GOVT. GEN. DEGREE COLLEGE, CHAPRA

[Affiliated to University of Kalyani]

DEPARTMENT OF PHYSICS

UG 4 YEAR PHYSICS (HONOURS/ HONOURS WITH RESEARCH)
(Under NEP 2020)

W.E.F. the Academic Session 2023-24

Programme Outcome (PO)-Course Outcome (CO)

SEMESTER-I

Course Code	Course Title (credit)	Nature of Course	Credit of Course	Class hours/ week	Evaluation		Total
					Internal	Semester End	
PHY-M-T-1 PHY-M-P-1	Mathematical physics I (4+2)	Major	6	6	15	60	75
PHY-MI-T-1 PHY-MI-P-1	Mathematical physics I (3+1)	Minor	4	4	10	40	50
PHY-MU-T-1	Physics in everyday life	Multidisciplinary Course	3	3	10	35	45
PHY-SEC-T-1	Electrical circuit and network skills	Skill Enhancement Course	3	3	10	35	45
		Value Added Course	4	4	10	40	50
			20	20	55	210	265

- Value Added Course will be common to all majors

SEMESTER-II

Course Code	Course Title	Nature of Course	Credit of Course	Class hours/ week	Evaluation		Total
					Internal	Semester End	
PHY-M-T-2	Mechanics (4+2)	Major	6	6	15	60	75
PHY-MI-T-2	Mathematical physics I (3+1)	Minor	4	4	10	40	50
PHY-MU-T-2	Physics in everyday life	Multidisciplinary Course	3	3	10	35	45
PHY-AECC-T-1		Ability Enhancement Course	4	4	10	40	50
PHY-SEC-T-2	Basic Instrumentation Skills	Skill Enhancement Course	3	3	10	35	45
For Certificate		Summer Internship	4*	4			
			20	20	45	220	265

SEMESTER-III

Course Code	Course Title	Nature of Course	Credit of Course	Class hours/ week	Evaluation		Total
					Internal	Semester End	
PHY-M-T-3	Electricity and magnetism (4+2)	Major	6	6	15	60	75
PHY-MI-T-3	Electricity and magnetism (3+1)	Minor	4	4	10	40	50
PHY-MU-T-3	Physics in everyday life	Multidisciplinary Course	3	3	10	35	45
PHY-SEC-T-3	Renewable Energy and Energy Harvesting	Skill Enhancement Course	3	3	10	35	45
		Value Added Course	4	4	10	40	50
			20	20	55	210	265

- Value Added Course will be common to all major

SEMESTER-IV

Course Code	Course Title	Nature of Course	Credit of Course	Class hours/ week	Evaluation		Total
					Internal	Semester End	
PHY-M-T-4	Wave Optics and Electromagnetic Theory (4+2)	Major	6	6	15	60	75
PHY-M-T-5	Thermal Physics (4+2)	Major	6	6	15	60	75
PHY-MI-T-4	Electricity and magnetism (3+1)	Minor	4	4	10	40	50
PHY-AECC-T-2		Ability Enhancement Course	4	4	10	40	50
For Diploma		Summer Internship	4**	4			
			20	20	50	200	250

Sem	Course/ Course Code	Course Credit	Theory/ Practical	Course Outcome (CO)
1st	**Major:** PHY-M-T -1/ PHY-M-P-1 Mathematical physics-I **Minor:** PHY-MI-T -1/ PHY-MI-P-1 Mathematical Physics -I	4T+2P =6 3T+1P =4	Theory Practical	After successful completion of this course students should be able to: • Apply calculus techniques, including differential equations and multivariable functions, to model physical systems. • Utilize vector calculus operations (gradient, divergence, curl) and integral theorems (Gauss, Stokes) in physical contexts. • Analyze matrices, eigenvalues, and eigenvectors to solve coupled linear differential equations. • Understand probability distributions (Binomial, Gaussian, Poisson) and their applications in physics. • Employ computational methods to simulate and solve numerical problems in physics. • Interpret and visualize mathematical concepts through graphing and coordinate transformations. **After going through the practical course, the students should be able** to develop proficiency in computer programming and numerical analysis, with a focus on applying these skills to solve physics problems. Students will gain hands-on experience in computational techniques using Sci-Lab/Python, a widely recognized open-source programming language, enabling them to simulate physical systems, analyze data, and implement numerical methods effectively. The course aims to bridge theoretical concepts with practical computational tools, preparing students for advanced studies and research in physics.
	Multi - disciplinary Course: PHY-MU-T-1 Physics in everyday life	3	Theory	After successful completion of this course students should be able to: • Explain fundamental physics principles and their applications in everyday phenomena. • Analyze real-world scenarios using concepts of mechanics, energy, waves, light, electricity, and magnetism. • Demonstrate the role of physics in technology, transportation, sports, and music through practical examples. • Apply critical thinking and the scientific method to solve problems related to natural and engineered systems. • Appreciate the impact of modern physics, including quantum theory and nuclear physics, on contemporary technology.
	Skill Enhancement Courses: PHY-SEC-T-1 Electrical Circuits & Network Skills	3	Theory	After successful completion of this course students should be able to: • Apply fundamental electrical principles (Ohm's Law, AC/DC circuits) to analyze circuits using multimeters and other measuring instruments. • Design, construct, and test basic electrical circuits, including series, parallel, and combination configurations. • Explain the working principles of generators, transformers, and electric motors, and their applications in real-world systems. • Operate and analyze solid-state devices (diodes, rectifiers) and understand their role in power regulation and conversion. • Implement electrical safety measures using protective devices like fuses, relays, and circuit breakers in wiring systems. • Demonstrate practical skills in household wiring, including conduit wiring, extension board preparation, and star/delta connections.

2nd	**Major:** PHY-M-T-2/ PHY-M-P-1 Mechanics	4T+2P =6	Theory	After successful completion of this course students should be able to: • Analyze classical mechanics systems using Newtonian dynamics, conservation laws (momentum, energy, angular momentum), and rotational motion principles. • Solve problems in collisions, variable-mass systems (e.g., rockets), and central force motion, including applications of Kepler's laws and satellite dynamics. • Apply concepts of elasticity, fluid motion, and oscillations, such as Poiseuille's flow, damped/forced oscillations, and resonance. • Understand non-inertial frames and fictitious forces (centrifugal, Coriolis) in rotating systems, and derive kinematic quantities in curvilinear coordinates. • Explain the principles of Special Relativity, including Lorentz transformations, time dilation, mass-energy equivalence, and relativistic kinematics. • Integrate theoretical knowledge with problem-solving skills to address complex mechanical systems and relativistic phenomena.
			Practical	**After going through the practical course, the students should be able to** • Master measurement techniques using precision instruments like vernier calipers, screw gauges, and microscopes, while analyzing random errors in observations. • Determine fundamental constants (e.g., acceleration due to gravity *g*, spring constant) and material properties (Young's modulus, rigidity, viscosity) through hands-on experiments. • Analyze mechanical systems by calculating MI, studying spring motion, and applying Poiseuille's and Stoke's methods to fluid dynamics. • Investigate oscillatory and wave phenomena, including resonance in sonometer wires and pendulum dynamics, to evaluate frequencies and system behaviors. • Develop experimental and analytical skills by linking theoretical principles (e.g., elasticity, kinematics, fluid mechanics) to practical observations and data interpretation.
	Minor: PHY-MI-T -1/ PHY-MI-P-1	3T+1P =4	Theory	After successful completion of this course students should be able to: • Apply calculus techniques, including differential equations and multivariable functions, to model physical systems. • Utilize vector calculus operations (gradient, divergence, curl) and

<table>
<tr><td></td><td>Mathematical Physics -I</td><td></td><td></td><td>integral theorems (Gauss, Stokes) in physical contexts.
• Analyze matrices, eigenvalues, and eigenvectors to solve coupled linear differential equations.
• Understand probability distributions (Binomial, Gaussian, Poisson) and their applications in physics.
• Employ computational methods to simulate and solve numerical problems in physics.
• Interpret and visualize mathematical concepts through graphing and coordinate transformations.</td></tr>
<tr><td></td><td></td><td></td><td>Practical</td><td>After going through the practical course, the students should be able to develop proficiency in computer programming and numerical analysis, with a focus on applying these skills to solve physics problems. Students will gain hands-on experience in computational techniques using Sci-Lab/Python, a widely recognized open-source programming language, enabling them to simulate physical systems, analyze data, and implement numerical methods effectively. The course aims to bridge theoretical concepts with practical computational tools, preparing students for advanced studies and research in physics.</td></tr>
<tr><td></td><td>Multi - disciplinary Course:

PHY-MU-T-1

Physics in everyday life</td><td>3</td><td>Theory</td><td>After successful completion of this course students should be able to:
• Explain fundamental physics principles and their applications in everyday phenomena.
• Analyze real-world scenarios using concepts of mechanics, energy, waves, light, electricity, and magnetism.
• Demonstrate the role of physics in technology, transportation, sports, and music through practical examples.
• Apply critical thinking and the scientific method to solve problems related to natural and engineered systems.
• Appreciate the impact of modern physics, including quantum theory and nuclear physics, on contemporary technology.</td></tr>
<tr><td></td><td>Skill Enhancement Courses:

PHY-SEC-T-1

Basic Instrumentation Skills</td><td>3</td><td>Theory + Lab</td><td>After successful completion of this course students should be able to:
• Operate key electronic instruments (multimeters, CROs, signal generators, LCR bridges) and evaluate their specifications, limitations, and applications in measurements.
• Analyze measurement errors (loading effects, precision, accuracy) and apply corrective techniques while using analog and digital instruments.
• Demonstrate proficiency with oscilloscopes by measuring voltage, frequency, time periods, phase angles, and troubleshooting circuits.
• Design and test circuits using impedance bridges, Q-meters, and digital multimeters, including calibration and range conversion tasks.
• Develop problem-solving skills in circuit tracing, coil/transformer winding, and troubleshooting electronic equipment through hands-on lab exercises.
• Compare analog vs. digital instruments and explain the principles of digital meters, universal counters, and advanced tools like distortion analyzers.
The course bridges theoretical knowledge with practical instrumentation skills, preparing students for real-world challenges in electronics and measurement technologies.</td></tr>
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<tr><td rowspan="3">3rd</td><td>Major:

PHY-M-T-3 / PHY-M-P-3

Electricity and Magnetism

Minor:

PHY-MI-T-3 / PHY-MI-P-3

Electricity and Magnetism</td><td>4T+2P =6

3T+1P =4</td><td>Theory

Practical</td><td>After successful completion of this course students should be able to:
• Apply fundamental laws (Gauss' Law, Biot-Savart's Law, Ampere's Law, Faraday's Law) to analyze electric and magnetic fields in symmetric charge/current distributions.
• Solve electrostatic and magnetostatic problems using concepts of potential, capacitance, polarization, magnetization, and vector calculus (divergence, curl).
• Analyze dielectric and magnetic materials by relating macroscopic properties (susceptibility, permeability) to microscopic behavior (polarization, hysteresis).
• Design and evaluate AC circuits with LCR components, including resonance, power dissipation, and quality factor calculations.
• Utilize network theorems (Thevenin, Norton, Superposition) to simplify and solve DC/AC circuits for practical applications.
• Explain electromagnetic phenomena such as induction, transients in LCR circuits, and energy storage in electric/magnetic fields.

After going through the practical course, the students should be able to
• Operate measurement instruments (multimeters, potentiometers, bridges, ballistic galvanometers) to quantify electrical parameters (resistance, capacitance, voltage, current) and troubleshoot circuits.
• Validate fundamental theorems (Thevenin, Norton, Superposition, Maximum Power Transfer) through hands-on experiments in DC/AC circuits.
• Analyze LCR circuits by determining resonant/anti-resonant frequencies, quality factor (Q), bandwidth, and impedance characteristics.
• Measure electromagnetic properties (self/mutual inductance, magnetic field strength, charge sensitivity) using bridge methods and galvanometers.
• Develop experimental rigor by documenting procedures, analyzing errors, and interpreting data to correlate theoretical principles with practical observations.</td></tr>
<tr><td>Multi - disciplinary Course:

PHY-MU-T-1

Physics in everyday life</td><td>3</td><td>Theory</td><td>After successful completion of this course students should be able to:
• Explain fundamental physics principles and their applications in everyday phenomena.
• Analyze real-world scenarios using concepts of mechanics, energy, waves, light, electricity, and magnetism.
• Demonstrate the role of physics in technology, transportation, sports, and music through practical examples.
• Apply critical thinking and the scientific method to solve problems related to natural and engineered systems.
• Appreciate the impact of modern physics, including quantum theory and nuclear physics, on contemporary technology.</td></tr>
<tr><td>Skill Enhancement Courses:

PHY-SEC-T-3

Renewable</td><td>3</td><td>Theory</td><td>After successful completion of this course students should be able to:
• Evaluate energy sources by comparing fossil fuels, nuclear energy, and renewable alternatives, highlighting their limitations and environmental impacts.
• Explain solar energy technologies, including thermal/electrical storage, photovoltaic systems, and applications like solar cookers and</td></tr>
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	Energy & Energy Harvesting			greenhouses. • Analyze wind and ocean energy systems, covering principles of wind turbines, OTEC cycles, and tidal power estimation. • Describe geothermal and hydro energy, including resource types, power plant designs, and their socio-environmental advantages/disadvantages. • Explore emerging technologies like piezoelectric energy harvesting, including material properties and modern applications.
4th	**Major:** PHY-M-T-4 / PHY-M-P-4 Wave Optics and Electromagnetic Theory	4T+2P =6	Theory	After successful completion of this course students should be able to: • Analyze wave phenomena including superposition, standing waves, and energy transfer in vibrating systems, and relate them to real-world applications like musical instruments. • Explain interference and diffraction principles, applying them to experiments (Young's double slit, Newton's rings) and interferometers (Michelson, Fabry-Perot). • Solve problems in wave optics using Fresnel and Fraunhofer diffraction theories, and evaluate resolving power of optical instruments (telescopes, gratings). • Derive and apply Maxwell's equations to describe electromagnetic wave propagation in unbounded/bounded media, including boundary conditions and Poynting theorem. • Investigate polarization mechanisms (linear, circular, elliptical) and their applications in crystals, retarders, and optical devices (Nicol prism, polarimeters).
			Practical	**After going through the practical course, the students should be able to** • Apply wave optics principles through experiments like Melde's setup (frequency determination) and interference techniques (Newton's rings, biprism). • Measure optical properties (wavelength, refractive index, dispersive power) using diffraction gratings, prisms, and wedge films. • Verify fundamental laws (Malus' law for polarization, X^2-T law in vibrations) and analyze spectral lines with precision instruments. • Investigate polarization phenomena by determining specific rotation of solutions and refractive indices via total internal reflection. • Develop experimental skills in aligning optical setups, recording data, and interpreting results to bridge theoretical concepts with practical observations.
	Major: PHY-M-T-5 / PHY-M-P-5 Thermal Physics	4T+2P =6	Theory	After successful completion of this course students should be able to: • Apply thermodynamic laws (Zeroth, First, Second, and Third) to analyze energy transfer, work, heat engines, and refrigerators, including efficiency calculations (Carnot cycle). • Analyze entropy changes in reversible/irreversible processes and interpret thermodynamic potentials (enthalpy, Helmholtz/Gibbs free energy) for phase transitions and material properties. • Utilize Maxwell's relations to derive equations for real gas behavior (van der Waals, Joule-Thomson effect) and predict thermodynamic properties (e.g., Cp−Cv). • Explain kinetic theory concepts, including Maxwell-Boltzmann velocity distribution, equipartition of energy, and transport phenomena (viscosity, diffusion, thermal conductivity). • Evaluate real gas behavior through critical constants, virial equations,

			Practical	and experiments (Andrews, Joule-Thomson), distinguishing between ideal and non-ideal systems. **After going through the practical course, the students should be able to** • Measure fundamental thermal properties, including mechanical equivalent of heat (J), thermal conductivity (good and bad conductors), and temperature coefficients (resistance, expansion). • Calibrate and use temperature sensors (thermocouples, platinum resistance thermometers) to determine phase transition points (boiling, melting) and thermo-emf variations. • Apply experimental techniques (Searle's, Angstrom's, Lee and Charlton's methods) to analyze heat conduction and validate theoretical models. • Develop hands-on skills in data collection, error analysis, and interpretation of thermal phenomena, bridging theoretical concepts with laboratory observations.
	Minor: PHY-MI-T-4 / PHY-MI-P-4 Electricity and Magnetism	3T+1P =4	Theory Practical	After successful completion of this course students should be able to: • Apply fundamental laws (Gauss' Law, Biot-Savart's Law, Ampere's Law, Faraday's Law) to analyze electric and magnetic fields in symmetric charge/current distributions. • Solve electrostatic and magnetostatic problems using concepts of potential, capacitance, polarization, magnetization, and vector calculus (divergence, curl). • Analyze dielectric and magnetic materials by relating macroscopic properties (susceptibility, permeability) to microscopic behavior (polarization, hysteresis). • Design and evaluate AC circuits with LCR components, including resonance, power dissipation, and quality factor calculations. • Utilize network theorems (Thevenin, Norton, Superposition) to simplify and solve DC/AC circuits for practical applications. • Explain electromagnetic phenomena such as induction, transients in LCR circuits, and energy storage in electric/magnetic fields. **After going through the practical course, the students should be able to** • Operate measurement instruments (multimeters, potentiometers, bridges, ballistic galvanometers) to quantify electrical parameters (resistance, capacitance, voltage, current) and troubleshoot circuits. • Validate fundamental theorems (Thevenin, Norton, Superposition, Maximum Power Transfer) through hands-on experiments in DC/AC circuits. • Analyze LCR circuits by determining resonant/anti-resonant frequencies, quality factor (Q), bandwidth, and impedance characteristics. • Measure electromagnetic properties (self/mutual inductance, magnetic field strength, charge sensitivity) using bridge methods and galvanometers. • Develop experimental rigor by documenting procedures, analyzing errors, and interpreting data to correlate theoretical principles with practical observations.