DEPARTMENT OF PHYSICS

M.Sc. PROGRAMME IN PHYSICS

(CBCS)

COURSE OUTCOME

COURSE CODE	COURSE TITLE	OBJECTIVE	COURSE OUTCOME
PH-C-I	**Mathematical Physics**	1. Write a problem in higher level Physics in the language in Mathematics. 2. Identify a range of diverse mathematical techniques to formulate and solve a problem in higher level physics. 3. Analyze various mathematical concepts and methods. 4. Apply the knowledge and understanding of these mathematical techniques to gain insight into a number of branches of physics like Quantum Mechanics, Electromagnetic Theory, Condense Matter Physics, Atomic and Molecular Physics, Nuclear Physics, Particle and High Energy Physics, Physics of Gravity etc.	1. Equip students with required mathematical skills to succeed in Physics. 2. Develop the analyzing ability of the students to solve problems in Physics. 3. Enable the students to pursue a research career in Physics and will ultimately help to contribute new knowledge.
PH-C-II	**Quantum Mechanics**	1. Acquaint the learners with fundamental concepts of Quantum Mechanics. 2. Acquaint the learners with Dirac notation. 3. Enable the learners to solve simple quantum mechanical	1. Understand the basic concepts of quantum mechanics 2. Solve simple quantum mechanical problems 3. Understand quantum dynamics

		problems. 4. Introduce the concepts of symmetry and conservation laws 5. Introduce the techniques of angular momentum algebra	4. Write down eigen values and eigen states of angular momentum
PH-C-III	**General Lab I**	1. To develop practical knowledge by applying the experimental methods and to correlate with the Physics theory. 2. To learn the usage of electrical and optical systemsfor various measurements. 3. To apply the analytical techniques and graphical analysis to interpret the experimental data. 4. To learn error propagation and its role in making conclusions.	1. Learn to minimize contributing variables and recognize the limitations of equipment. 2. Describe the methodology of science and the relationship between observation and theory. 3. Participate in the methodology by performing laboratory exercises.
PH-C-IV	**Classical Mechanics**	1. Acquaint the learners with the subject of classical mechanics in the context of the language and methods of modern nonlinear dynamics. 2. Enable the learners to make a smooth transition from classical mechanics to quantum mechanics and nonlinear dynamics.	1. Understand the basic concepts of Lagrangian and Hamiltonian dynamics 2. Understand the basic concepts of modern nonlinear dynamics 3. Understand canonical and noncanonical flows 4. Make a smooth transition from classical to quantum mechanics
PH-C-V	**Condensed Matter Physics**	1. Familiarize with fundamentals of Condensed Matter Physics.	1. Equip a student with basic concepts of Condensed Matter Physics so that

		2. Know about different lattice structures, behaviour and importance of crystalline state, contribution of X-Ray Diffraction in Crystallography, importance of defects and imperfections in a crystal etc. 3. Understand the behaviour in solids that depend primarily on the motion of electrons inside the solid.	the knowledge can be applied for further development of the subject. 2. Enable a student to work in both theoretical and experimental aspects of Condensed Matter Physics. 3. Help the students in thorough learning of the concepts associated to the course through the numerical, quizzes, assignments, projects etc.
PH-C-VI	**General Lab II**	1. Understand the basic techniques of design and analysis of simple transistor and OPAMP circuit. 2. Apply the knowledge to design and study different electronic circuits.	1. Design electronic circuits using various electronic components. 2. Analyze the circuits and understand their behaviors.
PH-C-VII	**Electronics**	1. To disseminate working knowledge of electronic principle using semiconductor devices 2. To allow students to learn the fundamentals of both analog and digital electronic devices 3. To allow students to apply their knowledge for designing small electronic systems. 4. To introduce students to advanced digital systems like microprocessor and microcontroller 5. To imbibe the spirit of application	1. Critically analyze analog and digital electronic circuits 2. Design small electronic systems as per design specifications 3. Write assembly language programs for doing simple arithmetic operation in microprocessor and microcontroller. 4. Apply their knowledge for real life problems solving in electronic

		oriented learning	
PH-C-VIII	**Electrodynamics**	1. This course utilizes physical and mathematical principles to provide in-depth analysis of the behaviour of electricity and magnetism in matter. 2. To apprise the students regarding the concepts of electrodynamics and Maxwell equations and use them in various situations.	1. Describe the nature of electromagnetic wave and its propagation through different media and interfaces. 2. Explain charged particle dynamics and radiation from localized time varying electromagnetic sources. 3. Understand potential formulation and magnetism in relativistic case.
PH-C-IX	**Computational Methods**	1. Get hands on training in problem solving using FORTRAN language in LINUX operating system. 2. Learn various numerical methods to solve physical problems as well as programming of such methods.	1. Apply their knowledge on computer programming and numerical analysis in solving real physical problems. 2. Deal with scientific computing in different research areas of Physics.
PH-C-X	**Nuclear Physics**	1. Have a basic knowledge of the nuclear force and its properties 2. Be able to visualize the nature of interaction of nucleons inside deuteron nucleus as well as in general nucleon-nucleon scattering 3. Be acquire knowledge about different theoretical models regarding nucleus as well as to apply those in determining nuclear properties	1. Develop knowledge regarding nucleus, its properties, nuclear force, nuclear reactions and 22 mechanisms, nuclear detectors as well as elementary particles and the properties related to them 2. Successfully apply the same knowledge in solving problems in the field of nuclear and particle Physics.

		4. Grasp knowledge about nuclear reactions and their various mechanisms along with an wide understanding of the decay process 5. Understand the basic forces in nature and classification of particles and study in detail conservations laws and quark models in detail 6. Know about the basic working principles of various nuclear detectors	
PH-C-XI	**Statistical Mechanics**	(1) To introduce the advance concepts of Statistical Mechanics so that students will be equipped with a sufficient knowledge of the subject. (2) To develop the critically thinking ability of students to understand the diverse physical phenomena. (3) To develop the interest and ability among students to solved challenging physical problems by the application of techniques of Statistical Mechanics in future.	(1) The students will be equipped with a sufficient knowledge of the Statistical Mechanics and hence will be able to look critically for analyzing any physical phenomena. (2) May motivate students to solve any challenging physical problem in future. (3) Will draw interest to the subject to pursue further higher study in future and will ultimately help to contribute new knowledge.
PH-C-XII	**Atomic and Molecular Physics**	1. Learn the physics of the atoms and molecules 2. Become familiar with various branches of spectroscopy and their applications	1. Determine the atomic and molecular structures 2. Analyze and demonstrate a spectra to identify and quantify information about atoms and molecules

		3. Equip with basic spectroscopic techniques and instrumentation 4. Learn to use spectroscopic techniques to identify materials 5. Learn theoretical background of laser and its application in various disciplines	3. Demonstrate the interaction of electromagnetic spectra with matter and the associated type of spectroscopy 4. Identify elements present in a sample and in the universe using spectroscopic techniques 5. Apply knowledge of spectroscopy or laser spectroscopy in various disciplines of Physics, Chemistry, Atmospheric Science, Astronomy, Laser Communication, remote sensing etc
PH-DSE-IA	**Theory of Relativity**	1. Acquaint the learners with the special theory of relativity, space time continuum. 2. Introduce the basic concepts of tensor calculus 3. Introduce the learners to the general theory of relativity	1. Understand the ideas of space time continuum, four vectors. 2. Understand tensors as geometrical objects, understand coordinate free formulation of physical laws. 3. Understand the basic ideas of geometrical formulation of gravity. 4. Understand basic ideas of cosmology.
PH-DSE-IB	**Atmospheric Physics**	1. Introduce the physics and chemistry of the Earth's neutral atmosphere. 2. Give an in depth introduction to the atmospheric thermodynamics.	1. Acquainted with the different layers of the atmosphere and the related physical phenomena. 2. Develop simple models of the atmosphere.

		3. Introduce atmospheric aerosols and analyse its impact on the global climate.	3. Understand the optical and microphysical properties of aerosol. 4. Understand the atmospheric chemistry of trace gases.
PH-DSE-IIA	**Plasma Physics**	1. Understand collective nature of plasma dynamics. 2. Describe the motion of charged particles in varying electric and magnetic fields. 3. Derive fluid description of collective plasma motion. 4. Learn foundations of plasma waves and instabilities.	1. Define plasma and its fundamental parameters, distinguish the single particle approach, fluid approach and kinetic statistical approach to describe different plasma phenomena 2. Determine the velocities (drift velocities) of charged particles moving in electric and magnetic fields that are either uniform or vary slowly in space and time 3. Classify the electrostatic and electromagnetic waves that can propagate in magnetised and non-magnetised plasmas, and describe the physical mechanisms generating these waves 4. Define and determine the basic transport phenomena such as plasma resistivity, diffusion (classical and anomalous) and mobility as a function of collision frequency and of the fundamental parameters for both magnetised and non-magnetised plasmas

PH-DSE-IIB	**Advanced Quantum Mechanics**	1. Acquaint the learners with the approximation methods in Quantum Mechanics. 2. Introduce the quantum mechanical treatment of scattering 3. Introduce the learners to the relativistic quantum mechanics	1. Understand the idea of different approximation techniques in quantum mechanics 2. Understand the quantum mechanical approach to scattering 3. Understand the consequences of incorporating special theory of relativity in quantum mechanics.
PH-DSE-IIIA	**High Energy Physics I**	1. Express physical quantities in natural units. 2. Explain the physics of relativistic wave equations. 3. Use the formulation of quantum field theory in a number of fields. 4. Apply the concepts of quantum field theory to quantum electrodynamics.	1. After the completion of this course, it is expected that this course will 2. Enable a student to acquire the basics of quantum field theory and realize its importance. 3. Enable a student to apply the framework of field theory to quantum electrodynamics. 4. Prepare a student for advanced topics in field theory and particle physics. 5. Motivate a student to pursue a career in high energy physics.
PH-DSE-IIIB	**Condensed Matter Physics I**	1. Gather a broader knowledge of Electronic Properties of Solids. 2. Understand the chronology in the Development of the Electron theory in Metals. 3. Understand comparatively the	1. Equip a student with quantum mechanical tools for the solution of Condensed Matter Physics problems. 2. Enable a student to work in both theoretical and experimental aspects of Electronic Behavior of Solids.

		Polarization and Magnetization behavior in a solid.	3. Enable the students for further study and contribution towards the development of the subject.
PH-DSE-IIIC	**Communication Electronics**	1. Understand the basic techniques of electronic communication like modulation, multiplexing etc. 2. Apply the knowledge to understand the current generation communication technologies.	1. Identify the basic techniques of communication like modulation, multiplexing. 2. Analyze the modulations schemes and their applicability. 36 3. Analyze present generation systems related to microwave communication, cellular communications, satellite communication.
PH-DSE-IIID	**Advanced Mathematical Physics**	1. Write a complex problem in higher level Physics in the language in Mathematics. 2. Identify a range of diverse mathematical techniques to formulate and solve a complex problem in higher level Physics. 3. Analyze various mathematical concepts and methods required in higher level Physics. 4. Apply the knowledge and understanding of these mathematical techniques to gain insight into a number of advance branches of physics like Theoretical Physics, Particle and High Energy Physics, Physics of Gravity, Cosmology etc.	1. Equip students with required mathematical skills to succeed in Physics. 2. Develop the analyzing ability of the students to solve critical problems in Physics. 3. Enable the students to pursue a research career in Physics and will ultimately help to contribute new knowledge.

PH-DSE-IIIE	**Laser Spectroscopy I**	1. Familiarize with various branches of spectroscopy 2. Equip with the knowledge on spectroscopic techniques and instrumentation 3. Learn to use spectroscopic techniques to apply in wide range of areas 4. Learn theoretical background of laser, its importance as spectroscopic light source and different types	1. Understand and explain fundamental concepts in laser spectroscopy 2. Compare the function and properties of different types of lasers 3. Use laser spectroscopic instruments in practice in physics and allied disciplines 4. Demonstrate the production mechanism of conventional as well as ultrafast lasers
PH-DSE-IVA	**High Energy Physics II**	1. Classify the elementary particles and their interactions. 2. Explain the physics of fundamental particles and their interactions. 3. Analyze the formulation of group theory. 4. Apply group theory to quark model and different interactions.	1. Enable a student to acquire the basic knowledge of elementary particles and their interactions. 2. Enable a student to apply the framework of group theory to particle physics. 3. Prepare a student for advanced topics in field theory and particle physics. 4. Motivate a student to pursue a career in high energy physics.
PH-DSE-IVB	**Condensed Matter Physics II**	1. Provide basic knowledge on Lattice vibration and some properties of solid related to lattice vibration.	1. Use the knowledge in fabrication of different thin film semiconductor devices. 2. Pursue some research or project

		2. Develop the basic knowledge of the thin film Physics. It will provide the knowledge of preparation and characterization of thin films and its application in devices. 3. Enhance the knowledge on semiconducting properties and optical effect in semiconductors.	work on semiconducting thin film device.
PH-DSE-IVC	**Digital and Optical Electronics**	1. Introduce students to microcontroller and programming for building digital systems. 2. Introduce students to digital signal and signal processing principles 3. Introduce students to optical electronic systems 4. Provide students with fundamental principles of optical devices 5. Introduce students to optical communication systems	1. Critically analyze microcontroller based digital electronic circuits 2. Write assembly language programs for microprocessor and microcontroller controlled devices. 3. Analyze optical electronic devices 4. Critically analyze optical communication systems 5. Apply the knowledge of optical electronics to make innovative optical products for real life problem solving.
PH-DSE-IVD	**Space Physics**	1. Introduce the Physics of the Earth's ionosphere. 2. Introduce the atmospheres of the solar system planets. 3. Introduce the Physics of the Sun.	1. Understand the basic plasma process in the Earth's ionosphere. 2. Acquainted with planetary atmospheres. 45

		4. Introduce radio astronomy.	3. Learn about Sun, Solar wind, CME, solar wind interaction with the magnetosphere, Solar -Terrestrial environment. 4. Understand the fundamentals of radio astronomy.
PH-DSE-IVE	**Laser Spectroscopy II**	1. Understand the basic principles of non linear spectroscopy 2. Familiarize with principles and instrumentations in modern non linear spectroscopy 3. Equip with the knowledge on different techniques of laser Raman spectroscopy and applications 4. Familiarize with recent developments in Laser Spectroscopy	1. Understand and explain concepts in non linear spectroscopy 2. Demonstrate the use of modern laser spectroscopic instruments in practice 3. Demonstrate the advantages of use of laser spectroscopy in recent discoveries in Physics and various other areas 4. Use laser spectroscopic techniques in research.
PH-DSE-VA	**High Energy Physics III**	1. Explain the basics of gauge theories. 2. Analyze symmetry breaking in gauge theories. 47 3. Apply the knowledge of gauge theory to QCD. 4. Outline a number of areas in beyond the standard model physics.	1. Enable a student to acquire the basic knowledge of gauge theories. 2. Enable a student to familiarize with the standard model. 3. Prepare a student for advanced topics in field theory and particle physics. 4. Motivate a student to pursue a career in high energy physics.

PH-DSE-VB	**Condensed Matter Physics Lab**	1. Gather a broader knowledge on the experimental techniques of solid state Physics 2. Understand the basic concepts in hands on mode through the basic solid state physics experiments.	1. Equip a student with different experimental techniques used for determination of various properties of solids. 2. Enhance the laboratory skill of a student which will help a student to experimental research work in the area. 3. Enable a student to understand the subject in some more detail.
PH-DSE-VC	**Electronics Lab**	1. To allow students to learn the electronic principles using hands-on philosophy 2. To allow students to design small analog circuit systems like small signal amplifier, filter comparator etc. 3. To allow students to apply their knowledge for assembly language programming to do arithmetic operations and make small data processing software. 4. To introduce students to use microprocessor and microcontroller to interface peripheral devices 5. To introduce students to radiation pattern of antenna through measurement.	1. Design small electronic circuits 2. Write assembly language program to do arithmetic, logical and data processing operations 3. Analyze antenna radiation pattern and characteristics for real life application 4. Understand the working of optical electronics components

		6. To introduce students to optical electronics components and measurements.	
PH-DSE-VD	**Space Physics Lab**	1. To familiarise students with basic tools used in the study of Space Physics 2. To provide students with hands on training of parameters associated to Space Physics study	1. A student will be able to operate basic tools like Ozonometer, aethalometer, scintillation monitor etc. 2. The hands on experience will enable a student to pursue further study in experimental Space Physics curriculum
PH-DSE-VE	**Laser Spectroscopy Lab**	1. Use and handle spectroscopic instruments in laboratory 2. Understand the principles of laser spectroscopy through performance of experiments 3. Provide exposure in practical application of spectroscopic instruments.	1. Handle various spectroscopic instruments in laboratory and use those in research 2. Demonstrate the uses of various laser spectroscopic instruments in the fields of interest
PH-GE-A	**Basic Quantum Mechanics**	1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics. 2. Know the applications of quantum mechanics in solving physical problems.	1. Understand the applications of quantum mechanics in other areas of science. 2. Apply quantum theory to physical problems.
PH-GE-B	**Foundation of Electronics**	1. Know about the basics of semiconductor PN junction, its various types and its application to different electronic circuits. 2. Understand bipolar junction transistor and its applications as	1. Learn the foundation knowledge of analog electronic systems. 2. Learn the working and applications of PN junction and bipolar junction transistors (BJT).

		amplifier and oscillators. 3. Familiarize with operational amplifiers, its applications and analysis. 4. Develop knowledge about analog to digital and digital to analog conversion techniques	3. Learn to analyze circuits containing PN junction and BJT along with the application of BJT as amplifiers and oscillators. 4. Develop basic knowledge of operational amplifier and its applications
PH-GE-C	**Fundamentals of Material Science**	1. The structure of crystalline materials 2. The behaviour of conduction electrons in crystalline materials and the formation of energy bands 3. Various types of phenomena like magnetism and super-conductivity 4. Nanomaterials and their interesting properties	1. Differentiate between different lattice types and explain the concepts of reciprocal lattice and crystal diffraction 2. Predict electrical and thermal properties of solids and explain their origin 3. Explain the concept of energy bands and effect of the same on electrical properties 4. Explain various types of magnetic phenomenon 5. Explain superconductivity 6. Gather knowledge on the underlying principles governing the fascinating behaviour of nano-materials
PH-GE-D	**Thermal Physics**	1. Develop knowledge of thermodynamical properties of matter.	1. Develop critical and analytical thinking on thermodynamics and allied disciplines.

		2. Understand the thermodynamics present in allied fields like Materials science, Condensed matter Physics, Atmospheric Physics, Solar Physics, etc.	2. Use the concept of thermodynamics in real world experiences.
PH-GE-E	**Classical Mechanics**	1. Acquaint the learners with the Lagrangian and Hamiltonian formulation of mechanics 2. Enable the learners to understand the idea of normal modes and normal coordinates. 3. Introduce the students to rigid body dynamics	1. Understand the basic concepts of Lagrangian and Hamiltonian dynamics 2. Understand the idea of normal coordinates and normal modes 3. Understand rigid body dynamics
PH-GE-F	**Meteorology**	1. Familiarize with the structure and composition of the atmosphere of Earth and other planets 2. Provide basic knowledge on the weather, climate and other aspects of atmosphere 3. Provide knowledge on meteorological parameters and their measurement techniques 4. Familiarize with weather forecasting	1. Demonstrate the various atmospheric phenomena and their evolution 2. Use meteorological parameters to explain observations in Atmospheric Physics, Life Sciences, Environmental Science etc. 3. Apply the laws of Physics to explain Atmospheric phenomena 4. Opt for interdisciplinary research
PH-GE-G	**Elements of Modern Physics**	1. Understand the theoretical basis for the understanding of quantum Physics as the basis for dealing with microscopic phenomena.	1. Gather knowledge about various concepts of Modern Physics such as quantum physics, atomic, nuclear physics and particle physics, Laser etc.

		2. Apply concepts of 20th Century Modern Physics to deduce the structure of atoms. 3. Explain the wave-particle duality of the photon. 4. Analyze the structure of matter at its most fundamental. 5. Develop insight into the key principles and applications of Nuclear Physics 6. Learn about different types of fundamental particles along with various elementary particles 7. Understand the basic principle of Laser	2. Successfully apply the same knowledge in solving problems in the field of Modern Physics.
PH-AEC-IA	**Experimental Techniques**	1. Understand the basic concepts of errors in measurements and techniques of data analysis. 2. Understand the principle of sensors and transducers and OPAMP	1. Identify the errors in measurement. 2. Analyze the working of various sensors and transducers.
PH-AEC-IB	**Observational Astronomy**	1. Introduction to observational astronomy. 2. Familiarisation of Coordinate systems, telescopes and observational instruments (CCDs, filters, spectrographs)	1. Develop the knowledge of handling telescopes and other modern image processing devices. 2. Describe the effects of the properties of light and Earth's atmosphere on astronomical observations, coordinate system for stars

		3. Familiarisation of Observational methods and techniques.	3. Acquire the knowledge of photometry and multi wave astronomy
PH-AEC-IIA	**Nano Structured Materials**	1. Provide a systematic coverage and insight into the promising area of nano materials in order to facilitate the understanding of the nature and prospects for the field. 2. Discuss about various types of nanomaterials with specific examples of semiconducting nanomaterials in various dimensions and carbon based nanomaterials, viz., fullerene and carbon nanotubes 3. Provide information about various synthesis and characterization techniques of nanomaterials 4. Discuss wide applications of nanomaterials	1. Know the underlying principles governing the fascinating behavior of nanomaterials 2. Gather knowledge about some of the modern promising nanomaterials such as quantum dots, carbon nanotubes etc. 3. Learn the various methods for synthesis and characterization of nanomaterials as well as their wide variety of applications
PH-AEC-IIB	**Vacuum Technique**	1. To introduce the theory of vacuum to the students. 2. Comprehension of thermal and flow behaviour of gases at very low pressures. 3. Methods of achieving and measurement low pressures. Vacuum pumps and vacuum meters.	1. Recognize the importance of vacuum in modern technology and research 2. Basics of kinetic theory of gases, pressure, particle collisions, velocity and free trajectory 3. Vacuum pumps: classification, basic types, range of application; vacuum meters: classification, basic types and range of application.

PH-AEC-IIC	**Meteorology**	1. Make familiar with the Earth's atmosphere as well as the weather and climate systems 2. Provide basic knowledge on meteorological parameters and their measurement techniques 69 3. Apply the laws of Physics to explain Atmospheric phenomena 4. Get familiar with weather forecasting	1. Demonstrate the various atmospheric phenomena and their evolution 2. Solve problems in the atmospheric sciences and related disciplines 3. Impart expertise in sub-disciplines of atmospheric science or related interdisciplinary areas 4. Develop skills for interpreting and applying atmospheric observation 5. Serve as a meteorologist, climate scientist, take part in policy making
PH-AEC-IID	**Dissertation/ Project**	.....	.....