Deshabandhu Mahavidyalaya

Department of Physics

Programme Specific Outcome (PSO) and Course Outcome (CO)

Programme Specific Outcome (PSO):

Students graduating with a B.Sc. in Physics should be able to:

PSO1: Demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.

PSO2: To acquire basic knowledge in physics, including the major premises of classical mechanics, quantum mechanics, electromagnetic theory, electronics, optics, special theory of relativity and modern physics.

PSO3: To design and conduct experiments demonstrating their understanding of the scientific method and processes.

PSO4: To discover the concepts of physics in other disciplines such as mathematics, computer science, engineering, and chemistry.

PSO5: Understand basic physical fundamentals and the key vocabulary to describe them: kinematics, dynamics, work and energy, rotations, gravitation, heat and thermodynamics, fluids.

PLO6: With Intermediate Physics Labs, participate in complex experiments where the computer is interfaced to their environment, understand the challenges and advantages of using computers in science, recognize applications in computer interfacing to other disciplines such as engineering, chemistry, medicine, meteorology, analyze real physical problems and develop correct solutions to them.

PSO7: Students will be able to apply the laws of physics in real life situations to solve the problems.

PSO8: After completing the program student will have developed interdisciplinary approach and can pursue higher studies in subjects other than physics.

Semester – I

Course Name: Mechanics & General Properties of Matter (Major & Minor)

Course	Course Content	Course Outcome
Mechanics & General Properties of Matter	1. Vector Calculus	CO1: Understand vector algebra and vector calculus.
	2. Mechanics of Single Particle	CO2: Understand the classical of single particles within the scope of the Newtonian formulation and its application.
	3. Oscillations	CO3: Learn about the various aspects of oscillatory motion, including simple harmonic motion properties, energy considerations, damped oscillations, forced oscillations, resonance phenomena, concepts of resonance and quality factors in a driven system.
	4. Gravitation	CO4: Understand and apply Kepler's laws and Newton's gravitational law to describe the motion of planets and satellites in circular Orbit.
	5. System of Particles	CO5: Understand Degrees of freedom, Centre of mass and Centre of gravity, Momentum, Angular momentum, Torque, energy for a system of particles.
	6. Rigid body Dynamics	CO6: Learn and understand rigid body dynamics, including moment of inertia calculations and conservation of rotational energy, and apply these concepts to analyse the dynamics of various rigid bodies.
	7. General properties of matter	CO7: Study the properties of matter, the response of the classical systems to external forces, and their elastic deformation and its applications and concept of viscosity and surface tension, along with its applications
Experinental	1. To study the Motion of Spring and calculate (a) Spring constant, (b) Acceleration due to gravity.	Students will develop skill to study various mechanical properties and they inter connections experimentally.
	2. To determine the Moment of Inertia of a Flywheel / regular-shaped body.	
	3. To determine Coefficient of Viscosity of water by Capillary Flow (Poiseuille's) Method.	
	4. Determination of Young's modulus by method of flexure.	
	5. To determine the Young's Modulus of a Wire by Optical Lever Method.	

	6. To determine the elastic Constants of a wire by Searle's method.	
	7. To determine the value of acceleration due to gravity using Bar Pendulum.	
	8. 7. To determine the value of acceleration due to gravity using Kater's Pendulum.	
	9. Determination of surface tension of a liquid by Jaeger's method.	
	10. Determination of surface tension of a liquid by capillary-rise method.	
	11. Determination of the rigidity modulus of a wire by statical /dynamical method.	

MD COURSE

PHYSICAL SCIENCE

COURSE CODE: MDC101

Course	Course Content	Course Outcome
PHYSICAL SCIENCE	1. Matter and Energy	CO1: Study the basic idea of matter Constituents of matter (upto elementary particles), and fundamental forces in nature and learn about energy and different types of energy, Conservation of energy, Equivalence of matter and energy, energy generation and distribution in our daily life (Nuclear reactors, electrical energy), Renewable and Non-renewable sources of energy; Solar energy, tidal energy, hydro energy.
	2. Gravity, Force and Space	CO2: Learn Gravity; Planetary motion, Newton's third law; Weightlessness; Low earth orbit; Geosynchronous satellites; Spy satellites; Medium Earth Orbit satellite; Circular Acceleration; momentum; Rockets; Airplanes, helicopters and fans; Hot air and helium balloons and Structure of the Universe.
	3. Applications of Physics	CO3: Understand the role of physics in everyday life and technological advances.

SEC COURSE

Computer Programming in C / FORTRAN/ Python/ SciLab

Course Code: BSCPHYSE101

Course	Course Content	Course Outcome
Computer Programming in C / FORTRAN/ Python/ SciLab	1. Introduction and Overview	Students will have the ability to CO1: Understand computer architecture, memory, and I/O devices.
	2. Basics of scientific computing	CO2: Explain how to perform arithmetic operations in different number systems and describe methods to manage floating-point precision issues. CO3: Identify and address errors in floating-point computations. CO4: Develop programs using basic programming concepts, including data types, control statements, and file I/O.
	3. Errors and error Analysis	
	4. Programming fundamentals	CO5: Use advanced programming constructs such as lists, dictionaries, and functions, to develop complex and efficient programs.
Sample Programming	1. (a) Conversion of components of a vector among cartesian, polar and cylindrical Calculating the positions, velocities of a particle from given mass, acceleration. (d) Finding the real / complex roots of a quadratic equation using Sridharacharya method.	CO1: Develop proficiency in using fundamental programming concepts and techniques to create efficient and effective solutions.
	2. To check the divisibility of an integer and find a set of prime numbers.	
	3. Conversion of a number between decimal, binary, octal, hexadecimal number systems.	
	4. Find the area / perimeter of circle / square /ellipse, volume of sphere / cube etc. using user defined functions.	
	5. Generation of terms, sum, ratios for arithmatic, geometric and Fibonacci / series.	
	6. To evaluate an infinite series with pre-assigned accuracy.	
	7. To find the largest/second largest/smallest of a given list of numbers. Find their locations in a sequence.	
	8. Sorting of numbers in ascending / descending order.	
	9. To generate a frequency distribution, mean, mode, median (from formula), standard deviation, correlation functions etc. from a given data.	
	10. Fitting an experimental data with linear least-square method.	
	11. To find the trace of a square matrix. Find the sum, difference and product of two square matrices.	
	12. Generation of pseudo-random numbers and test their auto-correlations.	
	13. To write in and read from an external file in a program.	

Semester – II

Course Name: Electricity and Magnetism (Major& Minor)

Course	Course Content	Course Outcome
Electricity and Magnetism	1. Electric Field for a point charge	Students will CO1: Understand the basic idea of electric field for point charge and its connection to electric potential.
	2. Electrostatic potential for a point charge	CO2: Learn about Coulomb's law, electric fields, and potentials, including their relations and apply Poisson's and Laplace's equations to physical problems.
	3. Multipole expansion of potential	CO3: Analyse the electric field and potential generated by multipoles, including dipoles.
	4. Gauss law in Electrostatics	CO4: Understand Gauss's Law to calculate the electric field for various charge distributions.
	5. Concept of Voltage and current Sources	CO5: Describe the behaviours of electric currents, current density, and conductors under the influence of electric fields and apply Ohm's Law, Kirchhoff's Laws, and network theorems to analyse circuits.
	6. Electrostatics in Conductors and Dielectrics	CO6: Understand the behaviours of electric fields and charges in conductors and dielectrics and learn about capacitor and calculate the electrostatic energy stored in capacitors.
	7. DC steady currents	CO7: Learn about electric currents, using Ampere's Law and Biot-Savart Law.
	8. Magnetostatics	CO8: Understand the fundamental concepts of magnetic fields.
	9. Magnetic materials	CO9: Study and understand magnetic intensity, induction, magnetisation, susceptibility, and permeability, such as various types of magnetic materials, including diamagnetic, paramagnetic, and ferromagnetic materials.
	10. Electromagnetic Induction	CO10: learn electromagnetic induction, including the effects on a conducting rod moving within a magnetic field and apply Faraday's laws of induction and Lenz's Law.
	11. AC circuits	CO11: Study the concepts of RMS and average values of AC signals and analyse the response of RL, RC, LC, and LCR circuits.
	12. Electromagnetic waves	CO12: Understand Maxwell's electromagnetic equations and an introduction to Gauge transformation and understand the concept of electromagnetic waves, including their propagation, transverse nature, and energy transport via the Poynting vector.

Course	Course Content	Course Outcome
Experimental	1. To study the characteristics of a series RC Circuit.	CO1: At the end of these experiments students will develop skill to design various electrical circuits.
	2. To determine an unknown low resistance using Potentiometer.	
	3. To determine an unknown low resistance using Carey Foster's Bridge.	
	4. To compare capacitances using De' Sauty's bridge.	
	5. To determine self-inductance of a coil by Anderson's bridge.	
	6. Measurement of magnetic field strength B and its variation in a solenoid (determinination of dB/dx).	
	7. To verify the Thevenin and Norton theorems in a wheatstone bridge.	
	8. To verify the superposition, and maximum power transfer theorems in a wheatstone bridge.	
	9. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.	
	10. To study the response curve of a parallel LCR circuit and determine its (a) anti-resonant frequency and(b) Quality factor Q.	
	11. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer	
	12. Determine a high resistance by leakage method using Ballistic Galvanometer.	
	13. To determine self-inductance of a coil by Rayleigh's method.	
	14. To determine temperature co-efficient of resistance of a metal / semiconductor by a meter-bridge.	

SEC Course

Electrical Circuits and Network Skill

Course Code: BSCPHYSE201

<table>
<tr><th>Course</th><th>Course Content</th><th>Course Outcome</th></tr>
<tr><td rowspan="8">Electrical Circuits and Network Skill</td><td>1. Basic Electricity Principles</td><td>Students will
CO1: Recall basic electricity principles, including voltage, current, resistance, power, and the behaviour of electrical components in DC and AC circuits.</td></tr>
<tr><td>2. Understanding Electrical Circuits</td><td rowspan="4">CO2: Understand the basic operations of generators, transformers, DC power sources, and AC/DC generators.
CO3: Explain the operation and control mechanisms of electric motors, including single-phase, three-phase, and DC motors.</td></tr>
<tr><td>3. Electrical Drawing and Symbols</td></tr>
<tr><td>4. Generators and Transformers</td></tr>
<tr><td>5. Electric Motors</td></tr>
<tr><td>6. Solid-State Devices</td><td>CO4: 4. Explain electrical circuits using rules for DC and AC sources, and describe power components and energy savings.</td></tr>
<tr><td>7. Electrical Protection</td><td rowspan="2">CO5: Interpret electrical drawings, schematics, and ladder diagrams to track connections and identify current flow.</td></tr>
<tr><td>8. Electrical Wiring</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><th>Course</th><th>Course Content</th><th>Course Outcome</th></tr>
<tr><td rowspan="9">Experiments</td><td>1. Determine the values of resistors from their colour code and their effect on series and parallel connection.</td><td rowspan="9">CO1: At the end of these experiments students will develop skill to design various electronic circuits.</td></tr>
<tr><td>2. Designing equivalent star and delta network.</td></tr>
<tr><td>3. Preparation of extension board for use in house wiring (220 V AC).</td></tr>
<tr><td>4. Two-way Switch connections.</td></tr>
<tr><td>5. Drawing of lay out for a prototype connections in domestic purposes.</td></tr>
<tr><td>6. Pin identification of a 741 IC and design an inverting amplifier.</td></tr>
<tr><td>7. Using multimeter determine the values of resistance, capacitor, inductor and construct a series LCR circuit with a known frequency ac voltage source. Draw the phrasor diagram by determining the voltages across each components.</td></tr>
<tr><td>8. Using multimeter determine the values of resistance, capacitor, inductor and construct a parallel LCR circuit with a known frequency ac voltage source. Draw the phrasor diagram by determining the voltages across each components.</td></tr>
<tr><td></td><td></td></tr>
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Course Content

SEC-2: Basic Instrumentation Skills

Course	Course Content	Course Outcome
Basic Instrumentation Skills	1. Basic of Measurement	Students will have the ability to CO1: Understand the principles of measurement including accuracy, precision, sensitivity, resolution range and Errors in measurements and loading effects..
	2. Multimeter	CO2: Learn to use multimeters for measuring DC and AC voltage, current, and resistance, and understand their specifications
	3. Electronic Voltmeter	CO3: Analyze the operation and specifications of AC millivoltmeters, including different types such as amplifier-rectifier and rectifier-amplifier
	4. AC millivoltmeter	
	5. Cathode Ray Oscilloscope	CO4: Gain knowledge of cathode ray oscilloscopes (CROs), including their construction, operation, and use for measuring voltage, frequency, and time period, as well as the basics of digital oscilloscopes.
	6. Signal Generators and Analysis Instruments	
	7. Impedance Bridges & Q-Meters	CO5: learn Block diagram of bridge and . Block diagram & working principles of a Q- Meter. Digital LCR bridges.
	8. Digital Instruments	
Experiments	1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.	CO1: Develop the ability to effectively use various measuring instruments and techniques to accurately analyze electrical parameters and understand their limitations in practical circuit applications.
	2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.	
	3. To measure Q of a coil and its dependence on frequency, using a Q- meter.	
	4. Measurement of voltage, frequency, time period and phase angle using CRO.	
	5. Measurement of time period, frequency, average period using universal counter/frequency counter.	
	6. Measurement of rise, fall and delay times using a CRO.	
	7. Measurement of distortion of a RF signal generator using distortion factor meter.	
	8. Measurement of R, L and C using a LCR bridge/ universal bridge.	
	9. Converting the range of a given measuring instrument (voltmeter, ammeter).	

Semester-III

Course Name: Classical Mechanics and Special Theory of Relativity

Course Code: BSCHPHSC301

Course	Course Content	Course Outcome
Classical Mechanics and Special Theory of Relativity	1. Kinematics and Dynamics of Rigid Body Motion a) Rotational Motion b) Central force Motion	Students will CO1: be able to learn the concept of moment of inertia for different shaped bodies. CO2: Understand the basic idea of motion of particle in a plane under central force and will be able to solve its problems. CO3: learn the characteristics of inverse square law, Kepler's law and apply them in our common Earth-Sun system.
	2. Lagrangian and Hamiltonian formulation of Classical Mechanics a) Lagrangian Formulation b) Hamiltonian Formulation	CO4: be able to understand the Lagrangian and Hamiltonian formulations of classical mechanics
	3. Special Theory of Relativity	CO5: explain the necessity of replacing Newtonian relativity through Einstein's special relativity, and elaborate on the classical mechanics of fast particles under the special relativity.

Course Name: Thermal Physics – I

Course Code: BSCHPHSC302

Course	Course Content	Course Outcome
Thermal Physics – I	1. Kinetic Theory of Gases	Students will CO1: be able to understand the first law of thermodynamics and MB distribution and law of equipartion of energy.
	2. Transportation Phenomenon	CO2: will learn the concept of transport phenomenon of gases.
	3. Brownian Motion and its application	CO3: learn the Brownian Motion and its application.
	4. Real Gases	CO4: will be able to explore the behavior of real gases under different conditions.
	5. Conduction of Heat	CO5: be able to learn the macroscopic mechanism of thermal conductivity.
	6. Radiation	CO6: be able to get the basic understanding of black body radiation.
Experiments	1. To determine mechanical equivalent of Heat, J, by Callender and Barne's constant flow method.	CO1: Students will develop sufficient skill to perform experiments related to different thermal properties of matter.
	2. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.	
	3. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.	
	4. To determine the temperature coefficient of resistance/boiling point by platinum resistance thermometer	
	5. To study the variation of thermo-emf of a thermocouple with difference of temperature of its two	
	Junctions.	
	6. To determine temperature co-efficient of resistance of metal/semiconductor by meter-bridge.	
	7. Determination of the boiling point of a liquid by Platinum resistance thermometer.	
	8. Determination of coefficient of linear expansion by optical lever/travelling microscope.	
	9. Determination of pressure coefficient of air by Jolly's apparatus.	

Course Name: Electrical Circuit Network Skills

Course Code: BSCHPHSSEC 301

Course	Course Content	Course Outcome
Electrical Circuit Network Skills	1. Basic Electricity Principles	
	2. Understanding Electrical Circuits	CO1: Hands on experience on design and trouble shoots the electrical circuits, networks and appliances and choose proper devices depending upon application considering economic and technology up-gradation.
	3. Electrical Drawing and Symbols	
	4. Generators and Transformers	
	5. Electric Motors	
	6. Solid-State Devices	
	7. Electrical Protection	
	8. Electrical Wiring	

Semester-IV

Course Name: Electromagnetic Theory

Course Code: BSCHPHSC401

Course	Course Content	Course Outcome
Electromagnetic Theory	1. Electromagnetic Theory	Students will CO1: learn the mathematical background of electro-magnetic theory and deduce the expressions for different dynamical parameters associated to the electromagnetic wave. CO2: analyse the propagation of electromagnetic waves using Maxwell's equations. CO3: explain the behaviour of electromagnetic waves in various media, including reflection, refraction, and transmission at dielectric interfaces. CO4: apply electromagnetic theory to understand modern-day communication systems such as optical fibres as wave guide and step index and graded index fibres.
	2. Dispersion	CO5: apply electromagnetic principles to explain various phenomena like dispersion, scattering, etc.
	3. Scattering	
	4. Electro-and Magneto-optic Effects	

Course Name: Waves and Optics

Course Code: BSCHPHSC402

Course	Course Content	Course Outcome
Waves and Optics	1. Superposition of Collinear Harmonic oscillations	Students will CO1: learn the results of the linear superposition of two or more collinear and perpendicular simple harmonic oscillations and wave motion.
	2. Superposition of two perpendicular Harmonic Oscillations	CO2: Understand and analyse wave phenomena like interference and its applications.
	3. Wave Motion	CO3: learn the concept of wave motion, group and phase velocities.
	4. Interference of light waves	CO4: Understand and analyse wave phenomena like interference and its applications
	5. Diffraction of light waves	CO5: understand the Fresnel diffraction and its use in calculating fringe patterns.
	6. Polarisation	CO6: Gain ability in the principles of polarisation, including different states of polarisation, double refraction, and principles of optical activity.
Practical	1. To verify the law of Malus for plane polarized light.	CO1: Students will develop skill to study various optical experiment.
	2. To determine the specific rotation of sugar solution using polarimeter.	
	3. To analyze elliptically polarized light by using a Babinet's compensator.	
	4. Determination of angle of prism and to determine refractive index of the material of a prism using sodium source	
	5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury/helium source.	
	6. To determine wavelength of sodium light using Fresnel biprism.	
	7. To determine wavelength of sodium light using Newton's rings.	
	8. To determine wavelength of (1) sodium source and (2) spectral lines of mercury/helium source using plane diffraction grating.	

Course Name: Digital Systems and Applications

Course Code: BSCHPHSC403

Course	Course Content	Course Outcome
Digital Systems and Applications	1. Integrated Circuits	Students will CO1: have basic idea of integrated circuits. CO2: understand integrated circuits (ICs), including active and passive components, discrete components, wafers, and chips.
	2. Digital Circuits:	CO3: learn about basic digital gates and binary logic and apply it to real-life problems
	3. Boolean algebra	CO4: learn about basic digital gates and binary logic and apply it to real-life problems.
	4. Data processing circuits	CO5: learn the basics of data processing.
	5. Circuits	CO6: Analyse and design basic digital circuits using combinational logic (multiplexers, demultiplexers, decoders, encoders) and sequential logic (SR, D, JK flip-flops).
	6. Computer Organization	CO7: explain the fundamental components and organisation of a computer system.
Practical	1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.	CO1: Students will develop skill needed for construction of digital circuits.
	2. To test a Diode and Transistor using a Multimeter.	
	3. To design a switch (NOT gate) using a transistor.	
	4. To verify and design AND, OR, NOT and XOR gates using NAND gates.	
	5. To design a combinational logic system for a specified Truth Table.	
	6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.	
	7. To minimize a given logic circuit.	
	8. Half Adder, Full Adder and 4-bit binary Adder.	
	9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.	
	10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.	
	11. To build JK Master-slave flip-flop using Flip-Flop ICs	
	12. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.	
	13. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.	
	14. To design an astable multivibrator of given specifications using 555 Timer.	
	15. To design a monostable multivibrator of given specifications using 555 Timer.	

Semester – V

Course Name: Quantum Mechanics

Course Code: BSCHPHSC501

Course	Course Content	Course Outcome
Quantum Mechanics	1. Old quantum theory	CO1: Students will be able to get the basic understanding of black body radiation and connection between wavelike and particle like characters of photons and other material particles. and probabilistic interpretation.
	2. Basic quantum mechanics	CO2: Understand and apply the fundamental principles of quantum mechanics
	3. Basic postulates of quantum mechanics	CO3: Understand the fundamental postulates of quantum mechanics, including Hermitian operators, eigenvalue equations, measurement, and expectation values.
	4. Time dependent and time independent Schrodinger equation	CO4: Apply the time-dependent and time-independent Schrodinger equation for simple potentials like for instance the harmonic oscillator and hydrogen like atoms.
	5. Simple applications of Quantum Mechanics	CO5: Analyse particle behaviour in one-dimensional potential problems like potential wells, barriers, and the free particle in a box.
	6. Schrodinger equation in spherical polar coordinates	CO6: understand the Schrödinger equation in spherical polar coordinates, including angular momentum operators, eigenvalues, and eigen functions, as well as the hydrogen atom problem.

Course	Course Content	Course Outcome
Experimental	1. Measurement of Planck's constant using black body radiation and photo-detector.	CO1: At the end of these experiments students will learn to study various optical phenomena experimentally.
	2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photoelectrons versus frequency of light.	
	3. To determine work function of material of filament of directly heated vacuum diode.	
	4. To determine the Planck's constant using LEDs of at least 4 different colours.	
	5. To determine the ionization potential of mercury.	
	6. To determine the absorption lines in the rotational spectrum of Iodine vapour.	
	7. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.	
	8. Determination of separation of D1 and D2 lines of sodium by using plane transmission grating.	
	9. Draw the calibration curve between μ and □ using mercury discharge tube and find out the unknown wavelength of a particular light.	
	10. Frank-Hertz experiment.	
	11. Determination of grating element of a diffraction grating using a semiconductor laser.	
	12. Determination of wavelength of light using laser and single slit/wire.	

Course Name: Thermal Physics II

Course Code: BSCHPHSSC502

Course	Course Content	Course Outcome
Thermal Physics II	1. First Law of Thermodynamics	CO1: Understand the first law of thermodynamics and basic features of thermodynamics and related properties.
	2. Second Law of Thermodynamics	CO2: Students will learn the second law of thermodynamics and its application to heat engines and the concept of entropy.
	3. Thermodynamic Functions	CO3: Students will be able to get an idea of thermodynamic functions such as enthalpy, Helmholtz and Gibbs free energies, Legendre transformations, Maxwell's relations.
	4. Heat Engines	CO4: Analyse heat engines and refrigeration cycles based on thermodynamic principles. CO5: Understand phase transitions, multicomponent systems, and the Nernst heat theorem. CO6: Learn Gibbs phase rule and simple Applications and Ehrenfest's classification. Clausius Clapeyron's equation and Joule Thomson effect.
	5. Refrigerators	
	6. Thermodynamics of Reversible cells	
	7. Change of State	
	8. Multicomponent Systems	CO7: Understand the multicomponent systems.
	9. Radiation	CO8: Explain radiation properties using Kirchhoff's law, blackbody radiation, and radiation pressure. Explore key radiation laws and their implications.

Discipline Specific Elective (DSE I & II)

Course Name: Nuclear and Particle Physics

Course Code: BSCHPHSDSE501

Course	Course Content	Course Outcome
Nuclear and Particle Physics	1. General Properties of Nuclei	CO1:Students will be able to recapitulate their previous understanding about the structure and properties of the nuclei so that they can easily capture the complex ideas in this field.
	2. Nuclear Models	CO2: Students will be able to explore the salient features of nuclear models.
	3. Radioactivity decay	CO3: Understand the radioactive decay of nuclei and prediction of neutrino.
	4. Nuclear Reactions	CO4: Realize the theory of nuclear reactions that discovered the nature of nuclear particles and their interactions.
	5. Particle Accelerators	CO5: Since for nuclear reactions we need high energy projectiles so the detailed knowledge of accelerators is very much essential for students going to be nuclear scientist in near future.
	6. Particle physics	CO6: Students will familiar with the ultimate constituents of the universe, their properties and interactions in the nature. They will be able to know why some reactions are allowed and others do not exist in nature.

Course Name: Communication Electronics

Course Code: BSCHPHSDSE502

Course	Course Content	Course Outcome
Communication Electronics	1. Electronic communication	CO1: Comprehend the basic means and modes of communication, including their definitions and functions. CO2: Gain a basic understanding of how radio frequencies are allocated and managed in India, including the role of TRAI (Telecom Regulatory Authority of India). CO3: Understand the electromagnetic communication spectrum, including different frequency bands and their usage.
	2. Analog Modulation	CO4: Understand AM principles, including modulation index and its impact on the frequency spectrum. Learn about AM generation (emitter modulation) and demodulation. CO5: Obtain a qualitative understanding of how a superheterodyne receiver functions.
	3.Analog Pulse Modulation	CO6: Learn about channel capacity and the sampling theorem's role in signal processing. CO7: Study the principles of PAM modulation and detection techniques. CO8: Understand the basic principles of PWM and PPM and Explore different multiplexing methods such as CDMA, TDMA, and FDMA.

Course Name: Atomic Physics & Spectroscopy

Course Code: BSCHPHSDSE503

Course	Course Content	Course Outcome
Atomic Physics & Spectroscopy	1. Atomic Spectrum	CO1: Understand the role of quantum numbers and selection rules in atomic spectra and also study the Bohr-Sommerfeld model and its limitations, and analyze fine structure using Michelson interferometer.
	2. Vector atom model 3. Many electron model	CO2: Understand space quantization and the Zeeman effect through the vector atom model. CO3: Comprehend the Pauli exclusion principle, shell structure, and Hund's rule. CO4: Analyze spectroscopic terms of many-electron atoms in the ground state.
	4. Molecular spectroscopy 5. Laser Spectroscopy	CO5: Gain a qualitative understanding of the Raman effect and its application in molecular spectroscopy. CO6: Understand population inversion, Einstein's coefficients, and feedback in a resonator. CO7: Study the principles behind 3-level and 4-level systems, and specific lasers like Ruby and He-Ne lasers.

Semester -VI

Course Name: Statistical Mechanics

Course Code: BSCHPHSC601

Course	Course Content	Course Outcome
Statistical Mechanics	1. Microstates and macro states	CO1: comprehend the concepts of microstates and macrostates, equilibrium, the hypothesis of equal a priori probability and statistical definitions of temperature, pressure, entropy, and chemical potential.
	2. Classical statistical mechanics	CO2: be proficient in classical statistical mechanics, including the Maxwell-Boltzmann distribution law and the calculation of thermodynamic quantities for ideal monoatomic gases.
	3. Motivations for quantum statistics	CO3: Explain the limitations of classical statistics and the need for quantum statistics and derive Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics as the most probable distributions.
	4. Quantum statistical mechanics Bose-Einstein statistics Fermi-Dirac statistics	CO4: Apply Bose-Einstein statistics to explain blackbody radiation and Planck's law, BoseEinstein condensation and specific heat model. Analyse the FermiDirac distribution at various temperatures.

Course Name: Condensed Matter Physics

Course Code: BSCHPHSC602

Course	Course Content	Course Outcome
Condensed Matter Physics	1.Crystal Structure Solids	CO1: Students will acquire knowledge about different types of crystals.
	2. Elementary Lattice Dynamics	CO2: Students will acquire knowledge thermal properties of crystals.
	3. Magnetic Properties of Matter	CO3: understand the magnetic properties of matter, including dia-, para-, ferri-, and ferromagnetic materials, and the classical Langevin theory of dia- and paramagnetic domains.
	4. Dielectric Properties of Materials	CO4: understanding of dielectric properties of materials, including polarisation, comprehend classical and complex theories of electric polarizability, normal and anomalous dispersion, Cauchy and Sellmeir relations, LangevinDebye equation, and optical phenomena crystals.
	5. Elementary band theory	CO5: Proficient in elementary band theory, including the KronigPenny model and band gap concepts.
	6. Superconductivity	CO6: students will have idea of superconducting materials.

Course Name: Applied Optics

Course Code: BSCHPHSDSE601

Course	Course Content	Course Outcome
Applied Optics	1. Fermat's Principle	CO1: Understand geometrical and ray optics through transfer matrix formalism. CO2: Acquire foundational knowledge of various optical phenomena.
	2. Matrix Method	
	3. Aberration	
	4. Eye piece	
	5. Sources and Detectors	CO3: Recognize the technological applications of optical phenomena in fiber optics, holography, lasers, and photodetectors. CO4: Analyze different laser systems and their applications across various fields.
	6. Holography	
	7. Fibre optics	CO5: Conceptualize optical fiber, its construction, and its significance in communication physics.

Course Name: Physics of Devices and Instruments

Course Code: BSCHPHSDSE602

Course	Course Content	Course Outcome
Physics of Devices and Instruments	1. Devices	CO1: Gain practical experience with various instruments and their uses through hands-on activities.
	2. Power supply and Filters	
	3. Multivibrators	
	4. Phase Locked Loop (PLL)	
	5. Processing of Devices	CO2: Evaluate the performance characteristics of different electronic devices.
	6. Introduction to communication systems	CO3: Understand the concepts of Communication Systems effectively.

Course Name: Classical Dynamics

Course Code: BSCHPHSDSE603

Course	Course Content	Course Outcome
Classical Dynamics	1. Calculus of variation	Students will CO1: Understand how Lagrangian and Hamiltonian mechanics are derived using the calculus of variations.
	2. Small Amplitude Oscillations	CO2: Learn how small oscillations in isolated and coupled systems are analyzed through normal modes.
	3. Special Theory of Relativity	CO3: Comprehend how special relativistic mechanics is formulated using four-vectors and the Minkowski cone.

Course Name: Nanomaterials and Applications

Course Code: BSCHPHSDSE604

Course	Course Content	Course Outcome
Nanomaterials and Applications	1. Nanoscale Systems	CO1: Understand the basic idea of nano-scale physics.
	2. Synthesis Of Nanostructure Materials	CO2: Students will learn the techniques of synthesis.
	3. Characterization	CO3: students will learn the techniques of characterization.
	4. Optical Properties	CO4: Understand the basic idea of optical properties of nanoscale materials.
	5. Electron transport	CO5: Students will have basic idea of electron transport within nanoscale materials.
	6. Applications	CO6: Students will learn the uses of nanoscate materials.

Course Outcome for GE/Program

Department of Physics

Semester - III

Course Name: Basics of Thermal and Statistical Physics

Course Code: BSCPPHSC301

Course	Course Content	Course Outcome
Basics of Thermal and Statistical Physics	1.Laws of Thermodynamics	Students will CO1: understand the Laws of Thermodynamics and Apply it to various processes.
	2.Kinetic Theory of Gases	CO2: learn about kinetic theory of gases, ideal gas laws, and Maxwell's distribution and transport phenomena in gases.
	3.Theory of Radiation	CO3: be able to get the basic understanding of black body radiation and Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law.
	4. Statistical Mechanics	CO4: Learn and understand Phase space, Macrostate and Microstate, Entropy and Thermodynamicmprobability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law.

Course	Course Content	Course Outcome
Practical	1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.	CO1: Students will develop sufficient skill to perform experiments related to different thermal properties of matter.
	2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.	
	3. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.	
	4. To determine the Temperature Coefficient of Resistance/boiling point by Platinum Resistance Thermometer	
	5. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.	
	6. To determine temperature co-efficient of resistance by meter-bridge.	
	7. Determination of coefficient of linear expansion by optical lever/travelling microscope	

Course Name: Electrical Circuit Network Skills

Course Code: BSCPPHSSEC301

Course	Course Content	Course Outcome
Electrical Circuit Network Skills	1. Basic Electricity Principles 2.Understanding Electrical Circuits 3. Electrical Drawing and Symbols 4. Generators and Transformers 5. Electric Motors 6. Solid-State Devices 7. Electrical Protection 8. Electrical Wiring	Students will have ability to CO1: Design and troubleshoot electrical circuits, networks, and appliances using a hands-on approach. CO2: Analyze any specified electrical network. CO3: Create an electrical network based on a given impedance or admittance function.

Semester - IV

Course Name: Basics of Waves and Optics

Course Code: BSCPPHSC401

Course	Course Content	Course Outcome
Basics of Waves and Optics	1. Superposition of Collinear Harmonic oscillations	Students will CO1: learn the results of the linear superposition of two or more collinear and perpendicular simple harmonic oscillations and wave motion.
	2. Superposition of two perpendicular Harmonic Oscillations	CO2: Understand and analyse wave phenomena like interference and its applications.
	3. Wave Motion	CO3: learn the concept of wave motion, group and phase velocities.
	4. Interference of light waves	CO4: Understand and analyse wave phenomena like interference and its applications
	5. Diffraction of light waves	CO5: understand the Fresnel diffraction and its use in calculating fringe patterns.
	6. Polarisation	CO6: Gain ability in the principles of polarisation, including different states of polarisation, double refraction, and principles of optical activity.

Course	Course Content	Course Outcome
Practical	1. To verify the law of Malus for plane polarized light.	CO1: Students will develop skill to study various optical experiments.
	2. To determine the specific rotation of sugar solution using Polarimeter.	
	3. To analyze elliptically polarized light by using a Babinet's compensator.	
	4. Determination of angle of prism and to determine refractive index of the Material of a prism using sodium source.	
	5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.	
	6. To determine wavelength of sodium light using Fresnel Biprism.	
	7. To determine wavelength of sodium light using Newton's Rings.	
	8. To determine wavelength of (1) sodium source and (2) spectral lines of mercury source using plane diffraction grating.	
	9. Determine the refractive index of the material of a convex lens with the help of a 'plane mirror and lens arrangement' for the same.	

Course Name: Basic Instrumentation Skills

Course Code: BSCPPHSSEC401

Course	Course Content	Course Outcome
Basic Instrumentation Skills	1.Basic of Measurement	CO1: The students will gain hands-on experience with various aspects of instruments and their usage. CO2: The students will conduct the experiments listed below as part of the ongoing topics.
	2. Electronic Voltmeter	
	3. Cathode Ray Oscilloscope	
	4. Signal Generators and Analysis Instruments	
	5. Impedance Bridges & Q-Meters	
	6. Digital Instruments	
	7. Digital Multimeter	
	8. Electrical Wiring	

Semester- V

DISCIPLINE SPECIFIC ELECTIVES (DSE)

Course Name: Modern Physics

Course Code: BSCPPHSDSE501

Course	Course Content	Course Outcome
Modern Physics	1. Quantum Theory	Students will CO1: Learn about the foundations of the old quantum theory. CO2: Understand the line spectra and Bohr's theory of Hydrogen atom; Franck and Hertz experiment and concept of quantum numbers. CO3: Apply the time-dependent and time-independent Schrodinger equation for simple potentials like for instance the harmonic oscillator and hydrogen like atoms.
	2. Structure of Solids	CO1; learn elementary ideas about crystal structure – unit cell, basis, lattice and Bragg's law.
	3. Semiconductor Physics	CO1: be able to stidy the qualitative ideas about energy bands; intrinsic semiconductors.
	4. Nuclear and Elementary Particle Physics	CO1: Learn about fundamentals of nuclear physics and Elementary Particle Physics.

Course Name: Astronomy & Astrophysics

Course Code: BSCPPHSDSE502

Course	Course Content	Course Outcome
Astronomy & Astrophysics	1. Astronomical Scales	CO1: interpret astronomical quantities such as distances, stellar radii, masses, and temperatures using various astronomical techniques and coordinate systems
	2.Astronomical techniques	CO2: Demonstrate proficiency in using optical telescopes and detectors, and apply physical principles to analyze astronomical phenomena and observational limits.
	3. The Sun	CO3: Understand and explain the structure, activity, and dynamics of the Sun, and apply this knowledge to the broader context of the solar system's formation and characteristics.
	4. The milky way	CO4: Describe the structure, rotation, and components of the Milky Way galaxy, including the nature of dark matter and the properties of the Galactic nucleus.
	5. Galaxies	CO6: Apply Hubble's law and the cosmic distance ladder to understand the expanding universe, the formation of galaxy clusters, and the role of dark matter in large-scale cosmic structures.
	6. Large scale structure & expanding universe	

Course Name: Technical Drawing Skills

Course Code: BSCPPHSSEC501

Course	Course Content	Course Outcome
Technical Drawing Skills	1. Introduction	CO1: Familiarize yourself with the conventions and methods used in engineering drawing. CO2: Analyze engineering drawings by applying basic technical mathematics. CO3: Create both basic and intermediate geometric shapes. CO4: Enhance visualization skills to apply them effectively in designing new products. CO5: Develop technical communication skills through the creation of clear and informative drawings. CO6: Understand the principles of projection theory.
	2. Projections	
	3.Object Projections	
	4. The milky way	
	4. CAD Drawing	

Semester -VI

Course Name: Basic Electronics

Course Code: BSCPPHSDSE601

Course	Course Content	Course Outcome
Astronomy & Astrophysics	1. Semiconductor Diodes	Students will CO1: understand the principles of semiconductor diodes and concept of Drift velocity. PN Junction fabrication.
	2. Two-terminal Devices and their Applications	CO2: Learn about doping, P-N junction diode and their characteristics.
	3. Bipolar Junction transistors	CO3: Understand, analyse and design basic electronic circuits using bipolar junction transistors (BJTs).
	4. Field Effect transistors	CO4: learn basic principle of operations of JFET and MOSFET only.
	5. Amplifiers 6. Digital Circuits 7. Boolean algebra 8.Data processing circuits	CO5: Learn about basic digital gates and binary logic and apply it to real-life problems. CO6: Analyse and design basic digital circuits using combinational logic (multiplexers, demultiplexers, decoders, encoders.
Practical	1. To study V-I characteristics of PN junction diode, and Light emitting diode.	CO1: Gain practical skills in designing, analyzing, and implementing various electronic and digital circuits for real-world applications.
	2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.	
	3. To study the characteristics of a Bipolar Junction Transistor in CE configuration..	
	4. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.	
	5. To design a digital to analog converter (DAC) of given specifications.	
	6. To add two dc voltages using Op-amp in inverting and non-inverting mode	
	7. To investigate the use of an op-amp as an Integrator and as a Differentiator.	
	8. To verify and design AND, OR, NOT and XOR gates using NAND gates.	
	9. To design a combinational logic system for a specified Truth Table.	
	10. Half Adder, Full Adder and 4-bit binary Adder.	
	11. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.	
	12. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.	
	13. To build JK Master-slave flip-flop using Flip-Flop	
	14. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.	
	15. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.	

Course Name: Nanomaterials and Applications

Course Code: BSCPPHSDSE602

Course	Course Content	Course Outcome
Nanomaterials and Applications	1. Nanoscale Systems	Students will CO1: Understand the basic idea of nano-scale physics.
	2. Synthesis Of Nanostructure Materials	CO2: learn the techniques of synthesis.
	3. Characterization	CO3: learn the techniques of characterization.
	4. Optical Properties	CO4: Understand the basic idea of optical properties of nanoscale materials.
	5. Electron transport	CO5: have basic idea of electron transport within nanoscale materials.
	6. Applications	CO6: learn about the applications of nanomaterials.
Practical	1. Synthesis of metal nanoparticles by chemical route.	CO1: Students will develop skill to study various synthesized technique for fabrication of nano materials.
	2. Synthesis of semiconductor nanoparticles.	
	3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.	
	4. XRD pattern of nanomaterials and estimation of particle size.	
	5. To study the effect of size on color of nanomaterials.	
	6. To prepare composite of CNTs with other materials.	
	7. Growth of quantum dots by thermal evaporation.	
	8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.	
	9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.	
	10. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.	
	11. Fabricate a p-n diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.	

Course Name: Computational Physics

Course Code: BSCPPHSSEC601

<table>
<tr><th>Course</th><th>Course Content</th><th>Course Outcome</th></tr>
<tr><td rowspan="7">Computational Physics</td><td>1. Introduction</td><td rowspan="7">Students will
CO1: learn importance of computers in Physics.
CO2: understand Algorithm and concept of flow chart.
CO3: learn about development of FORTRAN, Basic elements of FORTRAN and Layout of Fortran Program,format of writing Program and concept of coding, Initialization and Replacement Logic.
CO4: learn the basic idea of LaTeX and preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments.</td></tr>
<tr><td>2. Algorithms and Flowcharts</td></tr>
<tr><td>3. Scientific Programming</td></tr>
<tr><td>4. Control Statements</td></tr>
<tr><td>5. Programming</td></tr>
<tr><td>6. Scientific word processing: Introduction to LaTeX</td></tr>
<tr><td>7. Visualization</td></tr>
<tr><td rowspan="13">Hands on exercises</td><td colspan="2">1. To compile a frequency distribution and evaluate mean, standard deviation etc.</td><td rowspan="13">CO1: Use computer programming language FORTRAN for solving the problems in physics through programming.
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CO2: Visualize numerical data using Gnuplot software.</td></tr>
<tr><td colspan="2">2. To evaluate sum of finite series and the area under a curve.</td></tr>
<tr><td colspan="2">3. To find the product of two matrices</td></tr>
<tr><td colspan="2">4. To find a set of prime numbers and Fibonacci series.</td></tr>
<tr><td colspan="2">5. To write program to open a file and generate data for plotting using Gnuplot.</td></tr>
<tr><td colspan="2">6. Plotting trajectory of a projectile projected horizontally.</td></tr>
<tr><td colspan="2">7. Plotting trajectory of a projectile projected making an angle with the horizontally.</td></tr>
<tr><td colspan="2">screen. Saving it as an eps file and as a pdf file.</td></tr>
<tr><td colspan="2">9. To find the roots of a quadratic equation.</td></tr>
<tr><td colspan="2">10. Motion of a projectile using simulation and plot the output for visualization.</td></tr>
<tr><td colspan="2">11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs</td></tr>
<tr><td colspan="2">12. Motion of particle in a central force field and plot the output for visualization.</td></tr>
</table>