Program Outcomes (PO) relating to B.Sc Courses in Physics

1. Program Outcomes in B.Sc General, B.Sc (PCM), B.Sc (PEM), B.Sc (PMC)

The student graduating with the Degree B.Sc General, B.Sc (PCM), B.Sc (PEM), B.Sc (PMC) should be able to

 Acquire
(i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics like Astrophysics, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, Space science, and its linkages with related disciplinary areas / subjects like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology;
(ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;
(iii) skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.

 Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.

 Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.

 Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.

 Demonstrate relevant generic skills and global competencies such as (i) problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries; (ii) investigative skills, including skills of independent investigation of Physics-related issues and problems; (iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature; (iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translate them with popular language when needed; (v) ICT

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

 Demonstrate professional behavior such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii) the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.

2. Program Outcomes in B.Sc (Honours) Physics

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

 Acquire
(i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics like Astrophysics, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, Space science, and its linkages with related disciplinary areas/subjects like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology;
(ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;
(iii) skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.

 Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.

 Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.

 Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.

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

(ii) investigative skills, including skills of independent investigation of Physics-related issues and problems;
(iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;
(iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translate them with popular language when needed;
(v) ICT skills;
(vi) personal skills such as the ability to work both independently and in a group.

 Demonstrate professional behavior such as
(i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;
(ii) the ability to identify the potential ethical issues in work-related situations;
(iii) appreciation of intellectual property, environmental and sustainability issues; and
(iv) promoting safe learning and working environment.

Core Course for B.Sc (Hons.)

Sl. No.		CC-I	CC-II	CC-III	CC-IV	CC-V	CC-VI	CC-VII	CC-VIII	CC-IX	CC-X	CC-XI	CC-XII	CC-XIII	CC-XIV
1	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	Application of basic Physics concepts	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	Linkages with related disciplines	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	Procedural knowledge for professional subjects	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	Skills in related field of specialization	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	Ability to use in Physics problem	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	Skills in Mathematical modelling	X	X	X	X	X	_	_	X	_	_	X	X	X	X
8	Skills in performing analysis and interpretation of data	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	Develop investigative Skills	X	X	X	X	X	X	X	X	_	X	X	X	X	X
10	Skills in problem solving in Physics and related discipline	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11	Develop Technical Communication skills	X	X	X	X	_	_	X	X	X	X	X	X	X	X
12	Developing analytical skills and popular communication	X	X	X	X	_	_	_	_	X	_	_	X	X	X
13	Developing ICT skills X	X	X	X	X	X	X	X	X	_	X	X	X	X	X

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

Discipline Specific Electives (DSE) for B.Sc. (Hons.)

Sl. No.		DSE - I	DSE - II	DSE -III	DSE - IV	DSE - V	DSE - VI	DSE -VII	DSE -VIII	DSE -IX	DSE -X	DSE -XI	DSE -XII	DSE -XIII	DSE -XIV
1	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	Application of basic Physics concepts	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	Linkages with related disciplines	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	Procedural knowledge for professional subjects	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	Skills in related field of specialization	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	Ability to use in Physics problem	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	Skills in Mathematical modelling	_	_	_	X	X	X	X	_	_	X	_	_	_	X
8	Skills in performing analysis and interpretation of data	X	X	X	X	X	_	_	_	X	X	X	X	_	X
9	Develop investigative Skills	X	_	_	X	X	X	X	_	_	_	_	_	_	X
10	Skills in problem solving in Physics and related discipline	X	_	_	X	X	X	X	_	X	_	X	X	X	X
11	Develop Technical Communication skills	_	_	X	X	_	_	_	_	X	X	X	_	_	_
12	Developing analytical skills and popular communication	_	_	X	_	_	_	_	_	X	X	X	_	_	_
13	Developing ICT skills X	_	X	_	X	_	X	X	X	_	_	_	_	_	X
14	Demonstrate Professional behaviour with respect to attribute like objectivity, ethical values, self reading, etc	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Skill Enhancement Course (SEC) for B.Sc. (Hons.) and B.Sc. Regular

Sl. No.		SEC- I	SEC - II	SEC -III	SEC - IV	SEC - V	SEC - VI	SEC - VII	SEC - VIII	SEC - IX
1	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X
2	Application of basic Physics concepts	X	X	X	X	X	X	X	X	X

3	Linkages with related disciplines	X	X	X	X	X	X	X	X	X
4	Procedural knowledge for professional subjects	_	X	X	X	X	_	_	X	X
5	Skills in related field of specialization	_	_	_	X	_	_	_	X	X
6	Ability to use in Physics problem	_	X	X	_	_	X	X	X	_
7	Skills in Mathematical modelling	_	X	_	_	_	_	_	_	X
8	Skills in performing analysis and interpretation of data	X	X	X	X	X	X	X	X	X
9	Develop investigative Skills	X	_	_	_	_	_	_	X	_
10	Skills in problem solving in Physics and related discipline	_	X	_	X	_	_	_	_	_
11	Develop Technical Communication skills	_	X	X	X	X	X	X	X	X
12	Developing analytical skills and popular communication	_	X	X	_	X	X	X	X	X
13	Developing ICT skills X	_	X	_	_	_	_	_	_	_
14	Demonstrate Professional behaviour with respect to attribute like objectivity, ethical values, self reading, etc	X	X	X	X	X	X	X	X	X

Core Course & Generic Elective & Discipline Specific Electives for B.Sc Regular

Sl. No.		CC-I/ GEC - I	CC-II/ GEC - II	CC-III/ GEC -III	CC-IV/ GEC - IV	GEC - V	GEC - VI	GEC -VII	GEC - VIII	GEC - IX	GEC - X	GEC -XI	GEC/ DSEC - XII
1	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X	X	X	X
2	Application of basic Physics concepts	X	X	X	X	X	X	X	X	X	X	X	X
3	Linkages with related disciplines	X	X	X	X	X	X	X	X	X	X	X	X
4	Procedural knowledge for professional subjects	X	X	X	X	X	X	X	X	X	X	X	X
5	Skills in related field of specialization	X	X	X	X	X	X	X	X	X	X	X	X
6	Ability to use in Physics problem	X	X	X	X	X	X	X	X	X	X	X	_
7	Skills in Mathematical modelling	X	X	X	X	_	X	X	X	_	_	_	_
8	Skills in performing analysis and interpretation of data	X	X	X	X	X	X	X	X	X	_	X	_
9	Develop investigative Skills	X	X	X	X	X	_	X	X	X	_	_	_
10	Skills in problem solving in Physics and related discipline	X	X	X	X	X	X	X	X	X	_	X	_
11	Develop Technical Communication skills	X	X	X	X	X	X	X	X	X	_	X	_
12	Developing analytical skills and popular communication	X	X	X	X	_	X	X	X	X	X	X	X
13	Developing ICT skills X	X	X	X	X	X	_	X	X	_	X	_	X

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

Course Outcomes (CO)

A. B.Sc. (Hons.) Physics Courses

1. Core Courses (CC)	Course Outcome (CO)
CC-I: MATHEMATICAL PHYSICS-I (Credits: 06, Theory-04, Practicals-02)	□ Training in calculus will prepare the student to solve various mathematical problems. □ He / she shall develop an understanding of how to formulate a physics problem and solve given mathematical equation risen out of it.
CC-II: MECHANICS (Credits: 06, Theory-04, Practicals-02)	□ Learn basics of the kinematics and dynamics linear and rotational motion. □ Learn the concepts of elastic in constant of solids and viscosity of fluids. □ Develop skills to understand and solve the equations of Newtonian Gravity and central force problem. □ Acquire basic knowledge of oscillation. □ Learn about inertial and non-inertial systems and essentials of special theory of relativity.
CC-III: ELECTRCITY AND MAGNETISM (Credits: 06, Theory-04, Practicals-02)	□ This course will help in understanding basic concepts of electricity and magnetism and their applications. □ Basic course in electrostatics will equips the student with required prerequisites to understand electrodynamics phenomena.
CC-IV: WAVES AND OPTICS (Credits: 06, Theory-04, Practicals-02)	□ develop an understanding of various aspects of harmonic oscillations and waves specially (i) Superposition of collinear and perpendicular harmonic oscillations (ii) Various types of mechanical waves and their superposition. □ understand various optical phenomena, principles, workings and applications optical instruments.
CC-V: MATHEMATICAL PHYSICS-II (Credits: 06, Theory-04, Practicals-02)	□ Training in mathematical tools like calculus, integration, series solution approach, special function will prepare the student to solve ODE, PDE's which model physical phenomena. □ He / she shall develop an understanding of how to model a given physical phenomena such as pendulum motion, rocket motion, stretched string, etc., into set of ODE's, PDE's and solve them. □ These skills will help in understanding the behavior of the modeled system/s.
CC-VI:	□ This basic course in thermodynamics will enable the student to understand

THERMAL PHYSICS (Credits: 06, Theory-04, Practicals-02)	various thermo dynamical concepts, principles.
CC-VII: DIGITAL SYSTEMS AND APPLICATIONS (Credits: 06, Theory-04, Practicals-02)	□ Acquire skills to understanding the functioning and operation of CRO to measure physical quantities in electrical and electronic circuits. □ Learn the basics of IC and digital circuits, and difference between analog and digital circuits. Various logic GATES and their realization using diodes and transmitters. □ Learn fundamental of Boolean algebra and their role in constructing digital circuits. □ Learn about combinatorial and sequential systems by building block circuits to construct multivibrators and counters. □ Understand basics of microprocessor and assembly language programming with examples.
CC-VIII: MATHEMATICAL PHYSICS-III (Credits: 06, Theory-04, Practicals-02)	□ Knowledge of various mathematical tools like complex analysis, integral transform will equip the student with reference to solve a given ODE, PDE. □ These skills will help in understanding the behavior of the modeled system/s.
CC-IX: ELEMENTS OF MODERN PHYSICS (Credits: 06, Theory-04, Practicals-02)	□ Comprehend the failure of classical physics and need for quantum physics. □ Grasp the basic foundation of various experiments establishing the quantum physics by doing the experiments in laboratory and interpreting them. □ Formulate the basic theoretical problems in one, two and three dimensional physics and solve them. □ Learning to apply the basic skills developed in quantum physics to various problems in (i) Nuclear Physics (ii) Atomic Physics (iii)Laser Physics □ Learn to apply basic quantum physics to Ruby Laser, He-Ne Laser
CC-X: ANALOG SYSTEMS AND APPLICATIONS (Credits: 06, Theory-04, Practicals-02)	□ Learn basic concepts of semiconductor diodes and their applications to rectifiers. □ Learn about junction transistor and their applications. □ Learn about different types of amplifiers including operational amplifier (Op-Amp) and their applications. □ Learn about sinusoidal oscillators of various types and A/D conversion.
CC-XI: QUANTUM MECHANICS AND APPLICATIONS (Credits: 06, Theory-04, Practicals-02)	□ This course shall develop an understanding of how to model a given problem such as particle in a box, hydrogen atom, hydrogen atom in electric fields. □ Many electron atoms, L-S and J-J couplings. □ These skills will help in understanding the different Quantum Systems in atomic and nuclear physics.
CC-XII: SOLID STATE PHYSICS (Credits: 06, Theory-04, Practicals-02)	□ Learn basics of crystal structure and physics of lattice dynamics □ Learn the physics of different types of material like magnetic materials, dielectric materials, metals and their properties. □ Understand the physics of insulators, semiconductor and conductors with special emphasis on the elementary band theory of semiconductors. □ Comprehend the basic theory of superconductors. Type I and II superconductors, their properties and physical concept of BCS theory.
CC-XIII: ELECTROMAGNETIC THEORY	□ Comprehend the role of Maxwell's equation in unifying electricity and magnetism. □ Derive expression for (i) Energy density (ii) Momentum density (iii)

(Credits: 06, Theory-04, Practicals-02)	Angular momentum density of the electromagnetic field Learn the implications of Gauge invariance in EM theory in solving the wave equations and develop the skills to actually solve the wave equation in various media like (i) Vacuum (ii) Dielectric medium (iii) Conducting medium (iv) Dilute plasma Derive and understand associated with the properties, EM wave passing through the interface between two media like (i) Reflection (ii) Refraction (iii) Transmission (iv) EM waves Learn the basic physics associated with the polarization of electromagnetic waves by doing various experiments for: (i) Plane polarized light (ii) Circularly polarized light (iii) Circularly polarized light Learn the application of EM theory to (i) Wave guides of various types (ii) Optical fibers in theory and experiment
CC-XIV: STATISTICAL MECHANICS (Credits: 06, Theory-04, Practicals-02)	Learn the basic concepts and definition of physical quantities in classical statistics and classical distribution law. Learn the application of classical statistics to theory of radiation. Comprehend the failure of classical statistics and need for quantum statistics. Learn the application of quantum statistics to derive and understand 1. Bose Einstein statistics and its applications to radiation. 2. Ferm-Dirac statistic and its applications to quantum systems.

2. Discipline Specific Elective Course (DSE)	**Course Outcome (CO)**
DSE-I: EXPERIMENTAL TECHNIQUES (Credits: 06, Theory-04, Practicals-02)	Develop skills to analyse data, make approximation and perform error analysis using basic methods of statistics. Learn the working principle of transduces, their application and study of the efficiency. Develop understanding of analog and digital instruments and earn to use them in making physical measurements. Develop their understanding of signal, noise, and fluctuations in making physical measurements. Understanding of Impedances Bridges, Q meters as well as vacuum systems using various types of pumps and pressure gauges.
DSE-II: EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS (Credits: 06, Theory-04, Practicals-02)	Learn the architecture of embedded systems, their classification and application. Learn about the microprocessors and the organization of microprocessor based systems. Acquire knowledge of microcontrollers and their role in 1/0 port programming and their interface with peripherals. Learn about analog to digital and digital to analog convertors. Learn basics of Arduino and programming.
DSE-III: PHYSICS OF DEVICES AND COMMUNCICATION (Credits: 06, Theory-04,	Acquire knowledge and skills to understand the characteristics of the following devices and instruments and practical knowledge to use them by doing experiments in laboratory. (i) UJT (ii) BJT (iii) MOSFET (iv) CCD (v) Tunnel Diodes (vi) Various types of Power Supplies (vii) Various types of Filters (viii) Multivibrators

Practicals-02)	(ix) Oscillators
DSE-IV: ADVANCED MATHEMATICAL PHYSICS-I (Credits: 06, Theory-04, Practicals-02)	□ In this course, the students should the learn the skills of doing calculations with the linear vector space, matrices, their eigenvalues and eigenvectors, tensors, real and complex fields, linear and multilinear transformations in various physical situations, e.g., the Lorentz transformations etc. □ They also become efficient in doing calculations with the 'calculus of variation'. □ In the laboratory course, the students should acquire the skills of applying the the C++/ SCILAB/MATLAB/MATHEMATICA software in solving standard physical problems.
DSE-V: ADVANCED MATHEMATICAL PHYSICS-II (Credits: 06, Theory-04, Practicals-02)	□ learn variational principle and do simple application to calculate geodesics in one, two and three dimensions. □ Ability to derive Euler equations of motion and apply it to simple pendulum and harmonic oscillator. □ Learn basics of group theory □ Learn the basics of the theory of probability and ability to calculate probability in simple problems. □ Derive various probability distributions and their application to different types of physical problems. □ Learn the principle of least squares and apply it to some cases of analyzing physical experiments.
DSE-VI: CLASSICAL DYNAMICS (Credits: 06, Theory-05, Tutorials -01)	□ Learn to define generalised coordinates, generalised velocities, generalised force and write Lagrangian for mechanical system in terms of generalised coordinates. □ Learn to derive Euler-Lagrange equation of motion and solve them for simple mechanical systems. □ Learn to write Hamiltonian for mechanical systems and derive and solve Hamilton's equation of motion for simple mechanical systems. □ Formulate the problem of small amplitude oscillation and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems. □ Develop the basic concepts of special theory of relativity and its applications to dynamical systems of particles. □ Develop the methods of relativistic kinematics of one and two particle system and its application to two particle decay and scattering. □ Develop and understand the basic concepts of fluid dynamics and its applications to simple problems in liquid flow.
DSE-VII: APPLIED DYNAMICS (Credits: 06, Theory-04, Practicals-02)	□ Develop the concept of phase space to define and formulate the dynamical systems. □ Identify the dynamical systems in Biology, Chemistry, Economics and computing and visualizing trajectories using computer software. □ Learn computer software skills to do qualitative analysis of dynamical systems. □ Learn to generate computer simulation of trajectories in phase space for simple systems demonstrating chaotic systems. □ Learn to use fractal dimensions to describe self similar structures with help of examples. □ Learn to simulate onset of chaos in simple dynamical systems in various conditions.

	□ Formulate the basic equations of computational fluid dynamics using elementary theory of fluid dynamics. □ Learn to solve the basic equations to explain the basic properties of fluids like thermal conductivity, viscosity, mass diffusivity etc. □ Demonstrate some simple examples of fluid flow as described in the syllabi.
DSE-VIII: COMMUNICATION ELECTRONICS (Credits: 06, Theory-04, Practicals-02)	□ Learn the skills to understand the basic concepts of communication. □ Learn the techniques of different types of modulation of electromagnetic signals like (i) Amplitude Modulation (ii) Frequency Modulation (iii) Phase Modulation (iv) Analog Pulse Modulation (v) Digital Pulse Modulation □ Learn basics of satellite communication. □ Learn concepts and application of mobile telephony system.
DSE-IX: NUCLEAR & PARTICLE PHYSICS (Credits: 06, Theory-05, Tutorials-01)	□ Skills to describe and explain the properties of nuclei and derive them from various models of nuclear structure. □ To understand, explain and derive the various theoretical formulation of nuclear disintegration like α decay, β decay and γ decays. □ Develop basic understanding of nuclear reactions and decays with help of theoretical formulate and laboratory experiments. □ Skills to develop basic understanding of the interaction of various nuclear radiation with matter in low and high energy ……. □ Ability to understand, construct and operate simple detector systems for nuclear radiation and training to work with various types of nuclear accelerators. □ Develop basic knowledge of elementary particles as fundamental constituent of matter, their properties, conservation laws during their interactions with matter.
DSE-X: ASTRONOMY AND ASTROPHYSICS (Credits: 06, Theory-05, Tutorials-01)	□ Skills to learn and operate astronomical instruments to perform observations related to the positional astronomy measurement. □ Conceptualize skills to understand basic parameters for describing the properties of stars and making experimental measurements, their interpretation and role in understanding of astrophysical phenomenon. Study of solar and stellar spectra. □ Learn to describe solar parameters, solar atmosphere, origin of solar system, solar and extra-solar planets, planetary rings. □ Acquire basic knowledge of Milky Way and Galaxies, their properties and structure. □ Skills for understanding basics of large scale structures and expending universe.
DSE-XI: ATMOSPHERIC PHYSICS (Credits: 06, Theory-04, Practicals-02)	□ Develop skills to describe, understand and make measurements of various parameters to describe the physics of earth's atmosphere. □ Learn skills to formulate, solve the theoretical equations describing the atmospheric dynamics and develop software to simulate and demonstrate in laboratory the various atmospheric phenomenon like. i) Atmospheric oscillations of various types ii) Atmospheric waves of various types □ Learn the physics and equations for signal processing with help of (i) Radar (ii) Lidar and performing data analysis to understand atmospheric phenomenon. □ Learn to make various types of theoretical and experimental analyses to

	explore the atmospheric aerosols and the effect of solar and cosmic radiation on aerosols. Develop a theoretical and experimental understanding of the absorption and scattering of solar radiation with matter.
DSE-XII: **NANO MATERIALS AND APPLICATIONS** (Credits: 06, Theory-04, Practical-02)	Develop basic understanding of nanostructured materials. Learn the synthesis and characterization of nanostructured materials. Understanding the optical properties of nanostructured materials and electron transport phenomenon. Lean to understand the functioning of various analytical techniques using (i) X-ray Diffraction (ii) Atomic Force Microscopy (iii) Scanning Electron Microscopy (iv) Scanning Tunneling Microscopy (v) Transmission Electron Microscopy Application of nanoparticles in various fields like: (i) LED (ii) Solar Cells (iii) Single Electron Transform Devices (iv) Magnetic Data Storage (v) Micro-electrochemical Systems (MEMS) (vi) Nano- electrochemical Systems (NEMS)
DSE-XIII: **PHYSICS OF EARTH** (Credits: 06, Theory -05, Tutorial -01)	Knowledge of the place of Earth in this Universe and its formation, structure and its evolution shall enable the student to appreciate the reasons for keeping Earth 'SAFE'
DSE-XIV: **DIGITAL SIGNAL PROCESSING** (Credits: 06, Theory-04, Practicals-02)	Acquire basic understanding of Discrete-Time signals and systems. Learn the techniques of various types of fourier transforms e.g. in signal processing, i.e., (i) Discrete-Time Fourier Transforms (ii) Discrete Fourier Transforms (iii) Fast Fourier Transforms Learn various aspects of digital filters like (i) Various types of Digital Filters (ii) Realization of Digital Filters (iii) Finite Impulse Response Digital Filters (iv) Infinite Impulse Response Digital Filters
DSE-XV: **MEDICAL PHYSICS** (Credits: 06, Theory-04, Practicals-02)	learn Essential physics of Medical Imaging, Radiological Physics, Therapeutic Systems and Radiation Therapy is acquired.
DSE-XVI: **BIOLOGICAL PHYSICS** (Credits: 06, Theory-05, Tutorials-01)	learn basic concepts about biological physics and evolution

3. Skill-based Elective Courses (SEC)	**Course Outcome (CO)**
SEC-I: **PHYSICS WORKSHOP SKILLS** (Credits: 02)	Learn to use mechanical tools to make simple measurement of length, height, time, area and volume. Obtain hand on experience of workshop practice by doing casting, foundry, machining, welding and learn to use various machine tool like lathe shaper, milling and drilling machines etc. and working with wooden and metal blocks. Learn to use various instruments for making electrical and electronics

	measurements using multimeter, oscilloscopes, power supply, electronic switches and relays.
SEC-II: COMPUTATIONAL PHYSICS (Credits: 02)	□ The students should learn the skills for writing a flow chart and then writing the corresponding program for a specific problem using the C/ C++/FORTRAN language. □ The student should also acquire the proficiency in effectively using the GUI Windows, the LINUX operating system and also in using the LaTeX software for wring a text file.
SEC-III: ELECTRICAL CIRCUITS AND NETWORK SKILLS (Credits: 02)	□ Skills to understand various types of DC and AC circuits and making electrical drawings with symbols for various systems. □ Skills to understand and operate generators, transformers and electric motors. □ Develop knowledge of solid state devices and their uses. □ Skills to do electrical wiring with assured electrical protection devices.
SEC-IV: BASIC INSTRUMENTATION SKILLS (Credits: 02)	□ Develop skills to use basic electrical instruments like multimeter, electronic voltmeter, cathode ray, and oscilloscope. □ Acquire efficiency in making signal generators and analysis of obtained signals. □ Learn to understand and use various types of digital instruments. □ Develop knowledge of making measurements with Impedance Bridges and Q meters.
SEC-V: RENEWABLE ENERGY AND ENERGY HARVESTING (Credits: 02)	□ In this course student will study non –conventional energy sources and their practical applications.
SEC-VI: TECHNICAL DRAWINGS (Credits: 02)	□ This course learning will enable the student to be proficient in Basic understanding of how to read technical maps/draws. stereographic, 2D, 3D projections shall be acquired
SEC-VII: RADIATION SAFETY (Credits: 02)	□ General concepts of nuclei, nuclear forces and atomic physics are studied. □ Basic knowledge about nuclear radiation types and radiation detectors.
SEC-VIII: APPLIED OPTICS(Credits: 02)	□ This course will help in understanding about the lasers and detectors, Holography, Optical fibre and their applications.
SEC-IX: WEATHER FORECASTING (Credits: 02)	□ Learn the physical parameters to describe the basic structure of atmosphere and make their measurements. □ Understand the weather system and learn to measure the parameter describing the weather and its changes. □ Learn basic ideas about climate and physical factors affecting climate change. □ Learn basic physics of weather forecasting

4. Generic Elective Courses (GEC) for Minor Physics Course in the B.Sc.(Hons.) for other mains and Core Courses (CC)

and

Discipline Specific Elective Courses (DSEC) for B.Sc. (General) Courses with PCM, PMC and PEM combinations

Generic Elective Courses (GEC) and Core Courses (CC) and Discipline Specific Elective Courses (DSEC)	**Course Outcome (CO)**
CC-I &GEC-I: MECHANICS (Credits: 06, Theory-04, Practicals-02)	□ Learn basic mathematics like vectors and ordinary different equation and to understand linear and rotational motion. □ Learn basics of Newtonian gravitation theory and central force problem. □ Learn basic ideas about mechanical oscillators. □ Learn elasticity and elastic constants of material and perform experiments to study them. □ Acquire basic knowledge of special theory of relativity.
CC-II &GEC-II: ELECTRICITY AND MAGNETISM (Credits: 06, Theory-04, Practicals-02)	□ This course will help in understanding basic concepts of electricity and magnetism and their applications. □ Basic course in electrostatics will equips the student with required prerequisites to understand electrodynamics phenomena.
CC-III& GEC-III: THERMAL PHYSICS AND STATISTICAL MECHANICS (Credits: 06, Theory-04, Practicals-02)	□ In this course the students should skilled in doing calculations in thermodynamics and in statistical mechanics. □ They should also be proficient in doing calculations with the kinetic theory of ideal and real gases. □ In the laboratory course, the students should acquire the skills of doing basic experiments in thermal physics with the right theoretical explanations of results there from.
CC-IV & GEC-IV: WAVES AND OPTICS (Credits: 06, Theory-04, Practicals-02)	□ This course in basics of optics will enable the student to understand various optical phenomena, principles, workings and applications optical instruments □ He / she shall develop an understanding of Waves Motion and its properties.
GEC-V & DSEC-I: DIGITAL, ANALOG AND INSTRUMENTATION (Credits: 06, Theory-04, Practicals-02)	□ Understand the digital and analyse circuits and difference between them. Various logic GATES and their realization using diodes and transistors. □ Conceptualization of Bolear Algebra and its use in constructing logic circuits by various methods and their applications. □ Learn the physics of semiconductor devices. Different types of semiconductors, their use in making transistors and amplifiers and study

	their characteristics. Learn different types of operational amplifiers and oscillators and use them in laboratory experiments to explain their functioning. Learn to understand and use various instruments like: (i) CRO (ii) Power Supply (iii) Half wave and full wave rectifiers (iv) Zener diodes and their applications (v) Multivibrators
GEC-VI & DSEC-II: ELEMENTS OF MODERN PHYSICS (Credits: 06, Theory-04, Practicals-02)	Comprehend the failure of classical physics and need for quantum physics. Grasp the basic foundation of various experiments establishing the quantum physics by doing the experiments in laboratory and interpreting them. Formulate the basic theoretical problems in one, two and three dimensional physics and solve them. Learning to apply the basic skills developed in quantum physics to various problems in (i) Nuclear Physics (ii) Atomic Physics
GEC-VII & DSEC-III: MATHEMATICAL PHYSICS (Credits: 06, Theory-04, Practicals-02)	In this course, the students should acquire proficiency in doing calculations with vectors, beta, gamma and error functions, partial differential equations in rectangular, spherical and cylindrical coordinators, Fourier analysis of periodic functions, special functions, polynomials and their differential equations. Ability to learn mathematic of complex variables and solve simple problems with relative functions, complex integrals and their applications to physical problems. The students should also acquire the skills in writing programs in the C,C++ languages and doing calculations of physical interests with these languages. The students should also become proficient in computing integrations and in solving differential equations by various methods.
GEC-VIII & DSEC-IV: SOLID STATE PHYSICS (Credits: 06, Theory-04, Practicals-02)	Learn basics of crystal structure and physics of lattice dynamics Learn the physics of different types of material like magnetic materials, dielectric materials, metals and their properties. Understand the physics of insulators, semiconductor and conductors with special emphasis on the elementary band theory of semiconductors. Comprehend the basic theory of superconductors. Type I and II superconductors, their properties and physical concept of BCS theory.
GEC-IX & DSEC-V: QUANTUM MECHANICS AND APPLICATIONS (Credits: 06, Theory-04, Practicals-02)	This course shall develop an understanding of how to model a given problem such as hydrogen, particle in a box etc. atom etc using wave function, operators and solve them. These skills will help in understanding the different Quantum Systems.
GEC-X & DSEC-VI: EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS (Credits: 06, Theory-04, Practicals-02)	Learn the architecture of embedded systems, their classification and application. Learn about the microprocessors and the organization of microprocessor based systems. Acquire knowledge of microcontrollers and their role in 1/0 port programming and their interface with peripherals. Learn about analog to digital and digital to analog convertors. Learn basics of Arduino and programming.
GEC-XI & DSEC-VII:	Skills to describe and explain the properties of nuclei and derive them

NUCLEAR & PARTICLE PHYSICS (Credits: 06, Theory-05, Tutorials-01)	from various models of nuclear structure. To understand, explain and derive the various theoretical formulation of nuclear disintegration like α decay, β decay and γ decays. Develop basic understanding of nuclear reactions and decays with help of theoretical formulate and laboratory experiments. Skills to develop basic understanding of the interaction of various nuclear radiation with matter in low and high energy Ability to understand, construct and operate simple detector systems for nuclear radiation and training to work with various types of nuclear accelerators. Develop basic knowledge of elementary particles as fundamental constituent of matter, their properties, conservation laws during their interactions with matter.
DSEC-VIII: MEDICAL PHYSICS (Credits: 06, Theory-04, Practicals-02)	Essential physics of Medical Imaging, Radiological Physics, Therapeutic Systems and Radiation Therapy is acquired.