
(iv) Study the polarization property of light wave through polarimeter experiment.

COs - POs Mapping
Course Code : DSC 3

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√	√		√	√	√	√		√
CO4	√	√	√	√	√	√			√	√				√
CO5	√	√	√	√	√	√	√		√	√	√	√		√
CO6	√	√	√	√	√			√	√			√		√

Course Outcomes (COs)

DSC 4: Mathematical Physics I
(Credits: 04, Theory-03, Practicals-01)

CO1: Learn about power series, its convergence and ways to check the convergence.
CO2: Learn the Fourier analysis of periodic and non-periodic functions and their applications in physical problems such as vibrating strings etc.
CO3: Learn about the Fourier transform, the inverse Fourier transform, their properties and their applications in physical problems.
CO4: Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics.
CO5: Acquire basic knowledge of probability statistics.
CO6: Learn about one, two, three dimensional Diracδ −function and its properties.
CO7: Learn the beta, gamma and the error functions and their applications in doing integrations.
CO8: Learn numerical methods to solve algebraic equations, integrations, ordinary differential equations etc.
CO9: In the laboratory course,

- Learn the basics features of scientific python (scipy) and numerical python (numpy),their utility, advantages and disadvantages.
- Get introduced to 2d numpy arrays to solve problems related matrix and solving simultaneous equations.
- Solving different problems like differential equations, curve fitting, interpolation etc.
- Learn matplotlib for plotting.

COs - POs Mapping
Course Code : DSC 4

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√	√		√	√	√	√		√
CO4	√	√	√	√	√	√	√		√	√	√	√		√
CO5	√	√	√	√	√	√	√		√	√	√	√		√
CO6	√	√	√	√	√	√	√		√	√	√	√		√
CO7	√	√	√	√	√	√	√		√	√	√	√		√
CO8	√	√	√	√	√	√	√		√	√	√	√		√
CO9	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Course Outcomes (COs)

DSC 5: Modern Physics
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

CO1 : Understand the nature of black body and Planck's theory of blackbody radiation .

CO2 : To be introduced to the basic concepts of wave mechanics and wave particle duality.

CO3 : Developing of preliminary idea of quantum concepts and corresponding theory of quantum mechanics.

CO4 : Introduction to Schrodinger's equation and its application to solve simple problems involving one dimensional potential well, barriers.

CO5 : Use Schrodinger's equation to study the nature of a harmonic oscillator and hence evaluate the energy levels.

CO6 : Perform simple experiments in the laboratory on Photoelectric effect, tunnel diode , laser cross grating, measurement of e/m of an electron etc.

COs - POs Mapping
Course Code : DSC 5

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√			√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√	√		√	√	√	√		√
CO4	√	√	√	√	√	√	√		√	√	√	√		√
CO5	√	√	√	√	√	√	√		√	√	√	√		√
CO6	√	√	√	√	√			√	√		√			√

Course Outcomes (COs)

DSC 6: Electromagnetism
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

CO1: Learners can gather confidence regarding the basic concept of various parameter involves AC circuits like mean and r.m.s. values of current and emf with sinusoidal wave form.

CO2: Basic concept of electrostatic phenomenon has been implemented with the conception of Gauss' theorem of electrostatics, multipole expansion in electrostatics, dipole and quadrupole moment etc.

CO3: Interpret the Dielectric in an external electric field by studying Electric Fields inside matter, Electric Polarisation, bound charges, displacement density vector, relation between E, P and D etc.

CO4: Learn about Laplace's and Poisson equations, Uniqueness Theorems, Earnshaw's theorem, Dirichlet Boundary value problems in electrostatics.

CO5: Learners can understand the derivation of $\nabla . \boldsymbol{B}=0, \nabla \times \boldsymbol{B}=\mu_0 \boldsymbol{J}$. Magnetic vector potential and magnetic dipole. These also include the multipole expansion of vector potential for line currents, magnetic field for magnetic dipole and Calculation for vector potential in various simple cases.

CO6: Students have gather knowledge regarding the magnetic properties of matter. In this context they also understand the Potential and field due to a magnetic dipole, magnetic dipole moment, force and torque on a magnetic dipole in a uniform magnetic field, relation between **B**, **H** and **M** in different medium etc.

CO7: Students' attain confidence regarding Electromagnetic induction, Maxwell's equations and its applications in various cases.

CO8: They learn about the EM Wave Propagation in unbounded media like Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth.

CO9: They also acquire knowledge about EM Wave in Bounded Media, nature of Reflection and Refraction of plane waves at plane interface between two dielectric media, Laws of reflection and refraction, Fresnel's formulae for various conditions etc.

CO10: In the laboratory course, students will achieve hand on experience to perform several experiments in the arena of Properties of Electromagnetic fields like

1. To study series LCR circuit characteristics: resonance curve for two different R, variation with C, Phase angle plot.
2. To study mutual inductance between two coils.
3. To find horizontal component of Earth's magnetic field using magnetometer.
4. To verify Malus law using a pair of polaroids.
5. To verify Fresnel's equation by the reflection on the surface of a prism with help of two polariods.

COs - POs Mapping
Course Code : DSC 6

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√	√		√	√	√	√		√
CO4	√	√	√	√	√	√	√		√	√	√	√		√
CO5	√	√	√	√	√	√	√		√	√	√	√		√
CO6	√	√	√	√	√	√	√		√	√	√	√		√
CO7	√	√	√	√	√	√	√		√	√	√	√		√
CO8	√	√	√	√	√	√	√		√	√	√	√		√
CO9	√	√	√	√	√	√	√		√	√	√	√		√
CO10	√	√	√	√	√			√	√					√

Course Outcomes (COs)

DSC 7: Mathematical Physics II
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

CO1: Students will learn solving second-order ordinary differential equations, including singularity analysis, power series solutions, and special functions like Legendre and Hermite polynomials, with applications to various physical problems.

CO2: Students will develop a foundational understanding of linear vector spaces, including vector algebra, inner products, orthogonality, and basic concepts, applied to various representations (2D, 3D vectors, complex numbers, waveforms).

CO3: Students will understand vector and scalar transformations under rotation and learn the application of orthogonal curvilinear coordinates, including Jacobian transformation, to vector calculus operators.

CO4: Learn about tensors and their properties.

CO5: Learn about matrices, including operations, properties, and transformations, and apply these concepts to linear operators, eigenvalues, eigenvectors, and solving differential equations.

CO6: Students will learn numerical methods for solving partial differential equations, including finite difference approximations, explicit and implicit methods, and stability analysis, applied to heat conduction, Laplace's equation, and wave equation problems.

CO7: In the laboratory course the students will learn,

- to solve integrals, finding solution of differential equation, curve fitting, calling special function with user defined functions in scipy,
- to solve improper integrals and verifying Dirac δ- function properties,
- to solve PDE like heat wave, pluck string etc.

COs - POs Mapping
Course Code : DSC 7

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√	√	√	√	√	√	√		√
CO5	√	√	√	√	√	√	√	√	√	√	√	√		√
CO6	√	√	√	√	√	√	√	√	√	√	√	√		√
CO7	√	√	√	√	√	√	√		√	√	√	√	√	√

Course Outcomes (COs)

DSC 8: Classical Mechanics and Special Theory of Relativity
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

Students will get

CO1: An basic idea about the non-inertial systems, its equation of motion and different applications.

CO2: Comprehensive idea about rigid body and its motion, degrees of freedom, rotational dynamics, moment of inertia and related theorems.

CO3: thorough knowledge of application of variational calculus in physics, Langrangian formulation, canonical equations etc.

CO4: gain an insight on Special theory of Relativity, its postulates, Lorentz transformation and its consequences, mass-energy equivalence, Minkwoski space-time etc.

CO5: In the laboratory they will perform experiments on Young's modulus, moment of inertia, elastic constants, measurement of "g", study of simple pendulum using tracker software.

COs - POs Mapping
Course Code : DSC 8

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√	√	√	√	√	√	√		√
CO5	√	√	√	√	√			√	√			√		√

Course Outcomes (COs)

DSC 9: Analog Electronics
(Credits: 04, Theory-03, Practicals-01)

This course will enable the students to

CO1 : get familiar with the basic circuits and networks and to explore the active and passive components.

CO2 : understand the semiconductor diodes and its various applications in the field of electronic devices.

CO3 : learn the various techniques of Bipolar Junction Transistor's biasing and gather the basic knowledge of Q parameters and concept of h-parameter.

CO4 : study the various types of JFET and MOSFET characteristics, basic structure and principle of operation.

CO5 : gather a basic knowledge of different types of regulated power supply and its application in the field of electronic science.

CO6: learn to design different types of amplifiers and its frequency response.

CO7: understand the concept of Feedback amplifiers and its usefulness in OPAMP construction and its various applications.

CO8 : get an exposure in various multivibrators and its characteristics to construct different switches.

CO9 : understand the principles of various types of electronic oscillators and its application.

COs - POs Mapping
Course Code : DSC 9

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√	√	√		√
CO2	√	√	√	√	√	√		√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√	√	√		√	√	√	√	√		√
CO5	√	√	√	√	√	√		√	√	√	√	√		√
CO6	√	√	√	√	√	√		√	√	√	√	√		√
CO7	√	√	√	√	√	√		√	√	√	√	√		√
CO8	√	√	√	√	√	√		√	√	√	√	√		√
CO9	√	√	√	√	√	√		√	√	√	√	√		√

Course Outcomes (COs)

DSC-10: Nuclear and Particle Physics
(Credits:04, Theory-03, Tutorial-01)

Course learning outcome (COs):

Students will

CO1: Learn about the famous Rutherford scattering experiment and acquire knowledge about nuclear properties and its structure, binding energy of nucleus, nuclear magnetic moment, Bainbridge mass spectrograph, nature of nuclear force, stability of nucleus, liquid drop model, concepts of alpha and beta decay processes from semi-empirical mass formula, predictions of ground state nuclear spin parity using nuclear shell model, Nordheim's Rule.

CO2: Get fundamental concepts about radioactivity and its law: alpha decay-kinematics, range-energy relationship and Geiger - Nuttall law, beta decay – energy spectrum and Paulie's prediction of neutrino, selection rules: Fermi and Gamow-Teller transitions, emission of gamma rays, electron-positron pair production.

CO3: Gain knowledge about different types of nuclear reactions and their conservation laws, calculation of Q-values and reaction rates of nuclear reactions, basic concept of Ghoshal's experiment, acquire fundamental idea about nuclear fission and fusion reactions explained in terms of Liquid drop model, chain reaction and the basic principles of nuclear reactors.

CO4: Learn about the principles and construction of different types of particle accelerators like linear accelerator, cyclotron, betatron and several kinds of nuclear detectors such as gas detectors, GM counter and semiconductor detectors,

CO5: Gain fundamental concepts about basic features of several elementary particles and their families, fundamental interactions, different types of conservation laws like energy, momentum, parity, baryon number, lepton number, isospin, hypercharge and strangeness, basic idea of Wu's experiment, Gell-Mann -Nishijima formula, fundamental knowledge about quark model and quark structure of hadrons.

CO6: Learn about energy production in stars, p-p chain, CNO cycle, production of heavier elements.

COs - POs Mapping
Course Code : DSC 10

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√	√	√		√
CO2	√	√	√	√	√	√		√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√		√	√	√	√	√		√
CO5	√	√	√	√	√	√	√	√	√	√	√	√		√
CO6	√	√	√	√	√	√		√	√	√	√	√		√

Course Outcomes (COs)

DSC-11: Quantum Mechanics

(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

This course will enable the students to

CO1 : get familiar with the formulation of quantum mechanics in terms of vector space.

CO2 : understand the behavior of quantum particle encountering 2D and 3D potential well, isotropic and anisotropic harmonic oscillator.

CO3 : learn the techniques of the angular momentum algebra using Ladder operators.

CO4 : study the quantum theory of Hydrogen like atom and solve the problem using time independent Schrödinger equation.

CO5 : gather a basic knowledge of the system of identical particles, derivation of B-E and F-D statistics.

CO6: learn to calculate the macroscopic properties of degenerate photon gas using BE distribution law, understand Bose-Einstein condensation law and liquid Helium.

CO7 : understand the concept of Fermi energy and Fermi level, calculate the macroscopic properties of completely and strongly degenerate Fermi gas, electronic contribution to specific heat of metals.

CO8 : get an exposure in computational programming (python programming) in the computer lab, the student will be in a position to solve various time independent Schrodinger equation and find the energy eigen-values and their corresponding eigen functions for transcendental equation, boundary value problems using shooting algorithm and finite difference method.

COs - POs Mapping
Course Code : DSC 11

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√	√	√	√	√	√	√		√
CO5	√	√	√	√	√	√	√	√	√	√	√	√	√	√
CO6	√	√	√	√	√	√	√	√	√	√	√	√	√	√
CO7	√	√	√	√	√	√	√	√	√	√	√	√		√
CO8	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Course Outcomes (COs)

DSC-12: Thermal Physics and Statistical Mechanics

(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

CO1 : Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.

CO2 : Learn about the real gas equations, Van der Waal equation of state, the JouleThompson effect and basics of heat conduction in solid.

CO3: Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.

CO4: Learn to derive classical radiation laws of black body radiation. Wiens law, Rayleigh Jeans law, ultraviolet catastrophe.

CO5 :Understand the concepts of microstate, macrostate, ensemble, phase space, thermodynamic probability and partition function, different statistical ensembles and their properties.

CO6 :In the laboratory course, the students are expected to do some basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity, temperature coefficient of resistance, variation of thermo-emf of a thermocouple with temperature difference at its two junctions and calibration of a thermocouple, finding the boiling point of unknown liquid using Platinum resistance thermometer etc.

COs - POs Mapping
Course Code : DSC 12

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√		√	√	√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√	√	√	√	√	√	√		√
CO5	√	√	√	√	√	√	√	√	√	√	√	√		√
CO6	√	√	√	√	√	√		√	√	√	√	√		√

Course Outcomes (COs)

DSC-13: Digital Electronics

(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

As the successful completion of the course the student is expected to be conversant with the following.

CO1: Secure first-hand idea of different components including both active and passive components to gain a insight into circuits using discrete components and also to learn about integrated circuits.

CO2: Learn about and digital systems and their differences and advantages over Analog circuits, fundamental logic gates, combinational as well as sequential and number systems.

CO3 :Synthesis of Boolean functions, simplification and construction of digital circuits by employing Boolean algebra and combinational circuits.

CO4 :Sequential systems by choosing Flip Flop as a building bock- construct multivibrators, counters, registers to provide a basic idea about memory including RAM, ROM and also about memory organization.

CO5 :In the laboratory the student is expected to construct both combinational circuits and sequential circuits by employing basic gates and universal gates as building blocks and demonstrate Adders, multiplexer, Shift Registers.

COs - POs Mapping
Course Code : DSC 13

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√		√	√	√	√	√		√
CO2	√	√	√	√	√	√		√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√	√	√	√	√	√	√		√
CO5	√	√	√	√	√	√		√	√	√	√	√		√

Course Outcomes (COs)

DSC-14: Solid State Physics

(Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

CO1: Gain an understanding about the amorphous and crystalline materials, lattice, unit cell, Miller indices, reciprocal lattice, types of lattices Brillouin zone, diffraction of X-ray by crystals and the related X-Ray diffraction laws.

CO2: Learn about the lattice vibration of monoatomic and diatomic crystal structures, phonons alongside get deep knowledge about Einstein and Debye theories of specific heat of solids.

CO3: Acquire knowledge about free electron gas theory in metal, properties of electrons in solids such as mobility, conductivity, hall effect in metal, thermal conductivity and limitations of Drude's theory.

CO4: Get concepts about the dielectric properties of materials and related laws and relations.

CO5: Learn about the basic concepts of band theory of solids which helps the students to make differentiation among conductors, insulators and semiconductors.

CO6: Get fundamental understanding about properties and several theories of different types of magnetic materials like diamagnetic, paramagnetic, ferromagnetic and ferrimagnetic materials.

CO7: Gain basic idea of properties of different types of superconductors.

CO8: In the laboratory course, the students will gain hand on experience to perform several experiments like measurement of dielectric constant of solid materials, drawing of hysteresis loop for ferromagnetic materials, measuring of temperature coefficient of semiconductors based on the knowledge they gathered from the theoretical study of the course. They are able to measure the band gap and Hall voltage of semiconductor materials using linear four probe method.

COs - POs Mapping
Course Code : DSC14

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√			√	√	√	√		√
CO4	√	√	√	√	√	√			√	√	√	√		√
CO5	√	√	√	√	√	√			√	√	√	√		√
CO6	√	√	√	√	√	√	√		√	√	√	√		√
CO7	√	√	√	√	√	√			√	√	√	√		√
CO8	√	√	√	√	√	√		√	√	√	√	√		√

Course Outcomes (COs)

DSC-15: Atomic, Molecular, and Laser Physics

(Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

CO1: Understand the concept of generalized angular momentum, including orbital and spin angular momentum, gyromagnetic ratios, magnetic moments, and the significance of Larmor's theorem and the Stern-Gerlach experiment.

CO2: Students will be able to explain the Anomalous Zeeman effect as the splitting of atomic spectral lines in the presence of an external magnetic field and associated spectral line splitting, along with the application of selection rules.

CO3: Get an idea about many electron atoms the concept of identical particles and their wavefunctions, application of Slater determinant, understanding spin-singlet and spin-triplet states, Students will be able to apply Pauli's Exclusion Principle and Hund's Rule to understand the electronic configuration. Furthermore, they will be able to describe the origin of fine structure splitting, differentiate between L-S and j-j coupling in multi-electron atoms, utilize spectral notations and Term symbols to characterize atomic states, and analyze the key differences between the spectra of hydrogen and alkali atoms.

CO4: Students will gain knowledge about the rotational and vibrational energy levels in diatomic molecules. They will gain basic knowledge about the molecular spectra including the Raman effect and its basic application as a tool in molecular spectroscopy for gaining information about molecular structure and vibrations.

CO5: Students will be able to explain the fundamental principles of laser operation, including radiative and non-radiative transitions, absorption, and stimulated emission, understand the relationship between Einstein's A and B coefficients, the concepts of metastable states and population inversion, comparing the operational mechanisms of two-level, three-level, and four-level laser systems. Furthermore, students will be able to identify the basic components of a laser and explain the phenomena of free spectral range and various line broadening mechanisms, as well as describe the working principles of Ruby, He-Ne, and semiconductor lasers.

CO6: Understand the structure and function of optical fibers ,including wave propagation in optical fibers, step and graded index profiles, numerical aperture, attenuation, the concept of modes in a planar waveguide, including TE and TM modes and relate the concept of modes to guided modes in step-index optical fibers.

COs - POs Mapping
Course Code : DSC15

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√		√	√	√	√	√		√
CO5	√	√	√	√	√	√		√	√	√	√	√		√
CO6	√	√	√	√	√	√		√	√	√	√	√		√

Course Outcomes (COs)

Skill Enhancement Course

SEC1: Introduction to Computer Programming and Graph Plotting
(Credits: 04, Theory-0, Practicals-04)

Course learning outcome (COs):

Students will be able to

CO1: Perform 2D graph plotting using GNUPLOT.

CO2: They will have basic idea about Python Programming, its basic operations, conditional statements, built in function etc.

CO3: Idea about different data structures like list, tuple, string, set etc and their usage in writing programmes.

CO4: They will be able to solve simple physical problems involving sorting, matrix operations, and differential equations as well as finding the roots of equations.

COs - POs Mapping
Course Code : SEC 1

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√			√	√	√	√	√
CO2	√	√	√	√	√	√					√	√	√	√
CO3	√	√	√	√	√	√					√	√	√	√
CO4	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Course Outcomes (COs)

Skill Enhancement Course

SEC 2: SCIENTIFIC WRITING

(Credits: 04, Theory-00, Project-04)

Course learning outcome (COs):

At the end of the course the student is expected to have an idea/concept of the following,

CO1 : Introduction to scientific writing using LATEX and its different packages.

CO2 : Different document classes, page layout and list structure.

CO3 : Representation of different mathematical functions and equations.

CO4 : Usage of different fonts, creating tables, inserting figures.

CO5 : Students are expected to complete a project by writing articles, laboratory reports including graphical analysis of data, bio-data etc using LATEX.

COs - POs Mapping
Course Code : SEC 2

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1			√	√							√	√	√	√
CO2			√	√							√	√	√	√
CO3			√	√							√	√	√	√
CO4			√	√							√	√	√	√
CO5			√	√							√	√	√	√

Course Outcomes (COs)

Skill Enhancement Course

SEC 3: Arduino
(Credits: 04, Theory-01, Practicals-03)

Course learning outcome (COs):

Students will be able to

CO1 : Introduction to open source electronic prototyping: ARDUINO.

CO2 : Basic idea of ARDUINO board and installation of IDE for programming.

CO3 : structure of ARDUINO programming and interfacing with different devices.

CO4 : learn the basic theory of microcontroller and some modern sensors.

CO5 : students are expected to complete projects by performing experiments like LED blinking, interfacing of 7 segment display, construction of thermometer, constructing data logger for studying charging and discharging of capacitor, using LDR for detecting light levels, measurement of object distances using sensor etc.

CO6 : use different sensors by interfacing them with Arduino board to construct modern appliances and perform innovative experiments.

COs - POs Mapping
Course Code : SEC 3

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√		√	√		√	√	√	√
CO2	√	√	√	√	√	√		√	√		√	√	√	√
CO3	√	√	√	√	√	√		√	√		√	√	√	√
CO4	√	√	√	√	√	√		√	√		√	√	√	√
CO5	√	√	√	√	√	√		√	√	√	√	√	√	√
CO6	√	√	√	√	√	√		√	√	√	√	√	√	√

Course Outcomes (COs)

Interdisciplinary Course

IDC: Frontiers in Physics
(Credits: 03, Theory-02, Tutorial-01)

Course learning outcome (COs):

Students will be able to gain qualitative knowledge about

CO1: Basic Nature of Science, reasoning and universality of physics experimentation.

CO2: The Universe, its creation and evolution, celestial laws.

CO3: Matter and its constitutions, thermodynamics and radioactivity.

CO4: Basic laws of nature, dual property of light and introduction to quantum mechanics and relativity.

COs - POs Mapping
Course Code : IDC 1/ IDC 2/ IDC 3

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√		√				√			√		√
CO2	√	√	√		√				√			√		√
CO3	√	√	√		√				√			√		√
CO4	√	√	√		√				√			√		√