# B. Sc. General in Physics

Programme Specific Outcome (PSO)

By the end of the program B. Sc. General in Physics, the student will be able to:

- Students should formulate, analyze and solve complex and diverse problemsthrough analytical and computational techniques and apply them to other disciplines whenappropriate.
- Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological challenges.
- Analyses, test, and interpret technical arguments, and form independent judgments.
- Gather and organize relevant qualitative and quantitative information such as related problems, examples, and counterexamples.
- The graduates will be able to communicate physical ideas viaextended, clear, and well-organized written presentations.
- The degree with physics will prepare students for careers in the corporate sector, techindustry, and government agencies
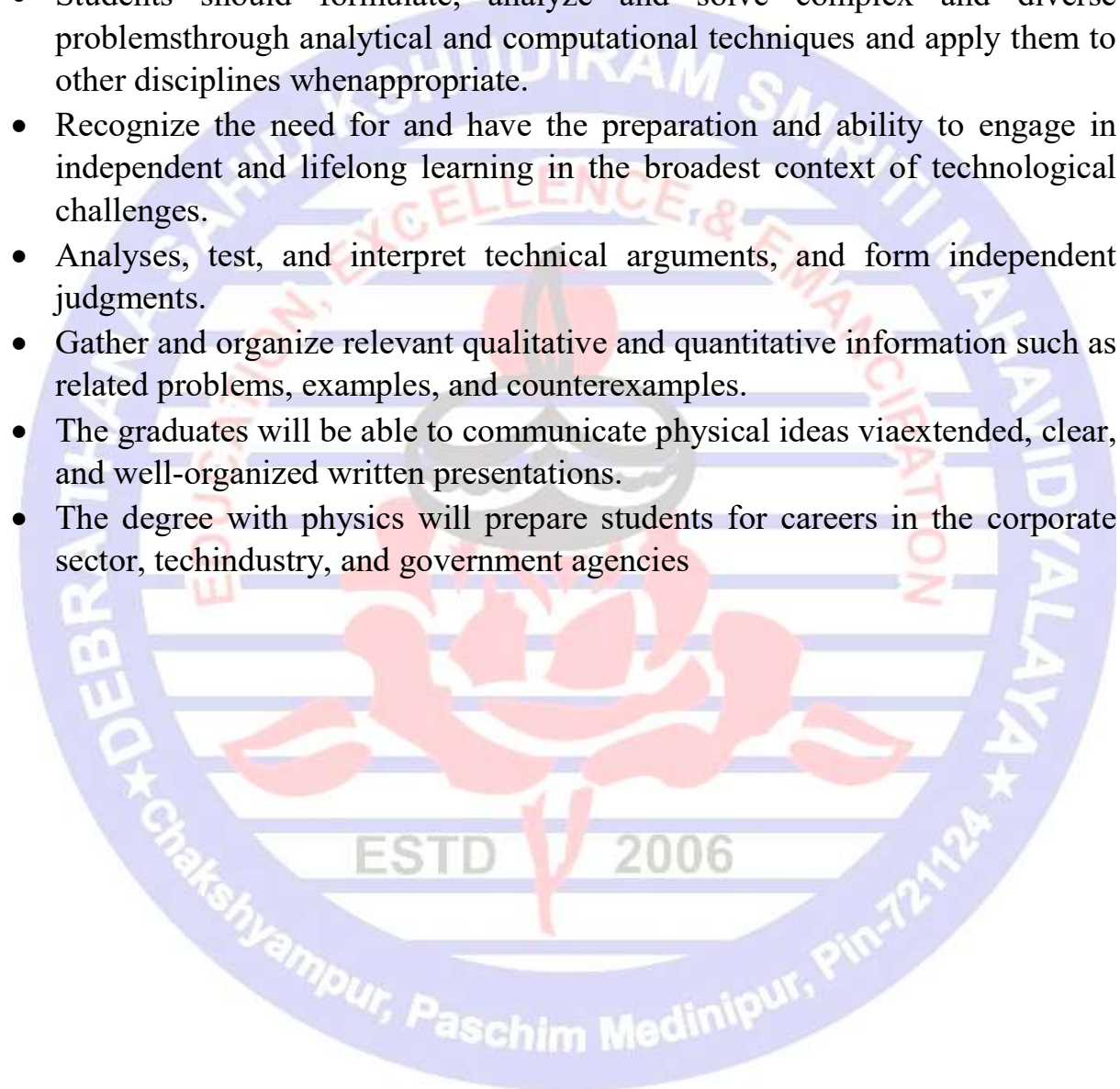
Course Outcome (CO)

PHSGDS01A: Mechanics
Outcomes:
Fundamentals of Dynamics

- Students will know about Reference frames. Inertial frames; Newton's Laws of Motion.
- Students will learn about Galilean transformations; Galilean invariance.
- Students will learn about Momentum of variable- mass system: motion of rocket.
- Students will able to calculate Motion of a projectile in Uniform gravitational field .
- Students will learn about Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum and able to solve problem related to this.

Work and Energy

- Students will learn about Work and Kinetic Energy Theorem.
- Students will learn about Conservative and non- conservative forces. Potential Energy.
- Students will be able to find Stable and unstable equilibrium condition.
- Students will able to calculate Elastic potential energy, Force as gradient of potential energy.
- Students will learn about Work & Potential energy. Work done by nonconservativeforces. Law of conservation of Energy.

Collisions

- Students will learn about Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames

Rotational Dynamics

- Students will learn about Angular momentum of a particle and system of particles.
- Students will able to calculate Torque.
- Students will learn about Principle of conservation of angular momentum.
- Students will learn about Rotation about a fixed axis. Moment of Inertia.
- Students will able toCalculate the moment of inertia for rectangular, cylindrical and spherical bodies.
- Students will learn about Kinetic energy of rotation. Motion involving both translation and rotation

Elasticity

- Students will learn about Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Fluid Motion

- Students will learn about Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary

Gravitation and Central Force Motion

- Students will learn aboutLaw of gravitation. Gravitational potential energy.
- Students will be able to solve problems related to gravitation

Oscillations

- Students will learn about Simple Harmonic Oscillations. Differential equation of SHM and its solution.
- Students will be able to calculate Kinetic energy, potential energy, total energy and their time-average values.
- Students will learn about Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality FactorLaw of gravitation.

Non-Inertial Systems

- Students will learn aboutNon-inertial frames and fictitious forces.
- Students will learn about Uniformly rotating frame. Laws of Physics in rotating coordinate systems.
- Students will able to solve problems related to relativity.

PHSGDS01B: Electricity and Magnetism
Outcomes:

- Students will know aboutElectric Field and Electric Potentialand able to solve problems related to this
- Students will know aboutDielectric Properties of Matter.
- Students will learn aboutMagnetic Properties of Matter
- Students will learn aboutThevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem
- Student will able to solve problems related to magnetism.

PHSGDS01C: Thermal Physics and Statistical Mechanics
Outcomes:

- Students will know about First Law of Thermodynamics and 2nd law of thermodynamics and able to solve problems based on this.
- Students will know about the Concept of Entropy.
- Students will learn about Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy.
- Students will learn aboutMaxwell-Boltzmann Law of Distribution and able to calculate problems based on this.

- Students will know about Maxwell-Boltzmann law, distribution of velocity, Quantum statistics - Fermi- dirac distribution law, Bose-Einstein distribution law, comparison of three statistics.
- Student will learn about Behaviour of Real Gases and Deviations from the Ideal Gas Equation.

PHSGDS01D: Waves and Optics

Outcomes:

- Students will knows about definition Linearity and Superposition Principle and this principle in Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats)..
- Students will know Graphical and Analytical Methods and Lissajous Figures with equal and unequal frequency and their uses.
- Students will learn about transverse waves on a string. Travelling and standing waves on a string and Normal Modes of a string and also Group velocity, Phase velocity.
- Students will know the Plane waves. Spherical waves and Wave intensity.
- Students will learn about Surface Tension of Synclastic and anticlastic surface - Excess of pressure - and its application to spherical and cylindrical drops and bubbles - variation of surface tension
- Students will know about the Viscosity and Rate flow of liquid in capillary tube and also Poiseuille's formula by which they can determinant of coefficient of viscosity of a liquid
- Students will learn about the simple harmonic motion - forced vibrations and resonance.
- .Students will know the Electromagnetic nature of light. Definition and Properties of wave front.
- Students will learn about Interference and their classes (Division of amplitude and division of wavefront.)
- Students will learn Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating and their classes.
- Students will know the Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization

PHSGSE01: Computational Physics

Outcomes:

Algorithms and Flowcharts:

- Students will able learn about Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates,

- Students will able to calculate roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series.
- Students can calculate of sin (x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

Scientific Programming:

- Students can understand about basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions
- Students can make Fortran Statements: I/O Statements (unformatted/formatted) Executable and Non-Executable Statements,
- Students can layout of Fortran Program and they can write Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

Control Statements:

- Students can write looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO)
- Students will get a clear idea about subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements),
- Students can structure disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems

PHSGSE02: Basic Instrumentation Skills

Outcomes:

Basic of Measurement:

- Students will learn principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Cathode Ray Oscilloscope:

- Students can make block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment),
- Students will get clear idea on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization.

- Students can use CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace.
- Students can make Digital storage Oscilloscope Block diagram and explain principle of working.

Signal Generators and Analysis Instruments:

- Students can make block diagram, of low frequency signal generators. Pulse generator, and function generator.
- Students will get brief idea for testing, specifications. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters:

- Students will able to make block diagram of bridge and then they can understand working principles of basic (balancing type) RLC bridge.
- Students will learn about specifications of RLC bridge, block diagram & working principles of a Q- Meter. Digital LCR bridges.

Digital Multimeter:

- Students will understand about block diagram and working of a digital multimeter.
- Students will learn working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

PHSHSE-03: Renewable Energy and Energy Harvesting

Outcomes:

- Students will learn about Fossil fuels and Nuclear Energy, theirlimitation, need of renewable energy, non-conventional energy sources.
- Students will learn about Solar energy, its importance, storage of solar energy, solar pond, nonconvective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. .
- Students will learn about Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.
- Students will know the Plane waves. Spherical waves and Wave intensity.

- Students will learn about Surface Tension ofSynclastic and anticlastic surface - Excess of pressure - and its application to spherical and cylindrical drops and bubbles - variation of surface tension.
- Students will learn about the Hydropower resources, hydropower technologies, environmental impact of hydro power sourcesStudents will learn about the simple harmonic motion - forced vibrations and resonance.
- Students will know about Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity and also Piezoelectric parameters and modelling piezoelectric generators, Piezoelectric energyharvesting applications.
- Students will know about Electromagnetic Energy Harvesting: Linear generators, physics mathematical models,recent applications. Carbon captured technologies, cell, batteries, power consumption.

PHSGSE-04: Weather Forecasting:

Outcomes:

- Students will learn about elementary idea of atmosphere and physical structure and composition; compositional layering of the atmosphere.
- Students will learn about Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall.
- Students will know the Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.
- Students will learn Climate: its classification; causes of climate change.
- Students will learn about Weather forecasting: analysis and its historical background; need of measuring weather and types of weather forecasting; weather forecasting.

PHSGDS-01: Elements of Modern Physics

Outcomes:

Planck's quantum:

- Student will be able to understand the concept of photon.
- Student will be able to explain photoelectric effect, Compton scattering.
- Student will know the concept of De Broglie wavelength and matter waves.
- Student will be able to explain Davisson-Germer experiment.

Problems with Rutherford model:

- Student will be able to understand Bohr's quantization rule and atomic stability;

- Student can calculate the energy levels for hydrogen like atoms and their spectra.
- Student can observe Instability of atoms and observation of discrete atomic spectra.

Position measurement:

- Student can understand about Gamma ray microscope thought experiment.
- Student can relate about Wave-particle duality and Heisenberg uncertainty principle.
- Student can estimate minimum energy of a confined particle using uncertainty principle and Energy-time uncertainty principle.

Two slit interference experiment:

- Student will obtain a basic concept about linear superposition principle as a consequence; Matter waves and wave amplitude.
- Student can solve Schrodinger equation for non-relativistic particle.
- Student will know the relation about Momentum and Energy operator.
- Student will obtain the basic concept stationary states; physical interpretation of wave function.
- Student can normalize any wave function.
- Student can calculate probabilities and probability current densities in one dimension of any given wave function.

One Dimensional infinitely Rigid Box:

- Student can calculate energy eigenvalues and Eigen functions, normalization constant.
- Student can understand Quantum mechanical scattering and tunneling in one dimension - across a step potential and across a rectangular potential barrier.

Size and structure of atomic nucleus and its relation with atomic weigh:

- Student can under the nature of nuclear force, NZ graph,
- Student will be able to calculate semi-empirical mass formula and binding energy.

Radioactivity:

- Student will be able to calculate Law of radioactive decay.
- Student can calculate Mean life and half-life; decay.
- Student will be able to explain decay - energy released, spectrum and Pauli's prediction of neutrino; -ray emission.

Fission and fusion:

- Student can calculate Mass deficit, relativity and generation of energy;
- Student will understand Fission - nature of fragments and emission of neutrons.

- Student will know about nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

PHSGDS02: <u>Digital and analog circuits and instrumentation</u>
<u>Outcomes:</u>

- Students will know about Integrated Circuits and different type of gates.
- Students will know about De Morgan's Theorems. Boolean Laws and Simplification of Logic Circuit using Boolean Algebra.
- Students will learn about Half and Full Adders. Half & Full Substractors, 4-bit binary Adder/Subtractor. Sequential Circuits.
- Students will learn aboutComputer memory. Memory organization & addressing. Memory Interfacing.
- Students will learn aboutSerial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers.
- Students will know about Conductivity and Mobility, Concept of Drift velocity, PN Junction Fabrication etc.
- Students will know about the Principle and structures of (1) LEDs, (2) Photodiode and (3) Solar Cell.
- Students will learn about n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations.
- Students will learn aboutTransistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.
- Student will learn about Op-Amps applications as (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Substractor(4)Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator.