Department of Physics

Program Outcomes

1. **Knowledge Acquisition:** Gain factual knowledge in basic sciences such as Physics, Chemistry, Botany, Zoology, and Mathematics.
2. **Conceptual Understanding:** Grasp fundamental concepts, principles, and scientific theories, understanding their relevance in daily life.
3. **Laboratory Skills:** Develop expertise in handling scientific instruments and conducting experiments with accuracy.
4. **Environmental Awareness:** Promote awareness about environmental sustainability.
5. **Innovative Thinking:** Cultivate innovative thinking to propose novel ideas and solutions.

Goals

The University has formulated two broad educational goals for the undergraduate degree programs:

1. **Physics Fundamentals:** Establish a strong foundation in Physics by integrating theory and experiments, fostering scientific enthusiasm.
2. **Problem-Solving Skills**: Equip students with tools to analyze problems, apply mathematical formalism, and synthesize solutions effectively.

Program Specific Outcomes (PO)

Knowledge Outcomes

After completing B. Sc. (Physics) Program, the student will be able to:

PO1: Apply fundamental Physics knowledge in various branches such as Newtonian Mechanics, Quantum Mechanics, and more, along with mathematical and experimental methods.

PO2: Solve problems using both qualitative and quantitative data, even with limited information.

PO3: Translate physical descriptions into mathematical equations and vice versa, using graphs and geometric arguments.

PO4: Develop numerical, computational, and data-processing skills.

PO5: Enhance reporting and presentation skills through projects and seminars.

PO6: Seize opportunities and set personal goals.

PO7: Improve IT skills.

Professional Skill Outcomes

After completing the B. Sc. Physics Program, the students will be able to:

PO8: Utilize and apply foundational Physics knowledge to analyze various physical phenomena.

PO9: Display comprehension and understanding of key facts, concepts, principles, and theories in Physics.

PO10: Demonstrate laboratory proficiency by taking accurate measurements and analyzing them to reach valid conclusions.

PO11: Exhibit scientific communication skills, both oral and written, along with the ability to think critically and work independently.

PO12: Communicate effectively using diverse techniques, including reports and presentations, within a scientific context.

PO13: Respond adeptly to unfamiliar problems within scientific environments.

PO14: Plan, design, execute, and report complex experiments or investigations, utilizing appropriate methods to analyze data and assess uncertainty levels.

PO15: Integrate and apply skills across various branches of Physics.

PO16: Interact and collaborate effectively with others, engaging in teamwork.

PO17: Plan and implement efficient and effective working methods.

PO18: Collaborate with others to achieve common goals.

PO19: Participate in academic group projects and committee work.

PO20: Work with others to organize events, contributing as part of a team in a professional setting.

PO21: Adapt to new situations and handle changes effectively.

Generic Competencies Outcomes

After completing the B. Sc. Physics Program, the students will be able to:

PO22: Analyze issues quantitatively.

PO23: Acquire knowledge independently through self-study.

PO24: Communicate information clearly, concisely, and logically, employing suitable analytical and approximation techniques.

Attitude/Value Outcomes

After completing the B. Sc. Physics Program, the student should have developed some positive attitudes and will have:

PO25: Take responsibility in study and work.

PO26: Develop confidence in capabilities.

PO27: Work effectively in teams.

PO28: Maintain motivation for learning and experimentation.

Scientific Outcomes

After completing the B. Sc. Physics, students will be able to:

PSO1: Exhibit understanding of fundamental principles and theories of Physics, including Newtonian Mechanics, Thermodynamics, Electrodynamics, Atomic and Molecular Physics, Electronics, Optics, Nuclear Physics, and Quantum Mechanics.

PSO2: Utilize vector algebra, differential and integral calculus, and graphical methods to solve problems.

PSO3: Apply classroom knowledge to design and conduct basic laboratory experiments.

PSO4: Solve problems using appropriate methods in mathematical, theoretical, and computational Physics.

Course Outcomes

F. Y. B. Sc.

Course: Vector analysis (PH – 101)

After completing this course, the student will be able to:

CO1: Understand the difference between vectors and scalars, combinations of vectors, and their products and solve Physics problems using them;

CO2: Study vector and scalar fields and functions along with their properties;

CO3: Understand the concept of scalar and vector operators;

CO4: Study gradient, divergence and curl and their examples;

CO5: Be familiar with some vector identities and verify them which will be useful to them in the study of Electrodynamics and Plasma Physics.

Course: Force and Newton's Laws (PH – 101)

After completing this course, the student will be able to:

CO1: Understand Newton's laws of motion in detail;

CO2: Use knowledge of Newton's laws and equations of motion to solve problems;

CO3: Study the law of conservation of momentum and its applications;

CO4: Understand uniform circular motion and relative motion.

Course: Momentum and System of Particles (PH – 101)

After completing this course, the student will be able to:

CO1: Obtain knowledge of collision and its types; study some real-life examples of collisions;

CO2: Establish relations between linear and angular variables.

Course: Elasticity (PH – 101)

After completing this course, the student will be able to:

CO1: Understand one of the basic properties of a material: elasticity, stress and strain, the difference between stress and pressure;

CO2: Study Hooke's law and various types of moduli;

CO3: Establish relations among elastic constants and problems based on them.

Course: Electrostatics I (PH – 102)

After completing this course, the student will be able to:

CO1: Understand Coulomb's law and its applications;

CO2: Study some basic quantities such as field, electric field, flux, electric flux etc.;

CO3: Understand Gauss's law for electrostatics and its applications for some specific charge distributions;

CO4: Solve numerical problems based on Coulomb's law, the principle of superposition and Gauss's law.

Course: Electrostatics II (PH – 102)

After completing this course, the student will be able to:

CO1: Study electrostatic potential and potential energy;

CO2: Establish the relationship between electric field and electrostatic potential;

CO3: Discuss equipotential surfaces and their significance;

CO4: Understand electric current and emf;

CO5: do some circuit analysis and analysis of RC circuits.

Course: Diode Circuits (PH – 102)

After completing this course, the student will be able to:

CO1: Study transformer and rectification;

CO2: Understand half-wave rectifiers, full-wave rectifiers and full-wave bridge rectifiers along with their parameters;

CO3: Study the necessity of filter circuits and understand different types of filters;

CO4: Discuss clippers, clampers and limiters.

Course: Optics (PH – 102)

After completing this course, the student will be able to:

CO1: Understand the basic nature of light;

CO2: Study Fermat's principle and use it to establish laws of reflection and those of refraction;

CO3: Study lens, lens system and cardinal points of a lens system;

CO4: Use mathematical analysis to obtain properties of the image, formed by the combination of lenses and apply the theory of optics to calculate the cardinal points of an optical system

CO5: Establish Newton's formula of a lens and study its uses;

CO6: Study aplanatic points and aplanatic surfaces;

CO7: Study the combination of two thin lenses and their cardinal points.

Course: Angular Momentum and Gravitation (PH – 201)

After completing this course, the student will be able to:

CO1: Understand rotational motion in detail along with its properties;

CO2: Study torque and moment of inertia, the relation between them, the significance of the moment of inertia, their applications and real-life problems related to it;

CO3: Understand the concept of angular momentum;

CO4: Discuss the case of spinning top;

CO5: Understand Newton's law of gravitation, gravitation near the earth's surface,

CO6: Study gravitational field and gravitational potential.

Course: Oscillations and Waves (PH – 201)

After completing this course, the student will be able to:

CO1: Have basic ideas of oscillations and oscillatory motion, waves and their classification;

CO2: Use knowledge of the superposition principle to analyze the combinations of SHOs;

CO3: Study the law of conservation of momentum and its applications;

CO4: Understand various wave properties.

Course: Particle Properties of Waves (PH – 201)

After completing this course, the student will be able to:

CO1: Study blackbody radiation and photoelectric effect, and obtain their experimental results;

CO2: Discuss the dual nature of light;

CO3: Study X-rays, their production, their properties and diffraction of X-rays;

CO4: Discuss the Compton Effect and establish the particle nature of radiation;

CO5: Study pair production and mass-energy relation.

Course: Elasticity (PH – 201)

After completing this course, the student will be able to:

CO1: Understand twisting of a cylinder, torsional pendulum and related problems;

CO2: Study the bending of a beam and a cantilever, to discuss real-world problems of beams/cantilevers;

CO3: Determine elastic constants by Searle's method.

Course: Magneto-statics and Electromagnetic Induction (PH – 202)

After completing this course, the student will be able to:

CO1: Study the basics of magnetism;

CO2: Study force on a moving charge and solve problems based on it;

CO3: Understand torque on a current carrying loop;

CO4: Faraday's experiments on electromagnetic induction;

CO5: Understand Faraday's and Lenz's law;

CO6: Study motional emf and its applications;

CO7: Understand the working of the generator and motor.

Course: Thermodynamics (PH – 202)

After completing this course, the student will be able to:

CO1: Study the basic ideas such as that of temperature, thermal equilibrium, thermal expansion, pressure, mean free path and entropy;

CO2: Discuss ideal gas and its equation;

CO3: Discuss laws of thermodynamics;

CO4: Change in entropy during various processes;

CO5: Understand the efficiency of heat engines.

Course: Special purpose Diodes and BJTs (PH – 202)

After completing this course, the student will be able to:

CO1: Study the basic ideas of construction and working of special purpose diodes;

CO2: Understand the characteristics of the Zener diode and its application as a voltage regulator;

CO3: Study the basic ideas of the construction of transistors and their biasing;

CO4: Discuss characteristics of transistors.

Course: Optics (PH – 202)

After completing this course, the student will be able to:

CO1: Understand the wave nature of light based on Huygens' theory;

CO2: Study recti-linear propagation of light;

CO3: Apply the superposition principle to the waves of light;

CO4: Study coherence, interference of light and diffraction of light;

CO5: Obtain intensity distribution on the screen because of two waves of light under different conditions;

CO6: Understand single-slit diffraction pattern.

Course: Physics Practical

After completing this course, the student will be able to:

CO1: Demonstrate an ability to collect data through observation;

CO2: Acquire technical skills in using laboratory equipment, tools and materials;

CO3: Experimentation and interpretation of data;

CO4: Demonstrate an understanding of laboratory procedures using scientific methods;

CO5: Demonstrate a deeper understanding of the basic concepts and theories gained by experiencing and visualizing them as authentic phenomena;

CO6: Acquire complementary skills of collaborative learning and teamwork in laboratory work.

S. Y. B. Sc.

Course: Kinetic theory of gases (PH – 303)

After completion of the course, the student will be able to:

CO1: Understand how statistics of the microscopic world can be used to explain the thermal features of the macroscopic world;

CO2: Use thermal and statistical principles in a wide range of applications.

Course: Damped Oscillations (PH – 303)

After completion of the course, the student will be able to:

CO1: Have basic concepts of oscillations, SHM and damping;

CO2: Obtain equation of motion of damped harmonic oscillator;

CO3: Discuss various parameters associated with the damped harmonic oscillator.

Course: Forced Oscillations (PH – 303)

After completion of the course, the student will be able to:

CO1: Study forced harmonic oscillator and resonance;

CO2: Obtain equation of motion of forced harmonic oscillator;

CO3: Discuss various parameters associated with forced harmonic oscillator;

CO4: Understand Q-factor and sharpness of resonance;

CO5: Study resonance in LCR circuit.

Course: Charged Particles in Electromagnetic Fields (PH – 303)

After completion of the course, the student will be able to:

CO1: Understand the behaviour of charged particles in crossed electric and magnetic fields;

CO2: Understand the construction and working of the mass spectrograph and electron microscope.

Course (PH304): Wave Properties of Particles (PH – 304)

After completion of the course, the student will be able to:

CO1: Have basic concepts of the wave-particle duality of matter and radiation;

CO2: Study de Broglie's theory and the concept of photon, along with its properties;

CO3: Establish an equation of a wave and its differential equation;

CO4: Have an understanding of phase velocity and group velocity – the velocity with which matter waves propagate;

CO5: Study of experimental confirmation of wave nature of particle by particle diffraction;

CO6: Understand the behavior of a particle confined to a one-dimensional box which will effectively lead to further strengthening the basic concepts of Quantum Mechanics;

CO7: Describe the uncertainty principle and its applications.

Course: Atomic Structure (PH – 304)

After completion of the course, the student will be able to:

CO1: Revise the old atomic models;

CO2: Outline the basic structure of an atom and the concept of the nucleus;

CO3: Explain the origin of atomic spectra;

CO4: Classify the atomic spectra;

CO5: Have a basic understanding of atomic orbits and quantized energy levels of electrons in an atom through the study of Bohr's atomic model;

CO6: Understand the correspondence principle;

CO7: Study the basic idea of the nucleus;

CO8: Have basic concepts of absorption, spontaneous emission and stimulated emission

CO9: Study production and properties of the laser.

Course: Fraunhofer Diffraction (PH – 304)

After completion of the course, the student will be able to:

CO1: Revisit the wave nature of light, the concept of wave-front, Huygens' Principle, diffraction of light and types of diffraction;

CO2: Understand the diffraction of light by a circular aperture;

CO3: Study resolving powers of various optical instruments;

CO4: Explain the construction of diffraction grating;

CO5: Establish the theory of transmission grating for different ways of incident light and solve problems based on it;

CO6: Study X-ray diffraction and Bragg's law.

Course: Aberrations (PH – 304)

After completion of the course, the student will be able to:

CO1: Outline the basic idea of aberrations produces in the image using monochromatic light and white light;

CO2: Describe optical aberrations produced in the image by lenses and methods;

CO3: Find methods of the removal of these aberrations;

CO4: Design eyepieces free from aberrations which can then be used in microscopes and telescopes;

CO5: Solve problems based on the phenomenon of aberration of light.

Course (PH305): Complex Variable (PH – 305)

After completion of the course, the student will be able to:

CO1: Redefine complex numbers and their complex conjugate, learn graphical representation of complex numbers;

CO2: Understand functions of complex variables and analytical functions;

CO3: Establish Cauchy-Riemann conditions;

CO4: Study some special integrals;

CO5: Understand Cauchy's theorem, Cauchy's integral formula and Cauchy's residue theorem;

CO6: Solve problems using complex algebra and complex calculus.

Course: Thermoelectricity (PH – 305)

After completion of the course, the student will be able to:

CO1: Outline the basic idea of thermo-electricity and thermos-emf;

CO2: Study Seeback effect, Peltier effect, Thomson effect and their applications;

CO3: Discuss thermos-couple, thermopile and bolometer.

Course: Transistor Biasing and AC Models (PH – 305)

After completion of the course, the student will be able to:

CO1: Outline the voltage and current sources, network theorems and network analysis;

CO2: Understand the load line and Q-point;

CO3: Describe different types of biasing and their comparison;

CO4: Explain amplifiers and amplification, small-signal operation of amplifiers;

CO5: Understand the two-transistor model.

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Course: Voltage and Power Amplifiers (PH – 305)

After completion of the course, the student will be able to:

CO1: Outline the basic concept of gain in an amplifier;

CO2: Understand multistage amplifiers and swamped amplifiers;

CO3: Get the concept of feedback in the circuits; CO4: describe class A, class B and class C amplifiers; CO5: study transistor power rating.

Course: Physics Practical (PH – 306)

After completing this course, the student will be able to:

CO1: Demonstrate an ability to collect data through observation;

CO2: Use various instruments and equipment used in the laboratory;

CO3: Design an experiment to test a hypothesis and/or determine the value of some unknown physical quantity;

CO4: Set up experimental equipment to implement an experimental approach;

CO5: Describe the methodology of science and the relationship between observation and theory;

CO6: Obtain and analyze data, plot appropriate graphs and reach conclusions from the data analysis;

CO7: Work in a group to plan, implement and report on a project/experiment;

CO8: Keep a well-maintained and instructive laboratory record book;

CO9: Express their knowledge and ideas through oral and written language.

Course: Thermodynamic relations, free energies and Thermodynamic equilibrium (PH – 403)

After completion of the course, the student will be able to:

CO1: Have basic concepts of the thermodynamic variables and their classification;

CO2: Study Maxwell's thermodynamic variables and Maxwell's thermodynamic relations;

CO3: Solve problems using TdS equations and laws of thermodynamics;

CO4: Study Gibbs-Helmholtz equation;

CO5: Study various thermodynamic processes;

CO6: Discuss Gibbs phase rule.

Course: Production of low temperatures (PH – 403)

After completion of the course, the student will be able to:

CO1: Discuss ordinary methods of cooling;

CO2: Understand adiabatic cooling;

CO3: Study Joule-Thomson effect and Joule-Kelvin effect: An isenthalpic process;

CO4: Understand adiabatic demagnetisation;

CO5: Study the third law of thermodynamics and its consequences.

Course: Crystal Structure (PH – 403)

After completion of the course, the student will be able to:

CO1: Understand the Periodic array of atoms;

CO2: Describe the fundamental type of lattices;

CO3: Understand the index system for crystal planes;

CO4: Describe simple crystal structure and direct imagining of atomic structure and non-ideal crystal structure;

CO5: Explain the diffraction of waves by crystals;

CO6: Describe Brillouin zones.

Course: Crystal Vibrations (PH – 403)

After completion of the course, the student will be able to:

CO1: study vibrations of crystals with monoatomic bases;

CO2: Understand two atoms per primitive basis.

Course: Quantum Mechanics (PH – 404)

After completion of the course, the student will be able to:

CO1: Get some flavor of Quantum Mechanics;

CO2: Distinguish Classical Mechanics and Quantum Mechanics;

CO3: Get the concept of the wave function of a particle and its properties;

CO4: Establish time-dependent Schrodinger's Equation and its steady state form;

CO5: Obtain the expectation value of an observable within the given interval;

CO6: Understand the significance of operators of some physical quantities/ observables in Quantum Mechanics.

Course: Quantum Mechanics (PH – 404)

After completion of the course, the student will be able to:

CO1: Establish time-dependent Schrodinger's Equation and its steady state form;

CO2: Use Schrodinger's Equation for solving problems of particle in a box finite potential and harmonic oscillator;

CO3: Understand the tunnel effect based on Schrodinger's Equation and its solution.

Course: Polarization and Double Refraction (PH – 404)

After completion of the course, the student will be able to:

CO1: Define unpolarized and polarized light, polarization of light, and polarizers;

CO2: Study various methods of polarizing an unpolarized light;

CO3: Understand and study applications of fundamental laws associated with polarization of light: Brewster's Law and Malus' Law;

CO4: Have an understanding of optical activity and specific rotation and real-life problems.

Course: Lasers: An Introduction and Optical Fiber Basics (PH – 404)

After completion of the course, the student will be able to:

CO1: Outline the importance of coherence in optical phenomena;

CO2: Describe different types of coherence and the factors affecting it;

CO3: Understand the concept of stimulated emission based on Einstein's theory;

CO4: Define absorption, spontaneous emission and stimulated emission processes and describe lasing action through EDFA;

CO5: Generate different types of Lasers;

CO6: Study properties and applications of Laser

CO7: Outline the phenomena such as reflection, refraction, total internal reflection and interference of light;

CO8: Study the structure of the optical fibre, and its significance in the context of communication.

Course: Fourier series (PH – 405)

After completion of the course, the student will be able to:

CO1: Outline the harmonic functions, odd and even functions and their expansion as Fourier series;

CO2: Establish Dirichlet's condition for the function to be Fourier expandable;

CO3: Solve problems and obtain Fourier series of some definite harmonic functions;

CO4: Discuss the properties and advantages of the Fourier series.

Course: AC bridges (PH – 405)

After completion of the course, the student will be able to:

CO1: Study phase analysis in AC circuits containing different combinations of components;

CO2: Do the mathematical analysis of balancing an AC bridge having arms containing circuit components such as inductor, resistor, capacitor etc;

CO3: Study different AC bridges and their applications.

Course: Emitter Follower (PH – 405)

After completion of the course, the student will be able to:

CO1: Have a basic idea of CC amplifier and its parameters;

CO2: Study Darlington connections;

CO3: Understand Class B push-pull emitter follower;

CO4: Describe Class B amplifiers;

CO5: Discuss voltage regulation.

Course: JFETs (PH – 405)

After completion of the course, the student will be able to:

CO1: Distinguish between BJT and FET;

CO2: Study FET, JFET, MOSFET and their parameters;

CO3: Discuss FET amplifiers and their applications.

Course: Physics Practical (PH – 406)

After completing this course, the student will be able to:

CO1: Demonstrate an ability to collect data through observation;

CO2: Use various instruments and equipment used in the laboratory;

CO3: Design an experiment to test a hypothesis and/or determine the value of some unknown physical quantity;

CO4: Set up experimental equipment to implement an experimental approach;

CO5: Describe the methodology of science and the relationship between observation and theory;

CO6: Obtain and analyze data, plot appropriate graphs and reach conclusions from the data analysis;

CO7: Work in a group to plan, implement and report on a project/experiment;

CO8: Keep a well-maintained and instructive laboratory record book;

CO9: Express their knowledge and ideas through oral and written language.

T. Y. B. Sc.

Course (PH506): Motion in Central Force Field

After completion of the course, the student will be able to:

CO1: Apply the concept of centre of mass and mechanics of a system of particles, linear

and angular momentum to solve dynamics problems;

CO2: Demonstrate an intermediate knowledge of central-force motion and the concept of converting two-body problems to single body problems and apply advanced methods to complex central-force motion problems;

CO3: Understand general features of the motion;

CO4: Demonstrate an intermediate knowledge of central-force motion;

CO5: Explain the equation of orbit;

CO6: Explain Kepler's three laws of planetary motion and apply Kepler's laws to calculate the characteristics of orbits.

Course (PH506): Lagrangian Formulation

After completion of the course, the student will be able to:

CO1: Understand the limitations of Newton's laws of motion;

CO2: Understand the concept of constraints, its significance and its classification;

CO3: Understand generalized coordinates and their physical significance;

CO4: Deduce Lagrange's equation using different methods;

CO5: Correlate Hamilton's principle, D' Alembert's principle and Newton's laws of motion;

CO6: Derive the general expression for kinetic energy;

CO7: Understand conservation theorems, symmetry properties, and Cyclic or ignorable coordinates;

CO8: Understand the Velocity-dependent potential of the electromagnetic field;

CO9: Understand and use Rayleigh's dissipation function.

Course (PH506): Free Electron Fermi Gas

After completion of the course, the student will be able to:

CO1: Derive an expression for energy levels for free electron gas in one dimension;

CO2: Understand the effect of temperature on the fermi dirac distribution;

CO3: Derive an expression for energy levels for free electron gas in one dimension;

CO4: Obtain an expression for the Heat capacity of the electron gas;

CO5: Study electric conductivity, thermal conductivity of metals and Ohm's law;

CO6: Study motion of charge particle in a magnetic field.

Course (PH506): Energy bands

After completion of the course, the student will be able to:

CO1: Study nearly free electron model, Bloch functions and Kronig – Penny model;

CO2: Obtain an expression for Wave equation of electron in a periodic potential.

Course (PH507): Electric Fields in Matter

After completion of the course, the student will be able to:

CO1: Understand the behavior of conductors and dielectrics in the presence of an external electric field;

CO2: Study polarization of dielectrics, resulting in surface and volume charge densities;

CO3: Have an understanding of the displacement field in the dielectric and its importance in the construction and working of a capacitor;

CO4: Study modified form of Gauss' law in the presence of dielectric and in turn derive electric field due to the given charge distribution;

CO5: Study linear dielectrics and their properties;

CO6: Discuss boundary value problems in the presence of dielectrics;

CO7: Obtain expressions for energy and forces in the presence of dielectrics.

Course (PH507): Magnetic Fields in Matter

After completion of the course, the student will be able to:

CO1: Classify materials based on their magnetic properties;

CO2: Study how to magnetize an unmagnetized substance, such substances have many applications;

CO3: Study the origin of the magnetic field in a substance;

CO4: Effect of magnetic field on diamagnetic, paramagnetic and ferromagnetic substances;

CO5: Study the origin of bound currents and its interpretation

CO6: Obtain Ampere's law in the presence of magnetized materials;

CO7: Define magnetic susceptibility and magnetic permeability;

CO8: Study the hysteresis cycle of a ferromagnetic substance.

Course (PH507): Multiple Beam Interferometry

After completion of the course, the student will be able to:

CO1: Outline the superposition principle and interference of light;

CO2: Study the multiple reflections from thin films;

CO3: Discuss the working of Fabry-Perot etalon and Fabry-Perot interferometer;

CO4: Obtain the basic idea of resolving power;

CO5: Study Lummer-Gehrcke Plate;

CO6: Get an introduction to interference filters.

Course (PH507): Holography

After completion of the course, the student will be able to:

CO1: To study the theory of holography and its applications.

Course (PH508): Quantum Theory of Hydrogen Atom

After completion of the course, the student will be able to:

CO1: Apply Schrodinger's equation to the simplest possible atom – hydrogen atom;

CO2: Extend the concepts of probability (of finding a particle) and (finding) expectation value (of an observable using wave function): the two pillars of Quantum Mechanics;

CO3: Compare theoretical data with experimental values of observables;

CO4: Understand how naturally quantum numbers get in when one solves Schrodinger's equation;

CO5: Come to know about the importance of quantum numbers in quantizing certain physical quantities.

Course (PH508): Quantum Theory of Hydrogen Atom

After completion of the course, the student will be able to:

CO1: Determine the characteristics of atomic spectra;

CO2: Study the effect of magnetic field on spectral lines (Zeeman Effect);

CO3: Will have an understanding of the spin motion of electrons;

CO4: Have an understanding of symmetric and antisymmetric wave functions and Pauli's exclusion principle.

Course (PH508): Nuclear Models

After completion of the course, the student will be able to:

CO1: Outline various nuclear models, their properties, successes and failures;

CO2: Have fundamental ideas on radioactivity, radioactive radiations and their properties;

CO3: Get a flavor of artificial radioactivity.

Course (PH508): Radioactivity

After completion of the course, the student will be able to:

CO1: Outline various nuclear models, their properties, successes and failures;

CO2: Have fundamental ideas on radioactivity, radioactive radiations and their properties.

Course (PH509): Blackbody Radiation

After completion of the course, the student will be able to:

CO1: Understand blackbody radiation in greater detail;

CO2: Learn fundamental laws associated with blackbody radiations;

CO3: Develop skills to solve problems based on classical statistical mechanics.

Course (PH509): Basic Concepts of Statistical Mechanics

After completion of the course, the student will be able to:

CO1: Outline phase space and quantum state;

CO2: Learn the significance of the state of the system;

CO3: Distinguish between macrostates and microstates;

CO4: Study types of ensembles;

CO5: Learn entropy and probability.

Course (PH509): The Experimental Background of the Theory of Special Relativity

After completion of the course, the student will be able to:

CO1: Outline Galilean transformations electromagnetism and Newtonian relativity;

CO2: Study the Michelson-Morley experiment and its outcome;

CO3: Learn Lorentz-Fitzgerald contraction Hypothesis; CO4: study the ether drag hypothesis;

CO5: Learn the postulates of the special theory of relativity.

Course (PH509): Relativistic Kinematics

After completion of the course, the student will be able to:

CO1: Outline the relativity of simultaneity;

CO2: Derive Lorentz transformation equations and discuss their consequences;

CO3: Learn aberration and the Doppler Effect of relativity.

Course (PH510): MOSFET, Thyristor & UJT

After completion of the course, the student will be able to:

CO1: Outline different types of FETs and MOSFETs;

CO2: Study their properties;

CO3: Understand the working of MOSFET amplifiers;

CO4: Have an introduction to thyristors and SCFR.

Course (PH510): Differential Amplifier

After completion of the course, the student will be able to:

CO1: Learn differential amplifiers and their analyses;

CO2: Study OP AMPs, their parameters and their applications.

Course (PH510): Digital logic and combinational logic circuit

After completion of the course, the student will be able to:

CO1: Have an introduction to logic gates and an understanding of universal gates;

CO2: Study Boolean algebra;

CO3: Learn how to prepare the Karnaugh map and use it;

CO4: Understand SOP and POS methods for solving Boolean expressions.

Course (PH510): Digital logic and combinational logic circuit

After completion of the course, the student will be able to:

CO1: Outline different number systems;

CO2: Study multiplexer and demultiplexer, comparators, encoders and decoders;

CO3: Learn parity generators and checkers;

CO4: Understand binary to decimal and decimal to primary conversions.

Course (PH511): Vector Analysis

After completion of the course, the student will be able to:

CO1: Establish and verify vector identities which find applications in almost all branches of Physics;

CO2: Outline the basic concept of curvilinear coordinates and different coordinate systems;

CO3: Deduce the expressions for gradient, divergence, curl and Laplacian in Cartesian coordinate system, spherical polar coordinate system and cylindrical coordinate system;

CO4: Learn and use vector calculus in solving problems.

Course (PH511): Numerical Methods

After completion of the course, the student will be able to:

CO1: Outline algebraic equations and polynomials;

CO2: Know different methods to solve algebraic equations;

CO3: Explain the bisection method and false position method to solve algebraic equations;

CO4: Explain the iteration method Newton-Raphson method to solve algebraic equations;

CO5: Define interpolation and understand different types of interpolation;

CO6: Come to know about errors in polynomial interpolation;

CO7: Outline various operators and their uses to derive different polynomials;

CO8: Understand Newton's difference formulation and solve the algebraic equation.

Course (PH511): C-programming

After completion of the course, the student will be able to:

CO1: Define types of programming languages and their uses, basic idea of flow chart;

CO2: Gain basic competency with numerical constants, define operators and expressions in C-programming;

CO3: Explain arithmetic operators and modes of expression, defining constants and declaring variable names;

CO4: Present arithmetic conversion, assignment expression and increment decrement statement.

Course (PH511): C-programming

After completion of the course, the student will be able to:

CO1: Describe input and output statement, conditional statement and loops;

CO2: Implement numerical algorithms into the C-program and visualize the results of the computations.

Course (PH-512): Physics Practical

After completion of the course, the student will be able to:

CO1: Describe the underlying theory of experiments in the course;

CO2: Perform derivations of theoretical models of relevance for the experiments in the course;

CO3: Follow instructions to perform laboratory experiments in Optics, Thermodynamics, Mechanics, Modern Physics, Electronics and Electromagnetism;

CO4: Document their results, using correct procedures and protocols;

CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant;

CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report;

CO7: Calculate permissible standard error in any physics experiment;

CO8: Derive conclusions from the analysis of own data;

CO9: Assess the language used to describe physics experiments and how it can alter perceptions of the method and results.

Course (Generic Elective): Modern Digital and Analog Communication System-I

Unit 1: Introduction: Communication System

After completion of the course, the student will be able to:

CO1: Learn about communication systems;

CO2: Study channel effect, signal-to-noise ratio;

CO3: Get introduced to modulation and detection.

Unit 2: Amplitude Modulations and Demodulations

After completion of the course, the student will be able to:

CO1: Understand the distinction between baseband and carrier communications;

CO2: Learn amplitude modulation and demodulation;

CO3: Study frequency division multiplexing and PLL.

Unit 3: Angle Modulation and Demodulation

After completion of the course, the student will be able to:

CO1: Get an introduction to ono-linear modulation;

CO2: Learn how to generate FM signals and their demodulation;

CO3: Understand super-heterodyne receivers;

CO4: Know about the FM broadcasting systems.

Unit 4: Sampling and analog-to-digital conversion

After completion of the course, the student will be able to:

CO1: Understand the sampling theorem;

CO2: Study various Pulse Code Modulations and digital multiplexing;

CO3: Know about delta modulation;

CO4: Study vocoders and video compression.

Course (Generic Elective): Astrophysics-I

Unit 1: Astronomical Instruments

After completion of the course, the student will be able to:

CO1: Learn about Optical telescopes;

CO2: Study the construction, working and challenges associated with radio telescopes;

CO3: Come to know about various detectors on board The Hubble Space Telescope

Unit 2: Star

After completion of the course, the student will be able to:

CO1: Understand the light coming from extraterrestrial objects in different electromagnetic spectra and their astronomical spectrograph;

CO2: Learn about the apparent and absolute brightness of the star;

CO3: Outline the magnitude of the star determined by the radiometer;

CO4: Have an introduction about the colour index and luminosities of the star.

CO5: Derive the Boltzmann's formula and Shah's equation of thermal ionization;

CO6: Learn the importance of ionization theory in astrophysics.

Unit 3: The Sun

After completion of the course, the student will be able to:

CO1: Know about the Sun in detail;

CO2: Understand the phenomenon of the photosphere: limb-darkening;

CO3: Understand about solar granulation;

CO4: Know in detail about various regions like the chromosphere, solar corona, Prominences, etc.;

CO5: Understand the 11-year solar cycle and sunspots and solar magnetic field;

CO6: Learn the theory of sunspots;

CO7: Study and understand the difference between solar flare, radio emission from the sun and solar wind;

CO8: Explain the solar neutrino puzzle.

Unit 4: Binary and Multiple Stars

After completion of the course, the student will be able to:

CO1: Understand the idea of binary and multiple stars;

CO2: Study visual binary, spectroscopic binary and eclipsing binary;

CO3: Know about the origin of binary stars;

CO4: Study the Steller masses and mass-luminosity relation;

CO5: Understand the mass transfer in a close binary system.

Course (Generic Elective): Measurement and Instrumentation-I

Unit 1: Optoelectronic measurement

After completion of the course, the student will be able to:

CO1: Learn the basics of optoelectronic measurement systems;

CO2: Get familiar with the terms relating to photometry and radiometry;

CO3: Study the optical sources and detectors.

Unit 2: Electronic Instruments

After completion of the course, the student will be able to:

CO1: Learn about electronic meters such as VTVM, differential amplifier type voltmeter etc.

Unit 3: Cathode Ray Oscilloscope

After completion of the course, the student will be able to:

CO1: Learn the principle, construction and working of CRT;

CO2: Study functions of deflection plates, graticule etc.;

CO3: Study basic CRO circuits;

CO4: Learn how to do the measurement of voltage, current, frequency and phase using CRO.

Unit 4: Transducers

After completion of the course, the student will be able to:

CO1: Learn the classification and static characteristics of transducers;

CO2: Describe the construction, working principle, characteristics and applications of various resistance transducers;

CO3: Discuss the operation and applications of modern industrial transducers.

Course (PH606): Moving Coordinate Systems

After completion of the course, the student will be able to:

CO1: Revisit the definition of motion and Newton's laws of motion to understand the physical significance of frame-of-reference and their types;

CO2: Analyze the motion of an object in a rotating coordinate system which ultimately leads to Coriolis force;

CO3: Learn the rotation of the earth through Foucault's pendulum, the effect of Coriolis force on a freely falling particle;

CO4: Redefine rigid body, rotational motion, moment of inertia and angular momentum.

Course (PH606): Motion of a Rigid Body

After completion of the course, the student will be able to:

CO1: Study Euler's theorem

CO2: Establish the law of conservation of angular momentum and study its physical significance through some examples;

CO3: Mathematically derive expressions for inertia tensor and principal axes of the body;

CO4: Derive Euler's equations of motion and Euler's angles;

CO5: Study Torque-free motion;

CO6: Study the motion of the symmetrical top in detail.

Course (PH606): Fermi Surfaces and Metals

After completion of the course, the student will be able to:

CO1: Study the reduced zone scheme and Periodic zone scheme;

CO2: Understand the Construction of fermi surfaces;

CO3: Know about Electron orbits, Hall orbits and open orbits;

CO4: Calculate the energy bands;

CO5: Learn Experimental methods in fermi surface studies.

Course (PH606): Superconductivity

After completion of the course, the student will be able to:

CO1: Study the Experimental Survey, Theoretical Survey of superconductivity;

CO2: Understand high-temperature superconductors.

Course (PH607): Electrodynamics

After completion of the course, the student will be able to:

CO1: Revise Ohm's law and emf;

CO2: Study electromagnetic induction;

CO3: Learn Faraday's law and inductance.

Course (PH607): Electrodynamics

After completion of the course, the student will be able to:

CO1: Signify the work of Maxwell by studying displacement current;

CO2: Analyze Maxwell's equations in different media;

CO3: Understand the nature and the properties of electromagnetic waves;

CO4: Study Poynting's theorem.

Course (PH607): Reflection and Refraction of Electromagnetic Waves

After completion of the course, the student will be able to:

CO1: Study reflection and refraction of electromagnetic waves for various cases;

CO2: Study polarization of waves and Brewster's law;

CO3: Learn total internal reflection, transmissivity and reflectivity.

Course (PH607): Optical Fiber Basics using Ray Optics

After completion of the course, the student will be able to:

CO1: Study the basics of optical fibres and their properties.

Course (PH608): Many Electron Atoms

After completion of the course, the student will be able to:

CO1: Outline the basic coupling schemes of spin and orbital motions of electrons in an atom and obtain the outcome as a result;

CO2: Understand the distribution of electrons in different shells and sub-shells in the atoms of the elements using Pauli's exclusion principle, prepare electron configuration in them and ultimately construct the periodic table;

CO3: Calculate the quantum state of electrons in an atom and establish spectral notation;

CO4: Study X-ray spectra and their applications.

Course (PH608): Molecular Physics

After completion of the course, the student will be able to:

CO1: Study the theory of molecular bonds;

CO2: Learn about rotational and vibrational energy levels.

Course (PH608): Particle Accelerators and Radiation Detectors

After completion of the course, the student will be able to:

CO1: Outline the importance of particle accelerators, their types and applications;

CO2: Describe various particle accelerators;

CO3: Outline the importance of particle detectors, their types and applications;

CO4: Describe various detectors.

Course (PH608): Particle Physics

After completion of the course, the student will be able to:

CO1: Classify elementary particles;

CO2: Understand the quantum numbers of elementary particles;

CO3: Explain the various conservation laws.

Course (PH609): Classical and Quantum Statistics

After completion of the course, the student will be able to:

CO1: Study the distinction between classical and quantum statistics;

CO2: Learn distribution functions, partition functions and thermodynamic properties of a system;

CO3: Obtain some deductions from Maxwell-Boltzmann statistics;

CO4: Learn distribution law for molecular speeds

CO5: Study-specific heat capacity of gases.

Course (PH609): Specific Heat Capacity of Solids

After completion of the course, the student will be able to:

CO1: Outline the specific heat of solids;

CO2: Learn Einstein's theory and Debye's theory;

CO3: Study negative temperature and its effects;

CO4: Einstein's formulation of spontaneous and stimulated emission of radiation;

CO5: Understand laser action.

Course (PH609): Relativistic Dynamics

After completion of the course, the student will be able to:

CO1: Learn the reason to redefine momentum;

CO2: Study relativistic momentum;

CO3: Learn relativistic force law and the dynamics of a single particle;

CO4: Study equivalence of mass and energy.

Course (PH609): Relativity and Electromagnetism

After completion of the course, the student will be able to:

CO1: Learn the interpretation of electric field and magnetic field and their transformations;

CO2: Study the field of a uniformly moving charge;

CO3: Revisit forces and fields near a current carrying wire;

CO4: Understand the invariance of Maxwell's equations;

CO5: Study the possible limitations of special relativity.

Course (PH610): Operational Amplifiers and Linear Op-Amp Circuits

After completion of the course, the student will be able to:

CO1: Learn the basics of OP-AMP;

CO2: Have an introduction to IC 741;

CO3: Study various applications of OP-AMP;

CO4: Construction and working of the instrumentation amplifier.

Course (PH610): Feedback & Oscillators

After completion of the course, the student will be able to:

CO1: Have an introduction to feedback amplifiers and their types;

CO2: Learn various oscillators;

CO3: Understand the construction and working of IC 555 and its applications.

Course (PH610): Arithmetic Circuits

After completion of the course, the student will be able to:

CO1: Learn clock waveforms;

CO2: Study Schmitt trigger;

CO3: Understand the construction and working of various multivibrators;

Course (PH610): Flip-Flop

After completion of the course, the student will be able to:

CO1: Learn the basics of flip-flops;

CO2: Understand the difference among various flip-flops;

CO3: Learn the need for a master-slave flip-flop and working.

Course (PH611): Differential equations

After completion of the course, the student will be able to:

CO1: Learn about partial differential equations;

CO2: Derive series solution of Frobenius method.

Course (PH611): Matrices

After completion of the course, the student will be able to:

CO1: Study matrices, matrix multiplication, diagonal matrices and matrix inversion;

CO2: Develop skills to solve orthogonal matrices and diagonalization of matrices.

Course (PH611): C-Programing

After completion of the course, the student will be able to:

CO1: Define array variable and syntax rule for array;

CO2: Learn to read and write in multidimensional arrays in C programming;

CO3: Explain logical operators and express their precision rule.

Course (PH611): C-Programing

After completion of the course, the student will be able to:

CO1: Study syntax rule for function declaration in C programming;

CO2: Learn to declare local and global variables in C programming.

Course (Generic Elective): Modern Digital and Analog Communication System-II

Unit 1: Principles of Digital Data Transmission

After completion of the course, the student will be able to:

CO1: Outline digital communication systems;

CO2: Study line coding and pulse shaping.

Unit 2: Principles of Digital Data Transmission

After completion of the course, the student will be able to:

CO1: Learn scrambling, digital receivers and regenerative repeaters;

CO2: Study PAM: M-ARY baseband signalling for higher data rate and its digital career modulation.

Unit 3: Performance Analysis of Digital Communication Systems

After completion of the course, the student will be able to:

CO1: Study linear detectors and their signal space analysis;

CO2: Understand binary signalling;

CO3: Learn vector decomposition of white noise random processes.

Unit 4: Performance Analysis of Digital Communication Systems

After completion of the course, the student will be able to:

CO1: Learn optimum receiver for while Gaussian noise channels;

CO2: Nonwhite channel noise, other useful performance criteria;

CO3: Non-coherent detection.

Course (Generic Elective): Astrophysics-II

Unit 1: Structure and Evolution of Stars

After completion of the course, the student will be able to:

CO1: Derive the equation of state for the stellar interior;

CO2: Study the mechanical and thermal equilibrium in stars and how the stellar evolution is taking place.

Unit 2: Pulsars, Neutron Stars and Black Holes

After completion of the course, the student will be able to:

CO1: Come to know about white dwarfs, pulsars, and black holes.

Unit 3: Quasars

After completion of the course, the student will be able to:

CO1: Learn about the discovery of Quasars, their optical and radio properties and redshift in Quasars.

Unit 4: Cosmology

After completion of the course, the student will be able to:

CO1: Outline the Redshift and expansion of the universe;

CO2: Derive the matter density in the universe and the declaration parameter;

CO3: Understand the cosmological principle and fundamental equation of cosmology;

CO4: Study the cosmic microwave background radiation.

Course (Generic Elective): Measurement and Instrumentation-II

Unit 1: Primary sensing elements and transducers 1

After completion of the course, the student will be able to:

CO1: Learn various thermometers and temperature transducers;

CO2: Study the construction and the functioning of LVDT and RVDT.

Unit 2: Primary sensing elements and transducers 2

After completion of the course, the student will be able to:

CO1: Understand capacitive transducers

CO2: Learn piezo-electric, Hall Effect and opto-electronic transducers.

Unit 3: Display Devices

After completion of the course, the student will be able to:

CO1: Learn about various display devices such as electrical, digital, SSD, dot matrix, LCD, LED etc.

Unit 4: Modern sensors and chemical sensors

After completion of the course, the student will be able to:

CO1: Learn about various types of modern sensors, detectors and filters.

Course (PH-612): Physics Practical

After completion of the course, the student will be able to:

CO1: Describe the underlying theory of experiments in the course;

CO2: Perform derivations of theoretical models of relevance for the experiments in the course;

CO3: Follow instructions to perform laboratory experiments in Optics, Thermodynamics, Mechanics, Modern Physics, Electronics and Electromagnetism;

CO4: Document their results, using correct procedures and protocols;

CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant;

CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report;

CO7: Calculate permissible standard error in any physics experiment;

CO8: Derive conclusions from the analysis of own data;

CO9: Assess the language used to describe physics experiments and how it can alter perceptions of the method and results.