ORIENTAL COLLEGE (AUTONOMOUS), TAKYEL, IMPHAL
TEACHING PLAN
(B.Sc.)
Name of Department: PHYSICS

Semester – I Year- 2022 (July-December)

Paper Name: Mathematical Physics Paper Code: PHY – HC 501

No. of Hours per Week	Credits	Total No. of Hours	Marks
4hr/week	4 (Theory)	60	CIA-40 End Sem (Theory – 45)

Course Objectives:

1) To introduce to the students: Review of the concepts of function and plot of different functions.
2) To assist them in: the calculation of first and second-order differential equations, understanding the concept of gradient of scalar field, divergence, and curl of vector field.
3) To acquaint the students with the concept of vector algebra and differentiation of vector quantity and derivation of gradient, divergence, and curl in different coordinate systems

Course Outcomes:

Upon completion of this course, the students will be able to

1) **Get acquainted with**: The function and their graphical representation, solving differential equations, and analysis of vector algebra. The differentiation and integration of vector quantity.
2) **Appreciate the**: Students can get the idea of solving differential equations of first and second order. The calculation of gradient, curl, and divergence of a vector field.
3) **Understand the**: The knowledge of solving differential equations, integration, and differentiation of vector quantity.
4) **Enhance their**: Students will be able to solve differential equations, vector multiplication, and integration of line, surface, and volume of scalar and vector fields. Prove Gauss's divergence theorem, Green's and Stokes's theorem, and their applications. Derivation of Gradient, Divergence, Curl, and Laplacian in different coordinate systems. Probability distribution functions.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Calculus**					
	A	Concept of function, Plot of graph using the concept of calculus	2	To understand the draw and interpret graphs of various functions using the concept of calculus	Lecture, discussion with PPT illustration	Asking questions during the class, giving assignments, and through short test multiple choice question
	B	First order differential equation, variable separation homogeneous & non-homogeneous differential equation	2	To understand the idea of differential equations and solve the differential equation	Lecture, discussion with problem solving	
	C	Exact and inexact differential equations and integrating factors and their application	3	To understand the method of solving exact and inexact differential equations; finding integrating factors and applying them to a physics problem	Lecture, discussion with problem solving	
	D	Second-order differential equation. Homogeneous equation with constant coefficient	2	To know the finding of solution of homogeneous differential equation of 2^{nd} order having constant coefficient	Lecture, discussion with problem-solving and derivation of formula	
	E	Wronskian and general solution	3	To understand the finding of the solution of differential equation by the Wronskian method	Lecture, discussion with problem solving	
	G	Particular Integral with operator method	2	To understand the finding of a particular integral of a differential equation	Lecture, discussion with problem solving	
	H	Method of undermined coefficients and method of variation of parameter	3	To understand the finding of a particular solution of a differential equation	Lecture, discussion with problem solving	

	I	Cauchy-Euler differential equation and simultaneous differential equation of First and Second order	3	To understand how to solve Cauchy-Euler differential equation	Lecture, discussion with problem solving	
II	**Vector Analysis**					
	A	Scalars and vectors, laws of vector algebra, scalar, and vector product, triple scalar product, interpretation in terms of area and volume, triple cross product,product of four vectors. Scalar and vector fields	5	To understand the basic concept of vector algebra, the different operations of vectors can also understand	Lecture, discussion with problem solving	Asking questions during the class, giving assignments, and through short test multiple choice question
	B	Ordinary derivative of a vector, the vector differential operator. Directional derivatives and normal derivatives. The gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Laplacian operator. Vector identities.	8	To understand the derivative of vector and function of del operator and its application	Lecture, discussion with problem-solving and formula derivation	
	C	Ordinary Integrals of Vectors. Double and Triple integrals, Jacobian. The notion of infinitesimal line, surface, and volume elements. Line, surface, and volume integrals of Scalar and Vector fields. Flux of a vector field	6	To understand the evaluation of line, surface, and volume integrals of scalar and vector fields	Lecture, discussion with problem-solving and formula derivation	

	D	Gauss' divergence theorem, Green's and Stoke's Theorems, their verification and applications	8	To understand the Gauss, Green, and Stokes theorem. Verify the theorems and evaluate line, surface, and volume integrals using these theorems	Lecture, discussion derivation of a formula	
	E	Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl, and Laplacian in Cartesian, Spherical, and Cylindrical Coordinate Systems.	6	To acquire knowledge on orthogonal curvilinear coordinates and to derive gradient, divergence, curl, and Laplacian in different coordinate systems	Lecture, discussion derivation of formula with the solving of related problem	
III	**Probability and statics**					
	A	Independent and dependent events, Conditional Probability. Bayes' Theorem, Independent random variables	2	To understand the independent and dependent events, conditional probability and Bayes' theorem	Lecture, discussion derivation of formula with the solving of related problem	Asking questions during the class, giving assignments, and through short test multiple choice question
	B	Probability distribution functions, special distributions: Binomial, Poisson and Normal	3	To understand the basic concept of the probability distribution function and can explain the difference of different distribution functions.	Lecture, discussion derivation of formula with the solving of related problem	
	C	The sample mean and variance and their confidence intervals for Normal distribution.	2	Able to calculate sample mean, variance, and confidence interval for a normal distribution.	Lecture, discussion derivation of formula with the solving of related problem	

Reference Book:

1) Advanced Mathematics for Engineers and Scientists: Schaum Outline Series
2) Differential equation, George F. Simmons
3) Differential Equations by Dr A P Singh
4) Vector analysis: Schaum Outline series
5) Statistical data analysis for the physical science by Adrian Bevan

Course Instructor:

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ORIENTAL COLLEGE (AUTONOMOUS), TAKYEL, IMPHAL
TEACHING PLAN

(B.Sc.)

Name of Department: PHYSICS

Semester – I Year- 2022 (July-December)

Paper Name: Mechanics Paper Code: PHY – HC 502

No. of Hours per Week	Credits	Total No. of Hours	Marks
4hr/week	4 (Theory)	60	CIA-40 End Sem (Theory – 45)

Course Objectives:

1) To introduce to the students: Review the concepts of mechanics learned at school from a more advanced perspective and go on to build new concepts.
2) To assist them in: Understanding the principle of conservation laws, study of central force field
3) To acquaint the students: with the concept of different motions in mechanics and central force problems with the planetary motion. The elaborate idea of the theory of relativity and its application.

Course Outcomes:

Upon completion of this course, the students will be able to

1) **Get acquainted with**: The laws of motion and their application to various dynamic situations. Application of Kepler's law of planetary motion in the motion of planets and artificial satellites. The proof of the absence of Ether in outer space by Michelson-Morley Experiment.
2) **Appreciate the**: Students can get the idea of the different types of motion in dynamics and also relativistic motion.
3) **Understand the**: The knowledge of angular momentum related to torque, central force field, and calculation of acceleration due to gravity at the place of observation.
4) **Enhance their**: Students will be able to understand the concept of laws of motion, momentum of variable mass system, a center of mass of discrete and continuous objects, the relation between work and energy, force as a negative gradient of potential function, relation between torque and angular momentum and their expression in terms of moment of inertia. The gravitational potential of different bodies and reduction of two body problems in terms of one body problem, planetary motion, the basic idea of simple harmonic motion and the idea of damped vibration, the application of Coriolis force, relativity theory, and mass-energy relation in relativistic kinematics.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Fundamental of Dynamics**					
	A	Reference frames, Inertial frames, Galilean transformations, Galilean invariance, Review of Newton's Laws of Motion	2	To understand the fundamentals of dynamics, frame of reference, and Newton's laws	Lecture, discussion with problem solving	Asking questions during the class, giving assignments, and through short test multiple choice question
	B	The momentum of the variable mass system: motion of the rocket. Dynamics of a system of particles. Principle of conservation of momentum. Impulse.	2	To understand the concept of momentum of the variable mass system and its application	Lecture, discussion with problem solving	
	C	Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D).	1	To understand the c.m. of different objects	Lecture, discussion with problem solving	
II	**Work and Energy**					

	A	Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable, unstable, and neutral equilibrium. Force is the gradient of potential energy. Work & Potential Energy. Work done by non-conservative forces.Law of Conservation of Energy	5	To understand the basic concept of work and energy. Calculation of problems in work and its relation to energy and conservation laws	Lecture, discussion with problem solving	Asking questions during the class, giving assignments, and through short test multiple choice question
	B	Elastic (1-D and 2-D) and inelastic collisions. Centre of Mass and Laboratoryframes.	4	To understand the principles of collision. The difference between the c.m. frame and the laboratory frame	Lecture, discussion with problem solving	
III	**Rotational Dynamics**					
	A	Angular momentum of a particle and system of particles. Torque	2	To understand the angular momentum of a system of particles and its relation with torque	Lecture, discussion with problem-solving, and PowerPoint presentation	Asking questions during the class, giving assignments, and through short test multiple choice question
	B	Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of inertia	2	To understand the conservation law of angular momentum and the relation between angular and m.I.	Lecture, discussion with problem-solving, and PowerPoint presentation	
	C	Theorem of parallel and perpendicular axes of M.I.	2	To understand the theorem of M.I. of their application.	Lecture, discussion with problem-solving, and PowerPoint presentation	

	D	Determination of moment of inertia of discrete and continuous objects [1-D, 2-D & 3-D (rectangular, cylindrical and spherical)].	2	To understand the calculation of M.I. of a ring, rectangular lamina, and cylindrical body	Lecture, discussion with problem-solving, and PowerPoint presentation	
	E	The kinetic energy of rotation. Motion involving both translation and rotation.	2	To understand the calculation of K.E. of rotation and motion of the body moving in general motion	Lecture, discussion with problem-solving, and PowerPoint presentation	
IV	**Gravitation and Central Force Motion**					
	A	Law of gravitation. Gravitational potential energy	1	To understand the law of gravitation and the concept of gravitational potential energy	Lecture, discussion with problem-solving, and PowerPoint presentation	Asking questions during the class, giving assignments, and through short test multiple choice question
	B	Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere	1	To understand between gravitational mass and inertial mass and the calculation of field and pot. Of spherical shell and solid sphere	Lecture, discussion with problem-solving, and PowerPoint presentation	
	C	Two-body problem, its reduction to one-body problem and its solution.	2	To be able to derive the reduction formula of two body problems in a single body problem	Lecture, discussion with problem-solving, and PowerPoint presentation	

	D	Reduction of angular momentum, kinetic energy, and total energy. The energy equation and energy diagram	2	To be able to derive the expression of angular momentum, and energy and can draw an energy diagram	Lecture, discussion with problem-solving, and PowerPoint presentation	
	E	Kepler's Laws. Satellites in circular orbit, Geosynchronous orbits.	3	To acquire knowledge of planetary motion and geostationary satellite	Lecture, discussion with problem-solving, and PowerPoint presentation	
V	**Oscillation**					
	A	The idea of SHM. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy, and their time-average values	3	To acquire a thorough knowledge of SHM. They will be able to drive the differential equation and KE, PE of SHM	Lecture, discussion with problem-solving, and PowerPoint presentation	
	B	Compound pendulum. Damped oscillation	2	Able to drive the time period of a Compound pendulum will understand different types of oscillations and can derive the expression of natural frequency of damped oscillation.	Lecture, discussion with problem-solving, and PowerPoint presentation	Asking questions during the class, giving assignments, and through short test multiple choice question
	C	Non-inertial frames and fictitious forces. Uniformly rotating frame	4	To have the idea of a non-inertial frame and will be able to explain the phenomenon of uniformly rotating bodies and be able to find the value of Coriolis force and centrifugal force.	Lecture, discussion with problem-solving, and PowerPoint presentation	

	D	Coriolis force and its applications	3	To understand how to apply Coriolis force to (i) a particle moving in a horizontal plane (2) the free fall of a body on earth's surface	Lecture, discussion with problem-solving, and PowerPoint presentation	
VI	**Special Theory of Relativity**					
	A	Michelson-Morley Experiment. Postulates of Special Theory of Relativity. Lorentz Transformations	3	Can be able to explain Michelson-Morley Expt. and Lorentz transformation and also be able to postulate the theory of relativity	Lecture, discussion with problem-solving, and PowerPoint presentation	
	B	Simultaneity, Length contraction, Time dilation. Relativistic transformation of velocity, acceleration, frequency, and wave number. Mass of relativistic particle. Mass-less Particles.	3	To acquire the concept of length contraction, time dilation, and relativistic transformation of velocity. Can derive the expression for the mass of relativistic particle.	Lecture, discussion with problem-solving, and PowerPoint presentation	Asking questions during the class, giving assignments, and through short test multiple choice question
	C	Mass-energy Equivalence. Relativistic Doppler effect	3	To be able to derive the relation between mass and energy and also understand the concept of the relativistic Doppler effect	Lecture, discussion with problem-solving, and PowerPoint presentation	
	D	Relativistic Kinematics	3	Can learn how to apply relativistic kinematics in decay problems in the elastic collision and Compton effect	Lecture, discussion with problem-solving, and PowerPoint presentation	

	E	Transformation of Energy and Momentum	3	Will be able to understand the phenomenon of transformation of energy and momentum	Lecture, discussion with problem-solving, and PowerPoint presentation	

Reference Book:

1. An introduction to Mechanics (2/e): Daniel Kleppner and Robert kolenkow
2. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel
3. Mechanics, D.S. Mathur
4. Special theory of Relativity, Resnick

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ORIENTAL COLLEGE (AUTONOMOUS), TAKYEL, IMPHAL
TEACHING PLAN
(B.Sc.)
Name of Department: PHYSICS

Semester – I Year- 2022 (July-December)

Paper Name: Physics Workshop Skills Paper Code: PHY – SE 501

No. of Hours per Week	Credits	Total No. of Hours	Marks
4hr/week	3 (Theory)	45	CIA-40 End Sem (Theory – 45)

Course Objectives:

1) To introduce to the students: To familiarize and experience with various mechanical and electrical tools through hands-on mode.
2) To assist them: The students will understand the working of various measuring devices and different types of machines.
3) To acquaint the students: Will develop the mechanical skills of the students by direct exposure to different machines.

Course Outcomes:

Upon completion of this course, the students will be able to

1) **Get acquainted with**: Students will learn the use of measuring devices like Vernier Calipers, Screw gauges, traveling microscopes, and Sextant.
2) **Appreciate the**: Acquire skills in the usage of multimeters, soldering iron, oscilloscopes, etc.
3) **Understand the**: Use of casting, foundry, and welding and will be familiar with common machine tools like lathe, shaper, drilling, and cutting machines.
4) **Enhance their**: Students will get the knowledge of measuring small quantities, drilling metal sheets and cutting an also electrical fitting of domestic wiring.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Introduction**					
	A	Vernier caliper, Screw gauge, and traveling microscope. Measure the dimensions of a solid block, the volume of a cylindrical beaker/glass, the diameter ofa thin wire, the thickness of a metal sheet,	7	To understand the use of Vernier Calliper, Screw Gauge, and Travelling Microscope to measure small distances.	Lecture, discussion with practical	Asking questions during the class, giving assignments, and practical
	B	Use of Sextant to measure the height of buildings, mountains, etc.	3	To understand the principle of use of Sextant at the height of a building	Lecture, discussion with Practical	
II	**Mechanical Skill**					
	A	Casting, foundry, machining, forming and welding. Types of Welding Joints and Welding Defects	5	To understand the basic use of different types of welding machine	Lecture, discussion with practical	Asking questions during the class, giving assignments, and practical
	B	Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling, and surface machines	5	To understand the use of a drilling machine	Lecture, discussion with practical	
	C	Cutting tools, lubricating oils. Cutting off a metal sheet using a blade. Smoothening of the cutting edge of the sheet using a file	5	To understand the use of a cutting machine	Lecture, discussion with practical	
	D	Drilling of holes of different diameter in metal sheets and wooden block	5	To understand the use of a drilling machine	Lecture, discussion with practical	

	E	Use of bench vice and tools for fitting. Make a funnel using a metal sheet.	5	To understand the fitting of electrical wiring	Lecture, discussion with practical	
III	**Introduction to prime movers**					
	A	Mechanism, gear system, wheel, Fixing of gears with motoraxel.	5	To understand the mechanism of the gear system of the machine	Lecture, discussion with practical	Asking questions during the class, giving assignments, and practical
	B	Lever mechanism, lifting of heavy weight using a lever. braking systems, pulleys, and the working principle of power generation systems. Demonstration of pulley experiment	5	To understand the basic principle of the lever, braking system, and pulley	Lecture, discussion with practical	

Reference Book:

1. A test book in Electrical Technology- B L Theraja
2. Performance and design of AC machines – MG Say
3. Mechanical Workshop practice – KC John

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ORIENTAL COLLEGE (AUTONOMOUS), TAKYEL, IMPHAL
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(B.Sc.)
Name of Department: PHYSICS

Semester – II Year- 2023 (January-June)

Paper Name: Electricity and Magnetism Paper Code: PHY – HC 503

No. of Hours per Week	Credits	Total No. of Hours	Marks
4hr/week	4 (Theory)	60	CIA-40 End Sem (Theory – 45)

Course Objectives:

1) To introduce to the students: The concepts of electricity and magnetism were introduced to the students. The network theorems were also introduced to the students.
2) To assist them in: The students will gain an idea about electric field, electric potential, electric potential, etc.
3) To acquaint the students: Will develop the concept of electricity and magnetism and capacitors as well as the network in electricity.

Course Outcomes:

Upon completion of this course, the students will be able to

1) **Get acquainted with**: The application of Gauss theorem, Laplace's and Poisson equations magnetic properties of matter, etc.
2) **Appreciate the**: Acquire the knowledge of electricity and magnetism and their relation and also a.c. circuit and network circuit.
3) **Understand the**: Idea of Gauss's law and its application in electricity, calculation of capacitance of different capacitors. Faraday's law and its application.
4) **Enhance their**: Students will get advanced knowledge of electricity and magnetism.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Electricity Field and Electric Potential**					
	A	Electric field: Electric field lines. Electric flux. Gauss Law with applications to charge distributions with spherical, cylindrical, and planar symmetry.	6	To understand the basic concept of electric lines of force and flux, and the application of Gauss law	Lecture, discussion with PPT presentation	Asking questions during the class, giving assignments and unit test
	B	Electrostatic Potential Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole	6	To acquire the knowledge of electrostatic potential and the potential and field of dipole	Lecture, discussion with PPT presentation	
	C	Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor.	5	To derive the electrostatic energy of a sphere and to acquire the knowledge of a conductor in an electrostatic field	Lecture, discussion with PPT presentation	
	D	The capacitance of a system of charged conductors. Parallel-plate capacitor. The capacitance of an isolated conductor. Method of Images and its Application to (1) Plane Infinite Sheet and (2) Sphere.	5	To understand the basic concept of a capacitor and determine the capacitance of a parallel plate capacitor. To understand the basic concept of the method of images and its application	Lecture, discussion, PPT, and Illustration.	

	E	Electric Field in Matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant	4	To understand the basic concept of dielectric properties and the difference between polar and non-polar dielectric. To understand the idea of susceptibility and dielectric constant	Lecture, discussion, PPT, and Illustration.	
	F	Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P**	4	To derive the capacitance of a parallel and spherical capacitor with and without a dielectric medium. And the relation between E, P, D	Lecture, discussion, PPT and Illustration	
II	**Magnetic Field**					
	A	Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole).	3	To recall the concept of magnetic field and application of Biot-Savart's law to calculate the magnetic field of straight wire, circular loop, and action of current carrying loop as a magnetic dipole	Lecture, discussion, PPT and Illustration	Asking questions during the class, giving assignments and unit test
	B	Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence	53	To understand the application of Ampere's circuital law and its application	Lecture, discussion, PPT and Illustration	

	C	Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.	3	Can calculate the magnetic force on point charge, current carrying wire, and torque acting to a current loop in a magnetic field	Lecture, discussion, PPT and Illustration	
	D	Magnetization vector (**M**). Magnetic Intensity (**H**). Magnetic Susceptibility and permeability. Relation between **B**, **H**, **M**. Ferromagnetism. B-H curve and hysteresis.	4	To understand the concept of magnetization, magnetic field intensity, and magnetic susceptibility and their relation	Lecture, discussion, PPT and Illustration	
	E	Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem.	3	To understand Faraday's law of electromagnetic induction and the concept of self and mutual inductance	Lecture, discussion, PPT and Illustration	
	F	Energy is stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.	3	Can calculate the magnetic energy and the basic idea of Maxwell's equation and conservation of charge.	Lecture, discussion, PPT and Illustration	
III	**Electrical Circuit**					
	A	AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance.	3	To understand about the Kirchhoff's laws for AC	Lecture, discussion, PPT and Illustration	

	B	Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit	2	Can calculate the resonance, power, quality factor, and band width in an LCR circuit	Lecture, discussion, PPT and Illustration	Asking questions during the class, giving assignments and unit test
	C	Ideal constant-voltage and constant-current Sources. Review of Kirchhoff's Current Law& Kirchhoff's Voltage Law. Mesh &Node Analysis	3	To understand current and voltage sources and also understand KVL and KCL	Lecture, discussion, PPT and Illustration	
	D	Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem. Applications to dc circuits	3	Can derive different network theorem in electricity	Lecture, discussion, PPT and Illustration	

Reference Book:

1. Introduction to Electrodynamics -D.J. Griffiths
2. Network, Line and Fields- John D. Ryder
3. Problems and Solutions in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan &Ravi Varshney.

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ORIENTAL COLLEGE (AUTONOMOUS), TAKYEL, IMPHAL
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(B.Sc.)

Name of Department: PHYSICS

Semester – II Year- 2023 (January-June)

Paper Name: Waves and Optics Paper Code: PHY – HC 504

No. of Hours per Week	Credits	Total No. of Hours	Marks
4hr/week	4 (Theory)	60	CIA-40 End Sem (Theory – 45)

Course Objectives:

1) To introduce to the students: The review of the concepts of wave and oscillation in a more advanced perspective.
2) To assist them in: The idea of superposition of harmonic oscillations leading to physics of traveling and standing waves.
3) To acquaint the students: Will prove an depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications.

Course Outcomes:

Upon completion of this course, the students will be able to

1) **Get acquainted with**: Can understand the Simple Harmonic oscillation and superposition principle.
2) **Appreciate the**: Acquire the knowledge of different types of waves and their velocities: Plane, Spherical, Transverse, and Longitudinal.
3) **Understand the**: Concept of normal modes in traverse and longitudinal waves and interference of waves.
4) **Enhance their**: Students will get advance knowledge of wave and oscillation and their related phenomena.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Superposition of Collinear Harmonic Oscillations**					
	A	Simple harmonic motion (SHM). Linearityand Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats).	3	To understand the basic concept of SHM and the superposition of collinear oscillations	Lecture, discussion with PPT presentation	Asking questions during the class, giving assignments and unit test
	B	Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences	3	To acquire the knowledge of N collinear Harmonic oscillations with equal phase and frequency	Lecture, discussion with PPT presentation	
	C	Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses.	2	Can understand graphical and analytical analysis of Lissajous figures	Lecture, discussion with PPT presentation	
	D	Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves.	2	To understand the basic concept of different types of waves	Lecture, discussion, PPT, and Illustration.	
	E	Wave Equation. Particle and Wave Velocities. The pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.	2	To understand the wave equation, velocity, and transport of energy	Lecture, discussion, PPT, and Illustration.	

	F	Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes concerning Position and Time. Energy of Vibrating String.	4	To understand the basic idea of wave on a string and analysis of phase and group velocities	Lecture, discussion, PPT and Illustration	
	G	Transfer of Energy. Normal Modes of stretched strings, Longitudinal Standing Waves, and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.	4	Can derive the energy transfer on normal modes of stretched strings. Operation of open and closed pipers.	Lecture, discussion, PPT and Illustration	
II	**Wave Optics**					
	A	Electromagnetic nature of light. Definition and properties of the wavefront. Huygens Principle. Temporal and Spatial Coherence.	4	To recall the concept of wave nature of light and Huygens principle in optics	Lecture, discussion, PPT and Illustration	Asking questions during the class, giving assignments and unit test
	B	Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films	5	To understand the idea of interference of light and the experiment of Young's double-slit experiment	Lecture, discussion, PPT and Illustration	
	C	Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.	5	Can calculate the fringe wide and wavelength using Newton's Ring experiment	Lecture, discussion, PPT and Illustration	

	D	Michelson Interferometer- (1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5)Visibility of Fringes. Fabry-Perot interferometer.	6	To understand the Michelson Interferometer and its applications	Lecture, discussion, PPT and Illustration	
III	**Diffraction**					
	A	Single slit. Rectangular and Circular aperture, Resolving Power ofa telescope	5	To understand the single slit diffraction and calculation of resolving power of telescope	Lecture, discussion, PPT and Illustration	Asking question during the class, giving assignment and unit test
	B	Double slit. Multiple slits. Diffraction grating. Resolving power of grating	5	To understand the double slit experiment and resolving power of grating	Lecture, discussion, PPT and Illustration	
	C	Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light.	5	To understand the assumptions of Fresnel's Half period zones for plane wave	Lecture, discussion, PPT and Illustration	
	D	Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Cornu`s spiral, and its applications. Straight edge, a slit, and a wire.	5	The concept of zone plate and Fresnel's Integral, Cornu's spiral and its application	Lecture, discussion, PPT and Illustration	

Reference Book:

1) Fundamentals of Optics, F.A. Jenkins and H.E. White
2) The Physics of Vibrations and Waves, H. J. Pain
3) The Physics of Waves and Oscillations, N.K. Bajaj

Course Instructor:

1) Dr. Kh. Keinahanbi Devi
2) Ksh. Satyabala Devi
3) Dr. S. Nabadwip Singh
4) Dr. N. Nilima Chanu

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HOD

ORIENTAL COLLEGE (AUTONOMOUS), TAKYEL, IMPHAL
TEACHING PLAN

(B.Sc.)

Name of Department: PHYSICS

Semester – II Year- 2023 (January-June)

Paper Name: Renewable Energy and Energy Harvesting

Paper Code: PHY – SE 502

No. of Hours per Week	Credits	Total No. of Hours	Marks
4hr/week	4 (Theory)	45	CIA-40 End Sem (Theory – 45)

Course Objectives:

1) To introduce to the students: The idea of various alternate energy sources to teach the ways of harvesting energy.
2) To assist them in: The idea of harvesting energy using wind, solar, mechanical, ocean, and geothermal energy.
3) To acquaint the students: the review of the working of various energy harvesting systems which are installed worldwide.

Course Outcomes:

Upon completion of this course, the students will be able to

1) **Get acquainted with**: Can understand the knowledge of various sources of energy harvesting.
2) **Appreciate the**: Acquire the knowledge of different types sources of energy
3) **Understand the**: Concept of knowledge about renewable energy technologies, different storage technologies, etc.
4) **Enhance their**: Students will gain hands-on experience of different kinds of alternative energy sources, conservation of vibration into voltage using piezoelectric material, etc.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Fossil fuels and Alternate Sources of Energy**					
	A	Fossil fuels and nuclear energy, their limitation, the need for renewable energy, and non-conventional energy sources. An overview of developments in Offshore Wind Energy,	3	To understand the basic concept of renewable energy their uses	Lecture, discussion with PPT presentation	Asking questions during the class, giving assignments and unit test
	B	Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, bio-gas generation, geothermal energy tidal energy, Hydroelectricity	2	To acquire knowledge of tidal, ocean wave, solar energy	Lecture, discussion with PPT presentation	
II	**Solar energy**					

	A	Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of the solar pond and solar energy, solar water heater,flat plate collector, solar distillation, solar cooker, solar greenhouses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun-tracking systems.	5	To understand solar energy and its different form of uses	Lecture, discussion with PPT presentation	
III	**Wind Energy harvesting**					
	A	Fundamentals of Wind energy, Wind Turbines, and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.	5	To understand the use of wind energy	Lecture, discussion, PPT, and Illustration.	

IV	**Ocean Energy**					
	A	Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.	5	To understand the use of ocean energy	Lecture, discussion, PPT, and Illustration.	
	B	Geothermal Resources, Geothermal Technologies. **Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydropower sources. Rainwater harvesting	5	To understand the use of Geothermal and hydroelectricity	Lecture, discussion, PPT and Illustration	
V	**Piezoelectric Energy harvesting**					
	A	Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezo-electricity,	5	To recall the concept piezoelectric effect and its mathematical formula	Lecture, discussion, PPT and Illustration	Asking questions during the class, giving assignments and unit test
	B	Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power	5	To understand the piezoelectric modeling and harvesting application	Lecture, discussion, PPT and Illustration	
	C	Linear generators, physical/mathematical models, recent applications Carbon captured technologies, cell, batteries, power consumption	5	To understand the mathematical models for carbon captured	Lecture, discussion, PPT and Illustration	

	D	Environmental issues and Renewable sources of energy, sustainability. Merits of Rain Water harvesting.	5	To understand the environmental issues and rainwater harvesting	Lecture, discussion, PPT and Illustration	

Reference Book:

1. Non-conventional energy sources, B.H. Khan,
2. Solar energy, Suhas P Sukhative,
3. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle
4. Solar Energy: Resource Assessment Handbook, P Jayakumar

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