PO and COs of Physics syllabus under NEP2020

<table>
<tr><td colspan="3">UG Physics Major</td></tr>
<tr><td colspan="3">Program Specific Outcomes (PSO):

• Students will gain a deep understanding of various fields of physics, including electronics, quantum physics, classical mechanics, statistical mechanics, condensed matter physics, astrophysics, particle physics, nuclear physics, and high-energy physics.
• They will also learn practical topics such as workshop skills, weather forecasting, and radiation hazards.
• Students will develop a strong foundation in basic mechanics and the properties of matter.
• They will be able to explain key concepts in electricity, magnetism, thermodynamics, optics, and spectroscopy.
• Students will learn to identify, approach, and analyse complex problems using the principles of mathematics, physics, and statistics.
• They will have the skills to design, build, and evaluate basic electronic and digital circuits.
• Students will understand the basics of programming languages and be able to apply them to solve numerical problems in physics.
• They will also improve their communication skills to effectively share ideas and information.</td></tr>
<tr><td>Course Code</td><td>Title</td><td>Course Outcome (CO)</td></tr>
<tr><td colspan="3">UG 1st Semester</td></tr>
<tr><td>PHY-M-T-1

Semester I</td><td>MATHEMATICAL PHYSICS-I</td><td>This course equips students with essential mathematical tools and techniques for solving complex physical problems. Students will master calculus and vector calculus, including differentiation, integration, and vector operations, with applications to physical systems. They will gain proficiency in vector integration, including line, surface, and volume integrals, and apply these concepts in diverse physical scenarios. The course introduces orthogonal curvilinear coordinates for solving problems in non-Cartesian systems, alongside matrix algebra for handling linear equations and transformations. Additionally, students will explore probability theory for analysing stochastic systems and learn the Dirac delta function and its applications. These skills form a strong mathematical foundation for advanced studies in physics and engineering.</td></tr>
<tr><td>PHY-M-P-1

Semester I</td><td>MATHEMATICAL PHYSICS-I</td><td>• The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.
• Highlights the use of computational methods to solve physical problems
• The course will consist of lectures (both theory and practical) in the Lab
• Evaluation done not on the programming but on the basis of formulating the problem
• Aim at teaching students to construct the computational problem to be solved
• Students can use any one operating system Linux or Microsoft Windows</td></tr>
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PHY-MI-T-1 Semester I	MATHEMATICAL PHYSICS-I	This course in Mathematical Physics provides students with a solid foundation in advanced mathematical techniques essential for understanding physical systems. Students will gain proficiency in calculus and vector calculus, including differentiation, integration, and vector operations, with applications to physical phenomena. They will learn vector integration, covering line, surface, and volume integrals, to solve problems in electromagnetism and fluid dynamics. The course also focuses on matrix theory for solving linear systems and transformations, and introduce the Dirac delta function and its applications. Overall, students will develop the mathematical skills necessary to analyse and solve complex problems in theoretical physics.
PHY-MI-P-1 Semester I	MATHEMATICAL PHYSICS-I	This practical course introduces students to programming concepts using languages such as Python/ Fortran/ MATLAB/ C/ or C++. Students will learn to write elementary programs, generate random numbers, and calculate mathematical constants like pi. They will also gain hands-on experience in solving algebraic and transcendental equations using numerical methods such as the Bisection, Newton-Raphson, and Secant methods. Additionally, the course covers the basics of data visualization, teaching students to plot graphs and analyse data using tools like Matplotlib, Gnu-plot, Origin, or Excel. By the end of the course, students will have developed strong programming and computational skills, along with the ability to visualize and interpret scientific data effectively.
PHY-MU-T-1	Physics in Everyday Life	This course aims to introduce the fundamental simple principles of physics and explore their applications in various aspects of everyday life. Multidisciplinary students will develop an understanding of the physical laws governing the world around us and how they manifest in common phenomena and technologies by a qualitative approach. This course will provide: • An overview of key physics concepts and principles. • A clear idea about relevance of physics in everyday life. • Critical thinking skills in analysing and explaining real-world phenomena using physics principles. • An appreciation for the scientific method and the role of physics in advancing society.
PHY-SEC-T-1:	ELECTRICAL CIRCUITS & NETWORK SKILLS	Upon completing this course, students will be able to: • Apply fundamental principles of electricity to analyse and solve basic electrical problems. • Understand the working and design of electrical circuits, including series and parallel configurations. • Comprehend the principles and operation of generators and transformers, including their applications in power systems. • Explore the construction, functionality, and applications of electric motors. • Gain knowledge of solid-state devices, such as diodes and transistors, and their roles in electrical and electronic circuits. • Understand the importance of electrical protection systems, including fuses, circuit breakers, and earthing mechanisms. • Develop practical skills in electrical wiring, including installation, troubleshooting, and maintenance of electrical systems.

Course Code	Title	Course Outcome (CO)
UG 2nd Semester		
PHY-M-T-2:	MECHANICS	Upon completing this course, students will be able to: • Apply Newton's laws of motion to solve problems in dynamics and understand the principles of work, energy, and their conservation. • Analyze elastic and inelastic collisions using momentum and energy conservation laws. • Understand rotational dynamics, calculate moment of inertia, and apply angular momentum conservation. • Explore the mechanical properties of materials through elasticity concepts like stress, strain, and elastic moduli. • Solve problems in fluid motion using Bernoulli's equation, viscosity, and streamline flow. • Analyze gravitational forces, Kepler's laws, and satellite motion using central force principles. • Derive and interpret equations of motion for particles in central force fields and understand orbital dynamics. • Understand the principles of oscillations, including SHM, damped and forced oscillations, and resonance. • Solve problems in non-inertial reference frames using concepts of fictitious forces. • Comprehend Einstein's special theory of relativity, including time dilation, length contraction, and energy-momentum relations. This course provides a comprehensive understanding of classical mechanics with practical and theoretical problem-solving skills.
PHY-M-T-2:	MECHANICS	Upon completion of this practical course, students will be able to perform precise measurements of length and diameter using vernier calipers, screw gauges, and traveling microscopes, and analyze random errors in observations. They will acquire the skills to determine the height of a building using a sextant and study the motion of a spring to calculate its spring constant and acceleration due to gravity (g). Students will gain hands-on experience in determining the moment of inertia of rigid bodies, measuring gravitational acceleration (g) and velocity for a freely falling body using digital timing techniques, and evaluating the coefficient of viscosity of water through Poiseuille's and Stoke's methods. Additionally, they will determine the Young's modulus of a bar by the flexure method, the modulus of rigidity of a wire by the dynamic method, and the elastic constants of a wire using Searle's apparatus. They will also measure the value of g using bar and Kater's pendulums, analyze frequency-resonance relationships in a sonometer wire, and calculate the unknown frequency of a tuning fork. This course provides practical expertise in mechanics, elasticity, fluid dynamics, and experimental techniques.

PHY-MI-T-2:	MECHANICS	Upon completing this course, students will be able to: • Understand and apply the laws of motion to analyze the dynamics of particles and systems of particles. • Analyze concepts of momentum and energy, including their conservation, in mechanical systems. • Explore the principles of rotational motion, including torque, angular momentum, and moment of inertia, and apply them to solve real-world problems. • Differentiate between inertial and non-inertial reference frames and solve problems involving fictitious forces like centrifugal and Coriolis forces. • Understand the principles of gravitation, derive Kepler's laws, and solve problems related to satellite motion and central force dynamics. • Study the mechanics of collisions, both elastic and inelastic, using conservation laws. • Comprehend oscillatory motion, including simple harmonic motion (SHM), damped and forced oscillations, and resonance phenomena. • Explore the mechanical properties of materials through elasticity, including stress, strain, and elastic constants. • Analyze fluid motion using principles such as Bernoulli's theorem, viscosity, and streamline flow. • Understand the postulates and implications of Einstein's special theory of relativity, including time dilation, length contraction, and mass-energy equivalence. This course equips students with a comprehensive understanding of classical mechanics, emphasizing problem-solving and the application of concepts to real-world scenarios.
PHY-MI-P-2:	MECHANICS	Upon successful completion of this practical course, students will be able to: • Perform precise measurements of length and diameter using vernier calipers, screw gauges, and traveling microscopes. • Analyze and quantify random errors in experimental observations to improve accuracy. • Use a sextant to measure the height of a building effectively. • Study the motion of a spring and calculate its spring constant and the acceleration due to gravity (g). • Determine the moment of inertia of a flywheel or rigid body experimentally. • Measure gravitational acceleration (g) and velocity for a freely falling body using digital timing techniques. • Calculate the coefficient of viscosity of water using Poiseuille's capillary flow method and Stoke's method. • Evaluate the Young's modulus of the material of a bar using the flexure method. • Determine the modulus of rigidity of a wire using the dynamic method. • Measure the elastic constants of a wire using Searle's apparatus. • Determine the value of gravitational acceleration (g) using both bar and Kater's pendulums. • Plot the frequency-resonance length curve of a sonometer wire and determine the unknown frequency of a tuning fork. This course develops students' experimental skills in mechanics, elasticity, fluid dynamics, and oscillatory motion, providing hands-on experience with fundamental principles and measurement techniques.

PHY-MU-T-02:	Weather Forecasting	Upon completing this course, students will be able to: - Understand the structure, composition, and dynamics of the Earth's atmosphere and its role in shaping weather and climate. - Learn various methods and instruments used for measuring key weather parameters such as temperature, pressure, humidity, wind speed, and precipitation. - Analyze the formation and characteristics of weather systems such as cyclones, anticyclones, and monsoons, and understand their global and regional impacts. - Explore the concepts of climate, climate variability, and the effects of climate change, including its social, economic, and environmental implications. - Develop foundational skills in weather forecasting, including interpreting meteorological data, understanding weather maps, and using predictive models for short-term and long-term weather predictions. - This course provides interdisciplinary knowledge and practical insights into weather systems, equipping students with the ability to understand and predict weather phenomena and their impact on various aspects of life and the environment.
PHY-SEC-T-2	Basic Instrumentat-ion Skills	Upon completing this course, students will be able to: - Understand the fundamental principles of measurement and the role of instruments in obtaining accurate data. - Gain knowledge of electronic voltmeters and their applications in measuring voltage and electrical signals. - Comprehend the functioning and use of Cathode Ray Oscilloscopes (CRO) in visualizing and analyzing electrical waveforms. - Understand the principles of signal generators and their role in generating different waveforms for testing and analysis. - Analyze the operation and application of impedance bridges and Q-meters in measuring impedance and quality factor in electrical circuits. - Explore the principles and applications of digital instruments in modern measurement systems. - Understand the use of digital multimeters for measuring electrical parameters such as voltage, current, resistance, and continuity. This course provides students with the theoretical foundation and practical understanding of essential instrumentation tools, enabling them to effectively use these instruments in laboratory settings and practical applications.

Course Code	Title	Course Outcome (CO)
		UG 3rd Semester
PSH-M-T-3	**Electricity and magnetism**	Upon completing this course, students will gain a comprehensive understanding of the principles of electric fields, electric potential, and dielectric properties of matter, along with their applications in electrostatics. They will analyse magnetic fields, magnetic properties of matter, and the fundamental concepts of electromagnetic induction, including Faraday's Law and Lenz's Law. Students will also explore transient behaviour in electrical circuits, apply network theorems to solve complex circuit problems, and understand the working and applications of the ballistic galvanometer. Through this, they will develop critical problem-solving skills and the ability to apply electromagnetic concepts in real-world scenarios and advanced technologies.
PSH-M-P-3	**Electricity and magnetism**	Through this practical course, students will gain hands-on experience in measuring current, DC/AC potential, resistance, and testing circuit components like fuses. They will analyse the behaviour of series R-C circuits, measure low resistance, capacitance, and magnetic field strength, and study the variation of magnetic fields in solenoids. Students will verify Thevenin's, Norton's, Superposition, and Maximum Power Transfer theorems, deepening their understanding of circuit analysis. Additionally, they will measure self and mutual inductance, examine the responses of series and parallel resonant circuits, and explore the sensitivity and figure of merit of a ballistic galvanometer. They will also learn to measure high resistance using a ballistic galvanometer, enhancing their experimental skills and understanding of electrical and magnetic systems. These practical exercises will enhance their ability to apply theoretical knowledge to real-world systems, fostering critical thinking and experimental accuracy in the field of electromagnetism.

PHS-MI-T-3	**Electricity and magnetism**	Upon completing this course, students will develop a strong foundation in electrostatics, understanding electric fields, potentials, and the behaviour of charges in various configurations. They will explore the principles of magnetism, including magnetic fields, forces, and the properties of magnetic materials. The course will deepen their understanding of electromagnetism through Faraday's and Ampere's laws, leading to the formulation and application of Maxwell's equations. Students will analyse how Maxwell's equations unify electric and magnetic phenomena and predict the behaviour of electromagnetic waves. This knowledge will equip them to understand wave propagation, energy transfer, and the principles underlying modern communication and electromagnetic technologies.
PHS-MI-P-3	**Electricity and magnetism**	Through this practical course, students will gain hands-on experience in measuring current, DC/AC potential, resistance, and testing circuit components like fuses. They will analyse the behaviour of series R-C circuits, measure low resistance, capacitance, and magnetic field strength, and study the variation of magnetic fields in solenoids. Students will verify Thevenin's, Norton's, Superposition, and Maximum Power Transfer theorems, deepening their understanding of circuit analysis. Additionally, they will measure self and mutual inductance, examine the responses of series and parallel resonant circuits, can use tangent galvanometer and explore the sensitivity and CDR of a ballistic galvanometer. They will also learn to measure high resistance using a ballistic galvanometer, enhancing their experimental skills and understanding of electrical and magnetic systems. These practical exercises will enhance their ability to apply theoretical knowledge to real-world systems, fostering critical thinking and experimental accuracy in the field of electromagnetism.
PHS-SEC-T-3	**Renewable energy and energy harvesting**	This course provides a comprehensive understanding of renewable energy and energy harvesting, focusing on the limitations of fossil fuels, including environmental and resource-based constraints. Students will explore various renewable energy sources, such as solar, wind, hydro, and bioenergy, along with their applications and challenges. The course also delves into advanced energy harvesting techniques, emphasizing piezoelectric and electromagnetic energy harvesting methods for converting ambient energy into usable power. By the end, students will be equipped to evaluate sustainable energy solutions, design energy-harvesting systems, and contribute to innovative approaches for addressing global energy needs.