UG Physics PO, PSO & CO

B.Sc. Physics	
Program Outcome	• To gain knowledge of physics by understanding basic concepts, fundamental principles and the scientific theories related to various physics phenomena and their relevance in the day-to-day life. • To improve the student's academic abilities, individual qualities and communicating skills this will give them an opportunity to develop requirement needed for a career. • Learning of experimental skills to understand the laws and concepts of Physics. • To obtain analytical and computational problem solving skills and to apply the theories learnt and the skills acquired to solve real time problems leading to research and development. • To apply in various fields' viz. science, engineering, teaching, public service, etc. with scientific knowledge, precision, analytical mind, innovative thinking, clarity of thought and expression and systematic approach • Preparing them to serve rapidly changing global community. • To provide the students with creative and analytical ability that will equip them to become job-ready.
Program Specific outcome	After Successful completion of B.Sc. Physics Course student will be able to • To be familiarized with the various topics of Physics, Demonstrate skills and competencies to conduct wide range of scientific experiments. • To know the facts of nature and the ability to link the facts to observe and to discover the laws of nature i.e. develop an understanding and knowledge of the basic Physics. • Enhance critical thinking and efficient problem solving skills in all the basic areas of the subject.

	• Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics • inspire students to pursue PG courses in reputed institutes, Identify their area of interest in academic and Research & Development, • Identify the specific job that they can pursue with the skills developed through the course of physics, • Illustrate Professional behaviour with respect to attribute like objectivity, ethical values, self reading, etc..

Physics Course outcome

First Semester : Physics 1 (Paper 101)
MECHANICS – 1 , HEAT AND THERMODYNAMICS – 1

Course objectives	The goal of this course is to introduce the students to concepts of mechanics, heat and thermodynamics as a fundamental requisite towards the basic understanding of the subject both in terms of mechanics and heat concepts. This course attempts to enlighten the student towards a better understanding of mechanics and thermodynamics.
Course outcome	• Understand the fundamental laws of motion and their application to various dynamical situations, enabling a better understanding of the subject. • Importance of Gravitation and its application in satellite motion in the form of Kepler's law of Planetary motion. • Students will understand the concept of conservation of energy, momentum, angular momentum and apply them to basic problems that also involves day-to- day situations. • Understand the phenomena of collisions and idea about centre of mass of a system of particles • Learn about the measurement of surface temperature of sun and other bodies based on concept of black body radiation spectrum which is a precursor to the study of astrophysics that they learn later in higher classes. • Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law of equipartition of energies, mean free path of molecular collisions, viscosity and thermal conductivity,

	• Learn about the state of a gaseous system, in terms of real gas equations, Equations of state and the concept of isotherms • Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems.
Learning outcome	• The students will get an idea about the knowledge of the fundamental of mechanics, leading to the concept of Newtonian mechanics. • The students will get the picture of motion of celestial bodies like planets and thereby the method of comparison of the natural planetary motion required to launch artificial satellites. • Students will get to know the difference between the ideal and real gases and their practical implications. • Study of thermodynamics gives the knowledge of basic working of heat engines and on what factors the efficiency of practical heat engines depends which has great practical applications in the field of Engineering.
First Semester : Physics 1 (Paper 102) **PRACTICAL PHYSICS – 1**	
Course objective	The course focusing on the skills of performing experiments in mechanics and heat & thermodynamics
Course outcome	• In the laboratory course, the students learn to do data analysis techniques like error analysis and graph techniques • To perform experiments in mechanics like determination of work done by a variable force, Moment of Inertia of Flywheel, conservation of energy, concept of static, kinetic and rolling friction etc.. • Determination of physical constants like coefficient of viscosity, interfacial tension and specific heat capacity. • To perform basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity,
Learning outcome	• Students will learn about the methodology of measurements and the errors involved in it. • Learn how experiments in mechanics, heat and thermodynamics lead to measurement of physical constants and their importance. • Preparation and performance of a wide range of experiments pertaining to their theoretical syllabi. • Presentation of experimental data in different approximate forms like tabulation of results and graph plots. • Analysis, Interpretation and Summary of the observed experimental results. • Communicate clearly the understanding of the various experimental principles and procedures.

	• The fundamental idea of Practical Physics at this level is to incorporate those experiments that are in relation to their elucidation in theory and hence the student gets a better idea of the Physics part involved both in terms of theory and practicals.

Second Semester : Physics II (Paper 201) MECHANICS – 2 , HEAT AND THERMODYNAMICS – 2	
Course objective	This course is an extension of first semester course of mechanics and heat & thermodynamics. This course will give an insight view into the understanding of oscillatory motion and applications to simple and compound pendulums leading to the understanding of Simple Harmonic Motion. The concept of elasticity is introduced leading to applications in civil engineering. In continuation of thermodynamics introduced in previous semester, energy relations are studied with the introduction of Free energy concepts. Phase transitions of first order is introduced to understand the process of change of state with heat. Under condensed matter physics, low temperature physics and liquefaction of gases and their applications are Studied.
Course outcome	• To understand the damping of oscillations, forced oscillations and their effects with the help of basics of simple harmonic motion • To understand the principles of Elasticity through the various modulii of Elasticity pertaining to objects of different dimensions. • To learn the concepts of first order phase transitions and equilibrium between phases with an emphasis on the understanding of Triple point of Water system. • To study different methods of achieving low temperatures leading to liquefaction of gases • To write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions as applicable to various rigid bodies of different shapes and sizes. • To describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in a merry-go-round experiences an outward pull? • Introduction to the new idea of Frames of Reference and the importance of Rest frame and moving frame. • To understand special relativistic effects and their effects on the mass and energy of a moving object and to appreciate the importance of Special Theory of Relativity, its significance in a new order Physics. • To identify and to use Standard wave equation to derive certain equations for oscillatory system

Learning outcome	• Students will get to know about the effects of undamped and damped oscillations as a precursor to their understanding of electromagnetism in higher classes. • Students will understand the phenomena of elasticity in the context of materials which undergo extension or bending, the difference between elastic and plastic bodies. • Study of phase transitions and low temperature physics provides a insight into effects of absorption of heat or removal of heat from a substance. • The students are exposed to the basics of relative motion in the context of inertial and non inertial frames.
Second Semester : Physics II (Paper 202) PRACTICAL PHYSICS – II	
Course objective	Diverse topics like oscillations, elasticity and phase transitions are introduced enabling the students to have an insight towards understanding the basics of these concepts.
Course outcome	• To perform experiments related to oscillatory motion (compound pendulum, Rigid pendulum and torsional pendulum)and to determine related physical parameters • To conduct experiments on rotational dynamics (Flywheel), To study elastic properties and measure elastic constants (Young Modulus by stretching and Modulus of Rigidity by dynamic method, Searle's double bar) enabling the students to understand the concept of Moment of Inertia and Rigid Dynamics. • Concept of Phase Transitions with variation of Boiling Points with pressure using Clausius Clapeyron equation.
Learning outcome	Students will be in a position to perform and understand the experimental outcome of oscillations and elastic properties of materials
Third Semester : Physics III (Paper 301) ELECTRICITY and MAGNETISM	
Course objectives	The course introduces the concepts of transient currents and AC circuits The analysis of circuits using different network theorems is introduced in the form of Thevenin and Norton's theorems. The concepts of magnetic fields and their effects are discussed leading to few applications. The electromagnetic wave concepts are dealt in detail with due emphasis on Maxwell's equations that form the basis of Electromagnetism.
Course outcome	The importance of various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electrical circuit analysis that form the basis of Electrical Engineering.

	• To learn and analyse dc and ac circuits containing passive elements like capacitors, inductors and resistors. • To study magnetic fields and their effects on moving charges and current carrying conductors. Applications of magnetic field and their effects in the working of BG and HTG are introduced. • To study Gauss law, Ampere law, Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields and propagation of electromagnetic waves in both homogeneous and heterogeneous media. • To apply Kirchhoff's rules to analyse AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor. • To study the concepts of thermoelectricity and to drawthermoelectric power diagrams, materials that form thermoelectric junctions and their analysis.
Learning outcome	Students learn to analyse dc and ac circuits using network theorems and their importance. By studying concepts of magnetic fields and its effects, students understand the working of magnetic instruments and their use under various conditions. Learning the concept of electromagnetism, students get exposure to the principles of propagation of electromagnetic waves in different media and vacuum and also that the light is a electromagnetic wave thereby the method of calculation of the velocity of light in free space or vacuum. By learning about the principles of thermoelectricity, students learn about the measurement of temperature over a wide range by a device called thermo electric thermometer.
Third Semester : Physics III (Paper 302) **PRACTICAL PHYSICS – III**	
Course objective	Students will develop the skill of building simple dc and ac circuits and analyse network theorems. Students calculate the values of inductance, capacitance and resistance by constructing different bridges and by principle of resonance, in terms of Series and Parallel Resonance Circuits.
Course outcome	To verify network theorems like Thevenin's theorem, superposition theorem and maximum power transfer theorems enabling them to understand the concept of network analysis.

	To determine the values of inductance in LCR series/parallel circuits using electrical resonance methods. To verify series and parallel combinations of capacitors using De-Sauty's bridge and to find inductance using Anderson's bridge learning the difference between the two bridges used.
Learning outcome	In the laboratory course the students will get an opportunity to verify various network theorems leading to circuit analysis. Students will be able to learn about the behaviour and response of passive elements to AC and DC Using laws in electricity and magnetism, students learn about the construction, working of various measuring instruments thereby enabling them to distinguish between AC and DC circuits.
Fourth Semester : Physics IV (Paper 401) **OPTICS and FOURIER SERIES**	
Course objectives	This course in fundamentals of optics will enable the students to understand various optical phenomena like refraction, diffraction, polarization and interference principles, workings and applications of optical instruments that involve these principles. Students also learn about the principle and working of laser devices along with different types of lasers. As a mathematical tool, Fourier analysis is introduced to analyse different types of waves with an emphasis of the Physics aspect of Fourier analysis.
Course outcome	• To learn basic principles and theories about the Huygens' wave nature of light and its application to reflection and refraction of light thereby highlighting the wave aspect of light. • To study the principles of wave motion and superposition and explain physics of interference, diffraction and polarisation of light as different forms of the wave nature of light. • To understand the working of selected optical instruments like bi-prism, diffraction grating, and polarimeter that are also in use in practical experiments that the students perform. • To learn the principle of action of LASER and understand the working of some laser devices, notably Ruby laser and semi-conductor laser. • To study Fourier analysis and Fourier transform and analyse different waves like sine wave, square wave and sawtooth waves and their applications to various physical phenomenon. • To study the principle and working of optical fibres and to learn about multimode optical fibres that are an essential part of modern-day communication systems.
Learning outcome	The course of optics will enable the students to understand various optical phenomena, principles, workings and applications of optical instruments.

	The students will also get exposed to one of the powerful tool called Laser device and their applications Students learn about one of the best communication mechanism called optical fibre which is a modern day essential technology.
Fourth Semester : Physics IV (Paper 402) **PRACTICAL PHYSICS – IV**	
Course objective	In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light, refractive index etc..
Course outcome	• To measure wavelength of light using principle of diffraction of laser light and to measure refractive index of water using the principle of refraction by a lens that are simple to perform. • To study the phenomenon of interference by the formation of Newton's rings and interference by air wedge thereby measuring the thickness of very minute objects like that of thickness of a hair strand. • To determine resolving power of an optical instrument and to verify Brewster's law giving an idea about a fine resolution aspect for construction of sophisticated optical instruments that require high resolution. • To determine focal length of combination of lenses and thereby to calculate the refractive index of glass.
Learning outcome	• Students get first hand exposure in handling of optical instruments and study different optical phenomena like interference, diffraction and polarization. • Students get to measure many physical values like wavelength of light, refractive index of a medium, wavelengths of different colours in white light etc..
Fifth Semester : Physics V (Paper 501) **STATISTICAL PHYSICS, QUANTUM MECHANICS – I, ATMOSPHERIC PHYSICS AND NANOMATERIALS**	
Course objective	The course will expose the students to behaviour of microscopic particles using statistical mechanics. Students will get to know about limitations in classical mechanics and introduces quantum mechanics that is an essential part of the sub-atomic world. The students will study the dynamics of atmosphere and their effects in terms of the various layers in the atmosphere and the significance of these layers with respect to our Earth system. Study of nano-materials exposes the students to behaviour of materials at nano scale along with examples of the classification of various types of nanomaterials , leading to a large number of applications in nano-science.
Course outcome	The students are introduced to Statistical Physics only at this stage as a subject.

	• To understand the concepts of microstate, macrostate, thermodynamic probability and the need for understanding the behavior of systems on a macroscopic scale only in terms of statistical distribution and not on an individual basis. • To study microscopic particles with their distinguishable or indistinguishable nature and conditions that lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation specific to the different systems under consideration. • To study the failures of classical mechanics and the need for quantum mechanical approach to explain some of the properties like photoelectric effect, Compton effect etc. as an example of particle nature of light. • To learn about the dual nature of matter basically wave nature of material particles through Thomson's and Davisson-Germer experiments as an experimental proof and to understand Heisenberg uncertainty principle and their applications in the form of Gamma-Ray Microscope. • To get good knowledge of Earth's atmosphere, its composition, effective temperature, Hydrostatic equation, atmospheric thermodynamics and atmospheric dynamics with the different forces involved • To study Nano systems and its implications in modifying the properties of materials at the nano-scale leading to different applications. • To learn different synthesis techniques including top down and bottom up approaches and study the properties and applications of nano-materials
Learning outcome	• Students learn the basic concepts and definition of physical quantities in classical physics and comprehend the failure of classical physics at the microscopic level and hence the need for quantum physics • Students learn the need for quantum mechanical approach to explain some properties of matter, notably the concept of photon and the importance of Planck's equation. • By learning atmospheric dynamics students gain knowledge of seasonal changes, trade winds, etc.. • Students develop basic understanding of nanostructure materials. • Able to understand the principle and characteristics of Zener diode, Photo diodes, Solar cells and LED.

Fifth Semester : Physics V (Paper 502) PRACTICAL PHYSICS – V	
Course objective	• The laboratory experiments involve study of statistical behaviour of particles. Students study the quantum mechanical phenomena of few properties of matter and determination of physical constants and learn to experimentally determine Planck's constant. Students are exposed to few electronic experiments that involve fundamentals of electronics.
Course outcome	• To learn the statistical distribution of different physical properties Monte Carlo experiment and other methods. • To analyse X-ray photograph of a crystalline material and determine the type of the crystal system. • To determine physical constants like Planck's constant using photocell • To describe, understand and make measurements of various parameters to describe the physics of earth's atmosphere • To construct electronic circuits like C-E amplifier, AF/RF oscillator, regulated power supply etc..
Learning outcome	• Students will learn the statistical analysis of microscopic particles and their properties with some simple representative experiments like Monte-Carlo experiment. • Students get exposure to constructions of basic circuits to study the phenomenon of amplification, oscillation etc.
Fifth Semester : Physics VI (Paper 503) **ASTROPHYSICS, SOLID STATE PHYSICS AND SEMICONDUCTOR PHYSICS**	
Course objective	• Students get basic knowledge about the celestial objects and their properties. Study of solid state physics which gives insight into the structure of solids (crystalline), properties of metals and semiconductors.

Course outcome	• To understand basic parameters of stars like brightness, radiant flux, luminosity, magnitude, spectral classification. Hertzsprung-Russel diagram. • To understand the evolution of stars: Stages of star formation and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars. • A brief idea about crystal systems-Bravais lattice and Miller indices Bragg's law. • To study classical and quantum mechanical analysis of free electron theory of metals. Thermal conductivity,Wiedmann-Franz law. To study Hall effect in metals. • To comprehend the basic theory of superconductors, their classification, their properties and concept of BCS theory. • To understand the band theory of solids and study semiconductors and their properties. • Expected to gain knowledge of superconductivity, experimental facts, zero resistivity, critical field, the critical current density, Meissner effect, its underlying principles and its applications to the modern world. • To study active elements like diodes and transistors and their properties with emphasis on diode as a regulator and transistor as an amplifier.
Learning outcome	• Students conceptualize skills to understand basic parameters for describing the properties of stars and stellar spectra. • The study of crystal structure and free electron theory of metals leads to understanding of properties of solid state materials • Students gain insight into understanding of physics of insulators, semiconductor and conductors with special emphasis on semiconductors. • Understand the formation of P-N junction, depletion region, Biased P-N junction, variation of width of the depletion region, drift and diffusion current, expression for diode current
Fifth Semester : Physics VI (Paper 504) **PRACTICAL PHYSICS – VI**	
Course objectives	• Using the experimental data available, students learn to analyse the date to determine properties of stars. Students get first hand experience in the experimental measurement of physical parameters of metals and semiconductors

Course outcome	• To determine the parameters of stars like luminosity, radius, mass etc.. using the experimental data. Sunspot photographs are used to determine sideral period of sun • Using parallax method distance of objects can be measured which can be reciprocate for star distance measurements. • To learn experimental skills to find Lorentz number and Fermi energy of a metal, Hall coefficient of a metal, Energy gap of a semiconductor etc… • To characterize various devices namely PN junction diodes, LEDs, Zener diode, solar cells, PNP and NPN transistors. Also to construct amplifiers and oscillators using discrete components.
Learning outcome	• Students learn to determine properties metals, semiconductors and semiconductor devices through experimentation and study their applications
Sixth Semester : Physics VII (Paper 601) **ATOMIC, MOLECULAR AND NUCLEAR PHYSICS**	
Course objective	• Students get to understand the structure of an atom/molecule with the help of different theories. Students are exposed to nuclear physics with emphasis on nuclear decay, nuclear reactions, detectors and particle accelerators
Course outcome	• To learn the effects of magnetic field on atomic spectra e.g Zeeman effect • To study molecular spectra and learn about the scattering of radiation by molecules • To calculate the decay rates and lifetime of radioactive decays like alpha, beta, gamma decay. Neutrinos and its properties and role in theory of beta decay. • To understand nuclear fission and fusion as well as nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars. Also to understand the working of particle accelerators • To gain knowledge on the basic aspects of particle Physics the fundamental interactions, elementary and composite particles and the classifications of particles
Learning outcome	• Students are exposed to understanding of atoms, molecules and also nuclei leading to the study their effects and applications. • Students develop basic understanding of nuclear reactions and decays with help of theoretical formulations and laboratory experiments. • Students develop basic knowledge of elementary particles as fundamental constituent of matter, their properties, conservation laws during their interactions with matter.

Sixth Semester : Physics VII (Paper 602) PRACTICAL PHYSICS – VII	
Course objective	• The course provides the students the experimental skills in the determination of atomic and molecular parameters like charge of an electron and molecular bond length. Experiments based on IC provides students with first hand exposure to verification of different logic gates
Course outcome	• To study hydrogen spectrum which provides the calculation of wavelength of various spectral line • To determine atomic constants like e/m of an electron by Thomson method and e by Millikan method • To study the characteristics of GM counter and determine the half life of radioactive elements • To analyse the molecular spectra of few compounds • To verify and design various logic gates and to construct adder and subtractor circuits
Learning outcome	• Students are exposed to various experimental skills in using equipment related to measurement of atomic and molecular parameters and also the determination of these values. • Students get an opportunity to design and analyse digital circuits
Sixth Semester : Physics VIII (Paper 603) **ELECTRONICS, MAGNETIC MATERIALS, DIELECTRICS AND QUNTUM MECHANICS – II**	
Course objective	The course provides the study of electronic devices useful in technology. The basic understanding of magnetic materials and dielectric materials provides the exposure to students in understanding of behaviour of materials under the action of magnetic and electric fields respectively. Students study an extension of quantum mechanical concepts to few applications like hydrogen atom

Course outcome	• To study operational amplifiers and knowledge of feedback concepts to inverting and non-inverting amplifiers and oscillators • To study frequency response of filters and to study differentiator and integrator circuits • To study number systems, logic gates and construct adders and subtractor circuits • To gain knowledge of different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss • To study different types of dielectric polarisation and to learn about dielectric and ferroelectric properties of materials. • To understand the theory of quantum measurements, wave packets and uncertainty principle. • To understand the concepts of quantum mechanics: wave functions, momentum and energy operator, the Schrodinger equation etc.. • To solve problems like one dimensional box, harmonic oscillator and hydrogen atom.
Learning outcome	• Students learn about different types of operational amplifiers and their applications. • By studying number system and logic gates students get exposure to design and analyse digital circuits • Students learn the physics of different types of material like magnetic materials and dielectric materials leading to their practical applications • Students develop an understanding of how to model a given problem such as particle in a box, hydrogen atom, simple harmonic oscillator etc
Sixth Semester : Physics VIII (Paper 604) **PRACTICAL PHYSICS – VIII**	
Course objective	Students learn to analyse the op-amp circuits to construct filters, amplifiers and oscillator circuits. Students study the magnetic and dielectric properties by measuring respective physical constants
Course outcome	• To carry out experiments based on the theory that students have learnt, to measure dielectric constant, trace hysteresis loop, determine dipole moment, absorption coefficient of gamma rays etc.. • To construct filter circuits, inverting and non inverting circuits, and oscillators and to construct and study op-amp as a differentiator and integrator
Learning outcome	• The experiments on magnetism and dielectrics provides in depth understanding some of the physical constants that measure their properties • Students learn to design, construct and analyse operational amplifier circuits