CO-PO attainment
in
CCFUP Programme
in
Outcome Based Education

Department of Physics

Government General Degree College, Kalna-I

Program Outcome (PO)

- ❖PO1: Disciplinary knowledge
- ❖PO2: Communication Skills
- ❖PO3: Critical thinking
- ❖PO4 : Problem solving
- ❖PO5: Self directed learning
- ❖PO6: Research-related skills
- ❖PO7: Scientific reasoning
- ❖PO8: Information/digital literacy
- ❖PO9: Lifelong learning

Program Specific Outcome (PSO): UG Physics

- ❖PSO1: **Foundation for Theoretical Concepts of Physics:** To use theoretical methodologies to explain physical laws around us.
- ❖PSO2: **Foundation for Experimental/Numerical tools of Physics :** The ability to implement/visualize the theoretical knowledge through laboratory based experimental /numerical techniques.
- ❖PSO3: **Foundation for possible further developments** : The ability to grasp the scientific ideas behind different physical laws and connecting them to broad area of real life applications and provide new ideas and innovations towards research.

Course Content

Semester: I

Course code : Major-Physics

Course name: Mathematical Physics-I

Course Code: PHYS1011
(Credits: Theory-03, Practicals-01)

MAJOR-I: F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The aim of this course is to equip the students with mathematical methods that are important prerequisites for physics courses.

Theory: 45 Lectures

Calculus:

Recapitulation: Limits, Continuity, Average and instantaneous quantities, Differentiation. Plotting functions. Intuitive ideas of continuous, differentiable etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). (3 Lectures)

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of the existence and the Uniqueness theorem for Initial Value Problems. Particular Integral. (9 Lectures)

Calculus of functions of more than one variable: Partial derivatives, Exact and inexact differentials. (6 Lectures)

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. (5 Lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. (6 Lectures)

Vector Integration: Ordinary integrals of vectors, Multiple integrals, Jacobian. Notion of an infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field, Gauss' divergence theorem. Green's and Stokes Theorems and their applications (no rigorous proofs). (10 Lectures)

Orthogonal Curvilinear Coordinates: Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. (6 Lectures)

Practical: 30 Lectures

Introduction and Overview: Computer architecture and organization, Memory, Input/Output devices.

Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, Algorithms, Sequence, Selection and Repetition, Single and double precision arithmetic, Underflow and overflow, Emphasize the importance of making equations in terms of dimensionless variables, Iterative methods.

Errors and Error-Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations.

Review of C & C++ Programming Fundamentals: Introduction to Programming, Constants, Variables, Data types, Operators and expressions, I/O statements, scanf and printf, cin and cout, Manipulators for data formatting, Control statements (Decision making statements: if statement, if else Statement, Nested if structure, else if ladder statement, Ternary Operator, goto statement, switch case statement. Unconditional and conditional looping: while loop, do-while loop, for loop, break and continue statements, Nested loops). Arrays (1D & 2D), Strings, User defined functions, Structure and Union, Idea of classes and objects.

1. Write and execute a program in C/C++ to compute the factorial of a positive integer including Zero.
2. Write and execute a program in C/C++ to calculate sum of squares of n natural numbers.
3. Write and execute a program in C/C++ to find the area and the volume of a Sphere by varying the radius.
4. Write and execute a program in C/C++ to display Fibonacci series.
5. Write and execute a program in C/C++ to find the value of Sine function using power series
6. Write and execute a program in C/C++ to find the value of Cosine function using power series
7. Write and execute a program in C/C++ to find the value of ex (x will be given during execution of the program).
8. Write and execute a program in C/C++ to sort elements of an array of elements in ascending/ descending order.
9. Write and execute a program in C/C++ to separate odd and even integers in arrays.
10. Write and execute a program in C/C++ to find the largest and smallest in a given set of numbers.
11. Write and execute a program in C/C++ to calculate value of π.

Course Outcome (CO)		Paper: PHYS1011		
Sl. No.	**Course Outcome (CO)**	**Knowledge Level**	**POs**	**PSOs**
Theory				
1	**Discussion** of the fundamental concepts of calculus, graphical representation, and approximation techniques. **Identification** and classification of different types of differential equations.	**L1: Remembering**	**1,2,3,7,8,9**	**1,2,3**
2	**Computation** of the First Order and Second Order Differential Equations, and solution of Particular Integral of a non-homogeneous linear differential equation. **Demonstration** of the concept of Partial derivatives.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Discussion** of the fundamental properties of vector algebra.	**L1: Remembering**	**1,2,3,4,5,7,9**	**1,2,3**
4	**Computation** of the differentiation and integration of vector fields and application of the techniques to solve problems in electromagnetism, fluid dynamics, and other fields.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
5	**Development** of a deeper understanding of orthogonal curvilinear coordinate systems of vector calculus and its geometric underpinnings.	**L6: Creating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
Practical				
1	**Outline** of the C Programming fundamentals	**L1: Remembering**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Computation** of basic mathematical operation using C programinning	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**

Programme Articulation Matrix (CO-PO Matrix)

CO		Program Outcome (PO) & Program Specific Outcome (PSO)											
		PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3
Theory	1	3	3	2	-	-	-	2	3	3	3	2	2
	2	3	3	2	2	2	2	2	2	2	2	2	2
	3	2	2	3	3	3	-	3	-	3	3	3	3
	4	3	3	3	3	3	3	3	2	2	2	3	3
	5	3	2	3	3	2	3	3	2	2	2	3	3
Practical	1	3	3	3	3	3	3	3	3	3	3	3	3
	2	3	3	3	3	3	3	3	3	3	3	3	3
	Average	2.9	2.7	2.7	2.8	2.7	2.8	2.7	2.8	2.6	2.6	2.7	2.7

Course Content

Semester: I

Course code : SEC-1: PHYS1051

Course name: RENEWABLE ENERGY AND ENERGY HARVESTING
(Credits: Theory-03)

SEC-1: F.M.=50 (Theory-40, Internal Assessment–10)

Theory

COURSE OBJECTIVE: The aim of this course is to impart knowledge about Renewable energy and energy harvesting in context of energy crisis and provide them with exposure and hands-on learning wherever possible.

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.
(3 Lectures)

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.
(6 Lectures)

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.
(3 Lectures)

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. (3 Lectures)
Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. (2 Lectures)

Geothermal Energy: Geothermal Resources, Geothermal Technologies. (2 Lectures)

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. (2 Lectures)

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power. (4 Lectures)
Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications. (2 Lectures)
Carbon captured technologies, cell, batteries, power consumption. (2 Lectures)
Environmental issues and Renewable sources of energy, sustainability. (1 Lecture)

Course Outcome (CO) **Paper: SEC-1: PHYS1051**

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	POs	PSOs
1	**Identify** renewable and non-renewable energy sources in the context of energy crisis	**L1: Remembering**	**1,2,3,5,9**	**1,2,3**
2	**Give example** of Solar, Wind, Geothermal, Ocean, Hydro energy sources	**L2: Understanding**	**1,2,3,4,5,7,9**	**1,2,3**
3	**Demonstrating** the fundamental ideas of Piezoelectric and Electromagnetic Energy harvesting	**L3: Applying**	**1,2,3,5,6,7,9**	**1,2,3**
4	**Illustrate** the basic concepts of Carbon capture technologies and Environmental issues along with sustainability of Renewable sources of energy	**L4: Analyzing**	**1,2,3,5,7,8,9**	**1,2,3**

Programme Articulation Matrix (CO-PO Matrix)

CO	Program Outcome (PO) & Program Specific Outcome (PSO)											
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO 3
1	3	3	2	-	2	-	-	-	2	3	3	2
2	3	3	2	2	2	-	2	-	2	3	3	3
3	2	2	3	-	3	2	3	-	3	2	2	3
4	3	3	3	-	3	-	3	2	3	2	3	3
Average	2.8	2.8	2.5	2.0	2.5	2.0	2.6	2.0	2.5	2.7	2.8	2.5

Course Content

Semester: I

Course code : Minor-Physics

Course name: Mathematical Physics-I

Course Code: PHYS1021
(Credits: Theory-03, Practicals-01)

MINOR-I: F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The aim of this course is to equip the students with mathematical methods that are important prerequisites for physics courses.

Theory: 45 Lectures

Calculus:

Recapitulation: Limits, Continuity, Average and instantaneous quantities, Differentiation. Plotting functions. Intuitive ideas of continuous, differentiable etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). (3 Lectures)

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of the existence and the Uniqueness theorem for Initial Value Problems. Particular Integral. (9 Lectures)

Calculus of functions of more than one variable: Partial derivatives, Exact and inexact differentials. (6 Lectures)

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. (5 Lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. (6 Lectures)

Vector Integration: Ordinary integrals of vectors, Multiple integrals, Jacobian. Notion of an infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field, Gauss' divergence theorem. Green's and Stokes Theorems and their applications (no rigorous proofs). (10 Lectures)

Orthogonal Curvilinear Coordinates: Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. (6 Lectures)

Practical: 30 Lectures

Introduction and Overview: Computer architecture and organization, Memory, Input/Output devices.

Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, Algorithms, Sequence, Selection and Repetition, Single and double precision arithmetic, Underflow and overflow, Emphasize the importance of making equations in terms of dimensionless variables, Iterative methods.

Errors and Error-Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations.

Review of C & C++ Programming Fundamentals: Introduction to Programming, Constants, Variables, Data types, Operators and expressions, I/O statements, scanf and printf, cin and cout, Manipulators for data formatting, Control statements (Decision making statements: if statement, if else Statement, Nested if structure, else if ladder statement, Ternary Operator, goto statement, switch case statement. Unconditional and conditional looping: while loop, do-while loop, for loop, break and continue statements, Nested loops). Arrays (1D & 2D), Strings, User defined functions, Structure and Union, Idea of classes and objects.

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8. Write and execute a program in C/C++ to sort elements of an array of elements in ascending/ descending order.
9. Write and execute a program in C/C++ to separate odd and even integers in arrays.
10. Write and execute a program in C/C++ to find the largest and smallest in a given set of numbers.
11. Write and execute a program in C/C++ to calculate value of π.

Course Outcome (CO)		Paper: PHYS1021		
Sl. No.	**Course Outcome (CO)**	**Knowledge Level**	**POs**	**PSOs**
Theory				
1	**Discussion** of the fundamental concepts of calculus, graphical representation, and approximation techniques. **Identification** and classification of different types of differential equations.	**L1: Remembering**	**1,2,3,7,8,9**	**1,2,3**
2	**Computation** of the First Order and Second Order Differential Equations, and solution of Particular Integral of a non-homogeneous linear differential equation. **Demonstration** of the concept of Partial derivatives.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Discussion** of the fundamental properties of vector algebra.	**L1: Remembering**	**1,2,3,4,5,7,9**	**1,2,3**
4	**Computation** of the differentiation and integration of vector fields and application of the techniques to solve problems in electromagnetism, fluid dynamics, and other fields.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
5	**Development** of a deeper understanding of orthogonal curvilinear coordinate systems of vector calculus and its geometric underpinnings.	**L6: Creating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
Practical				
1	**Outline** of the C Programming fundamentals	**L1: Remembering**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Computation** of basic mathematical operation using C programinning	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**

Programme Articulation Matrix (CO-PO Matrix)

	CO	Program Outcome (PO) & Program Specific Outcome (PSO)											
		PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3
Theory	1	3	3	2	-	-	-	2	3	3	3	2	2
	2	3	3	2	2	2	2	2	2	2	2	2	2
	3	2	2	3	3	3	-	3	-	3	3	3	3
	4	3	3	3	3	3	3	3	2	2	2	3	3
	5	3	2	3	3	2	3	3	2	2	2	3	3
Practical	1	3	3	3	3	3	3	3	3	3	3	3	3
	2	3	3	3	3	3	3	3	3	3	3	3	3
	Average	2.9	2.7	2.7	2.8	2.7	2.8	2.7	2.8	2.6	2.6	2.7	2.7

Course Content

Semester: II (Major)
Course name: Mechanics

Course Code: Major: PHYS2011
(Credits: Theory-04, Practicals-02)

PHYS2011: F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamics of classical mechanical systems.

Theory: 45 Lectures

Fundamentals of Dynamics: Reference frames; Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. (6 Lectures)

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. (4 Lectures)

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. (3 Lectures)

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and pherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. (8 Lectures)

Elasticity: : Elastic properties of matter, Hooke's Law, Relation between Elastic constants, Twisting torque on a cylinder or a wire, Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane and a concentrated load W is applied at the midpoint. (4 Lectures)

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. (4 Lectures)

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). (6 Lectures)

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. (6 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. (4 Lectures)

COURSE OUTCOME: This course in Mechanics serves as the foundation for further progress towards the study of physics at graduate or post-graduate level. Upon completion of the course, the student will be able to apply Newton's laws of motion to different force fields for a single particle and for a system of particles.

Practical Paper:

1. To study the Motion of Spring and calculate (a) Spring constant,(b)gand (c)Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Course Outcome (CO)		Paper: PHYS2011		
Sl. No.	**Course Outcome (CO)**	**Knowledge Level**	**POs**	**PSOs**
Theory				
1	**Outline** the laws of Newtonian Mechanics leading to the ideas behind inertial reference frame and free body diagram.	**L1: Remembering**	**1,2,3,4,5,6,7,9**	**1,2,3**
2	**Distinguish** between various types of conservative and non-conservative systems, and illustrate these concepts using energy diagrams**.**	**L4: Analyzing**	**1,2,3,4,5,6,7,9**	**1,2,3**
3	**Demonstrate** the ideas behind rotational motion and moment of inertia in this aspect.	**L3: Applying**	**1,2,3,4,5,6,7,9**	**1,2,3**
4	**Illustrate** the central force and outline Gravitational field as an example of the same.	**L4: Analyzing**	**1,2,3,4,5,6,7,9**	**1,2,3**
5	**Discuss** the Simple Harmonic Oscillator as a general framework for studying bound systems in the perturbative regime, including an analysis of free and forced oscillators. Additionally, provide an **outline** of non-inertial reference frames, with examples such as the Coriolis force and centrifugal force.	**L1: Remembering**	**1,2,3,4,5,6,7,9**	**1,2,3**
Practical				
1	**Demonstrate** experimental verifications of different Mechanical properties like Spring constant, Young's Modulus, Modulus of Rigidity etc. of material of a wire.	**L3: Applying**	**1,2,3,4,5,6,7,9**	**1,2,3**
2	**Measure** gravitational acceleration due to Earth using Kater's pendulum method.	**L5: Evaluating**	**1,2,3,4,5,6,7,9**	**1,2,3**

Programme Articulation Matrix (CO-PO Matrix)

	CO	Program Outcome (PO)								
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Theory	1	3	3	2	3	3	2	3	-	3
	2	3	3	2	3	2	2	2	-	3
	3	3	2	2	3	2	3	2	-	3
	4	3	2	3	3	3	3	3	-	3
	5	3	2	3	3	3	3	3	-	3
Practical	1	3	3	3	3	2	2	3	-	3
	2	3	3	3	3	2	2	3	-	3
	Average	3	2.6	2.6	3	2.4	2.4	2.7	-	3

Course Content

Semester: II

Course name: ELECTRICAL CIRCUITS AND NETWORK SKILLS

Course Code: SEC-2: PHYS2051
(Credits: Theory-03)

SEC-2: PHYS2051: F.M.=50 (Theory-40, Internal Assessment–10)

COURSE OBJECTIVE: The aim of this course is to enable the students to understand the basics of electronic circuits. Practical design and trouble shoot of electronic instrument is also a major objective of this Couse.

Theory: 45 Lectures

COURSE OBJECTIVE: The aim of this course is to enable the students to understand the basics of electronic circuits. Practical design and trouble shoot of electronic instrument is also a major objective of this Couse.

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. (5 Lectures)

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyse DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyse AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. (8 Lectures)

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. (5 Lectures)

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. (5 Lectures)

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. (5 Lectures)

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources. (5 Lectures)

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device). (5 Lectures)

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. (7 Lectures)

COURSE OUTCOME: After the completion of the course the student will acquire necessary skills/ hands on experience /working knowledge on Multimeter, voltmeters, ammeters, electric circuit elements, dc power sources. With the knowledge of basic electronics a student can able to detect troubleshoot and repair some of the electronic instruments used in our daily life.

Course Outcome (CO) **Paper: SEC-2: PHYS2051**

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	Pos	PSOs
1	**Identify** Basic Electricity Principles and Understanding Electrical Circuits	**L1: Remembering**	**1,2,3,5,9**	**1,2,3**
2	**Explain** the principle of operation of Electric Generator, Transformer and Electric Motors	**L2: Understanding**	**1,2,3,4,5,7,9**	**1,2,3**
3	**Demonstrating** the fundamental ideas of Solid State Devices such as Resistors, inductors and capacitors. Diode and rectifiers	**L3: Applying**	**1,2,3,4,5,6,7,9**	**1,2,3**
4	**Outline** the fundamental ideas of Electrical Protection and Electrical Wiring.	**L4: Analyzing**	**1,2,3,4,5,7,8,9**	**1,2,3**

Programme Articulation Matrix (CO-PO Matrix)

CO	Program Outcome (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
1	3	3	2	-	2	-	-	-	2
2	3	3	2	2	2	-	2	-	2
3	2	2	3	3	3	2	3	-	3
4	3	3	3	3	3	-	3	2	3
Average	2.8	2.8	2.5	2.6	2.5	2.0	2.6	2.0	2.5

Course Content

Semester: II (Minor)
Course name: Mechanics

Course Code: Minor: PHYS2021
(Credits: Theory-04, Practicals-02)

PHYS2011: F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamics of classical mechanical systems.

Theory: 45 Lectures

Fundamentals of Dynamics: Reference frames; Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. (6 Lectures)

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. (4 Lectures)

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. (3 Lectures)

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and pherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. (8 Lectures)

Elasticity: : Elastic properties of matter, Hooke's Law, Relation between Elastic constants, Twisting torque on a cylinder or a wire, Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane and a concentrated load W is applied at the midpoint. (4 Lectures)

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. (4 Lectures)

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). (6 Lectures)

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. (6 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. (4 Lectures)

COURSE OUTCOME: This course in Mechanics serves as the foundation for further progress towards the study of physics at graduate or post-graduate level. Upon completion of the course, the student will be able to apply Newton's laws of motion to different force fields for a single particle and for a system of particles.

Practical Paper:

1. To study the Motion of Spring and calculate (a) Spring constant,(b)gand (c)Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Course Outcome (CO)		Paper: PHYS2021		
Sl. No.	**Course Outcome (CO)**	**Knowledge Level**	**POs**	**PSOs**
Theory				
1	**Outline** the laws of Newtonian Mechanics leading to the ideas behind inertial reference frame and free body diagram.	**L1: Remembering**	**1,2,3,4,5,6,7,9**	**1,2,3**
2	**Distinguish** between various types of conservative and non-conservative systems, and illustrate these concepts using energy diagrams**.**	**L4: Analyzing**	**1,2,3,4,5,6,7,9**	**1,2,3**
3	**Demonstrate** the ideas behind rotational motion and moment of inertia in this aspect.	**L3: Applying**	**1,2,3,4,5,6,7,9**	**1,2,3**
4	**Illustrate** the central force and outline Gravitational field as an example of the same.	**L4: Analyzing**	**1,2,3,4,5,6,7,9**	**1,2,3**
5	**Discuss** the Simple Harmonic Oscillator as a general framework for studying bound systems in the perturbative regime, including an analysis of free and forced oscillators. Additionally, provide an **outline** of non-inertial reference frames, with examples such as the Coriolis force and centrifugal force.	**L1: Remembering**	**1,2,3,4,5,6,7,9**	**1,2,3**
Practical				
1	**Demonstrate** experimental verifications of different Mechanical properties like Spring constant, Young's Modulus, Modulus of Rigidity etc. of material of a wire.	**L3: Applying**	**1,2,3,4,5,6,7,9**	**1,2,3**
2	**Measure** gravitational acceleration due to Earth using Kater's pendulum method.	**L5: Evaluating**	**1,2,3,4,5,6,7,9**	**1,2,3**

Programme Articulation Matrix (CO-PO Matrix)

	CO	Program Outcome (PO)								
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Theory	1	3	3	2	3	3	2	3	-	3
	2	3	3	2	3	2	2	2	-	3
	3	3	2	2	3	2	3	2	-	3
	4	3	2	3	3	3	3	3	-	3
	5	3	2	3	3	3	3	3	-	3
Practical	1	3	3	3	3	2	2	3	-	3
	2	3	3	3	3	2	2	3	-	3
	Average	3	2.6	2.6	3	2.4	2.4	2.7	-	3