Department of Physics
Government General Degree College at Kalna -I

Lesson Plan
for
B.Sc. Semester-II
Subject: Physics
Paper Name: Mechanics
Paper Code: Major: PHYS2011

Credits: Theory-03, Practicals-01
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.

Module-I **Fundamentals of Dynamics** (6 lectures)
Contents 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.
Module Objectives: In this module, Newtonian mechanics is developed from Galilean transformation. Three laws of motion and their implications are discussed. Finally, Newtonian framework is being used to solve different problems.

Lecture Serial	Topics of Discussion
Lecture-1	Review of basic ideas of Classical mechanics: Applicability, Limitation, Historical ideas
Lecture-2	Newton's laws of motion 1: Three laws with their importance. How 1st law is not a byproduct of 2nd law? Inertial frame as a fundamental idea of classical dynamics. Galilean transformation
Lecture-3	Newton's laws of motion 2: Problem solving using Newton's laws: Free body diagram
Lecture-4	Newton's laws of motion 3: Third law of motion and conservation of linear momentum
Lecture-5	Motion of a projectile in Uniform gravitational field and rocket motion.
Lecture-6	Dynamics of system of particles: Center of mass and its usefulness

Module-II **Work and Energy** (4 lectures)
Contents 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.
Module Objectives: Force and Energy in Mechanics. Conservative and non-conservative forces and their implication. Energy diagram as a qualitative tool to analyze motion.

Lecture Serial	Topics of Discussion
Lecture-1	Work-Kinetic Energy Theorem as general consequence of Newton's laws of motion.

Lecture-2	Conservative and non- conservative forces. Examples of both. Path independence of work done under conservative force field.
Lecture-3	Idea of potential energy in context of conservative forces and conservation of mechanical energy for conservative forces.
Lecture-4	Energy diagram as a tool of analyzing particles in conservative force field.

Module-III **Collisions** (3 lectures)
Contents Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.
Module Objectives: Theories Elastic and inelastic collision are discussed in this module.

Lecture Serial	Topics of Discussion
Lecture-1	Theory of collision and its significance in terms of modern aspects of Physics.
Lecture-2	Elastic, inelastic and partially elastic collisions. Co-efficient of restitution in this aspect.
Lecture-3	Laboratory frame and COM frame for analysis of collision.

Tutorial Assignment—I

Module-IV **Rotational Dynamics** (8 lectures)
Contents 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 spherical bodies.Kinetic energy of rotation. Motion involving both translation and rotation.
Module Objectives: Angular momentum being a key physical quantity is discussed in this module and its conservation principle is highlighted. Also, moment of inertia and its tensorial form is discussed in some detail which leads to concepts like principal axes of inertia and ellipsoid of inertia.

Lecture Serial	Topics of Discussion
Lecture-1	Rotational dynamics and key ideas about them.
Lecture-2	Angular momentum and Torque as key concepts in rotational dynamics.
Lecture-3	Angular momentum of a particle and system of particles and its conservation.
Lecture-4	Orbital and Spin angular momentum and their connection to orbital and Spin components of torque.
Lecture-5	Rotation about a fixed axis.Moment of Inertia tensor.
Lecture-6	Calculation of moment of inertia. Parallel axis and Perpendicular axis theorem
Lecture-7	Calculation of moment of inertia for rectangular, cylindrical and spherical bodies
Lecture-8	Kinetic energy of rotation. Ellipsoid of inertia. Motion involving both translation and rotation.

Module-V **Elasticity** (4 lectures)
Contents 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.

Module Objectives:
1. This module gives knowledge about different elastic constants and relation between them 2. one can get knowledge about twisting torque on a cylindrical wire and Torsional pendulum

Lecture Serial	Topics of Discussion
Lecture-1	Elastic constants: Hooke's law, stress-strain diagram, Youngs modulus, Bulk modulus, Rigidity modulus Poisson's ratio and relation between them
Lecture-2	Torsion of a wire: Work done in deforming a wire, Torsional Pendulum, Twisting torque on a Cylindrical Wire.
Lecture-3	Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane
Lecture-4	Bending of Beams: A concentrated load W is applied at the midpoint.

Tutorial Assignment—II

Module-VI **Gravitation and Central Force Motion** (4 lectures)
Contents Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Gravitational potential and the gravitational field due to a spherical shell and a solid sphere
Module Objectives: This unit gives idea about Gravitational potential energy and one can gain idea how to find Potential and field due to spherical shell and solid sphere inside and outside of it.

Lecture Serial	Topics of Discussion
Lecture-1	Basic theory of Gravitation: Law of gravitation.
Lecture-2	Gravitational potential energy. Inertial and gravitational mass.
Lecture-3	Potential and field due to spherical shell and solid sphere
Lecture-4	Potential and field inside and outside of a spherical shell and solid sphere and their graphical variation with distance

Module-VII **Motion of a particle under a central force field** (6 lectures)
Contents 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).
Module Objectives: 1. This unit delivers idea about the motion of a particle under central force field and the energy equation and energy diagram. 2. One can get idea about equation and types of orbits of a particle depending upon its energy. 3. One can also get knowledge about Kepler's Laws. 4. Basic idea about communication satellite can also be obtained.

Lecture Serial	Topics of Discussion
Lecture-1	Two-body problem and its reduction to one-body problem and its solution
Lecture-2	Central force: Definition and general properties, Form of equation of motion.
Lecture-3	The energy equation and energy diagram: Effective potential, Motion of a particle in inverse square field, Equation of orbit.
Lecture-4	Kepler's Laws: Kepler's Laws and their proofs

Lecture-5	Satellite in circular orbit and applications: Communication Satellites
Lecture-6	Geosynchronous orbits. Weightlessness, Basic idea of global positioning system (GPS).

Tutorial Assignment—III

Module-VIII **Oscillations** (6 lectures)
Contents Simple Harmonic Oscillations: Differential equation of SHM and its solution, Kinetic energy, potential energy, Total energy and their time-averaged values. Damped oscillation, Forced oscillations: Transient and steady states, Resonance, Sharpness of resonance, Power dissipation and Quality Factor, Compound pendulum.
Module Objectives: In this module, students will learn the motion of a simple harmonic oscillator and analyze the same in different domains.

Lecture Serial	Topics of Discussion
Lecture-1	Simple Harmonic Oscillations: definition, different examples
Lecture-2	Differential equation of SHM and its solution: $x(t) = A \sin(\omega t+\phi)$ significance of A and ϕ
Lecture-3	Energy of Simple harmonic oscillator: Kinetic energy, potential energy, total energy and their time-average values
Lecture-4	Damped oscillation: Solutions for (i) over, (ii) critical and (iii) under damping and its interpretation
Lecture-5	Forced oscillations: Transient and steady states
Lecture-6	Resonances: Amplitude resonance, velocity resonance. Power dissipation and Quality Factor

Module-IX **Non-Inertial Systems** (4 lectures)
Contents 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.
Module Objectives: In this module, non-inertial frames will be discussed and physics in the same will be highlighted via Galilean transformations

Lecture Serial	Topics of Discussion
Lecture-1	Non-inertial frames and fictitious forces as their by-product.
Lecture-2	Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.
Lecture-3	Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.
Lecture-4	Apply the ideas of non-inertial frames to explain Foucault's pendulum and hence understand the rotation of earth.

Tutorial Assignment—IV

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.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.

3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
6. An Introduction to Classical Mechanics, R G Takwale & P S Puranik, TMG Hill.
7. Mechanics, P K Srivastava, New Age International Pvt. Ltd.
8. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
9. Vibrations, Waves and Acoustics, D Chattopadhyay and P C Rakshit, Books and Allied Pvt. Ltd.
10. Advanced Acoustics, D P Roychaudhuri and P Banerjee, The New Book Stall, 2009

Practical

Course Object:
1.To gain practical knowledge by applying the experimental methods to correlate with the theory of classical mechanics.
2. To apply the analytical techniques and graphical analysis to the experimental data.

Contents
1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (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.

Lab:
1. . To study the Motion of Spring and calculate (a) Spring constant, (b) g and (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.

Reference Books:
1. Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna,11thEdn,2011, KitabMahal.
3. Engineering Practical Physics, S.Panigrahi &B.Mallick,2015,CengageLearningIndiaPvt.Ltd.
4. Practical Physics,G.L.Squires,2015, 4thEdition,CambridgeUniversityPress.
5. Practical Physics, D Chattopadhyay, P C Rakshit and B Saha, Books and Allied Pvt. Ltd.
6. Advanced Practical Physics, B Ghosh and K G Mazumdar, Sreedhar Publishers.
7. B. Sc. Practical Physics, Harnam Singh and P S Heme, S Chand and Company Limited.
8. B. Sc. Practical Physics, C L Arora, S Chand and Company Limited.

Department of Physics

Government General Degree College at Kalna -I

Lesson Plan

for

B.Sc. Semester-I I

Subject: Physics

Paper Name: Electrical Circuits and Network Skills

Paper Code: SEC-2:PHYS2015

Credits: Theory-03

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.

Module-I

Basic Electricity Principles, Understanding Electrical Circuits, Electrical Drawing and Symbols

Contents

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 analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze 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)

Module Objectives:

1. Grasp fundamental electrical concepts
2. Analyze circuit components and Apply circuit analysis techniques
3. Creating Clear and Effective Diagrams

Lecture Serial	Topics of Discussion
Lecture-1.	Basic idea on Voltage, Current, Resistance, and Power.
Lecture-2.	Ohm's law. Series, parallel, and series-parallel combinations of resistance
Lecture-3.	Basic idea on AC Electricity and DC Electricity
Lecture-4.	Idea about Volmeter and ammeter
Lecture-5.	Measurment current and voltage with multimeter
Lecture-6.	Undersanding about Main electric circuit elements and their combination
Lecture-7.	Analyze DC sourced electrical circuits

Lecture-8.	Discuss on Current drop across the DC circuit elements.
Lecture-9.	Discuss on Voltage drop across the DC circuit elements.
Lecture-10.	Analyze Single-phase and three-phase alternating current sources.
Lecture-11.	Rules to analyze AC sourced electrical circuits
Lecture-12.	Real, imaginary and complex power components of AC source.
Lecture-13.	Power factor. Saving energy and money.
Lecture-14.	Mastering Electrical Symbols
Lecture-15.	Understanding Drawing Standards
Lecture-16	Ladder diagrams. Electrical Schematics. Power circuits. Control circuits.
Lecture-17	Tracking the connections of elements and identify current flow
Lecture-18	Tracking the connections of elements and identify voltage drop.

Tutorial Assignment—I

Module-II

Generators and Transformers, Electric Motors, Solid-State Devices, Electrical Protection, Electrical Wiring

Contents

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. Conduit Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. (7 Lectures)

Module Objectives:

1. Understanding Generator Operation and Analyzing Transformer Operation
2. Applying Motor Control Techniques
3. Analyzing Semiconductor Diodes
4. Understanding Fault Types and Studying Protective Devices
5. Executing Proper Wiring Techniques

Lecture Serial	**Topics of Discussion**
Lecture-1.	Understanding of DC Power sources
Lecture-2.	Working principal of AC/DC generators.
Lecture-3.	Connection of Inductance, capacitance

Lecture-4.	Calculation of impedence and admitance
Lecture-5.	Operation of transformers
Lecture-6.	Idea of Single-phase, three-phase & DC motors
Lecture-7.	Basci connection of Single-phase, three-phase & DC motors
Lecture-8.	Interfacing DC sources to control heaters & motors.
Lecture-9.	Interfacing AC sources to control heaters & motors.
Lecture-10.	Calculation of Speed & power of ac motor.
Lecture-11.	Solid-State Devices: Resistors, inductors and capacitors.
Lecture-12.	Basic idea on Diode and rectifiers.
Lecture-13.	Components in Series or in shunt
Lecture-14.	Response of inductors and capacitors with DC sources
Lecture-15.	Response of inductors and capacitors with AC sources
Lecture-16	Working principal of Relays. Fuses and disconnect switches.
Lecture-17	Circuit protection: Circuit breakers Overload devices. Ground-fault protection.
Lecture-18	Circuit protection: Grounding and isolating. Phase reversal. Surge protection.
Lecture-19	Interfacing DC sources to control elements
Lecture-20	Interfacing AC sources to control elements
Lecture-21	Different types of conductors and cables. Basics of wiring-Star and delta connection
Lecture-22	Calculation of Voltage drop and losses across cables and conductors.
Lecture-23	Instruments to measure current, voltage, power in DC circuits.
Lecture-24	Instruments to measure current, voltage, power in AC circuits.
Lecture-25	Solid and stranded cable. Conduit Cable trays.
Lecture-26	Splices: wire nuts, crimps, terminal blocks, split bolts, and solder.
Lecture-27	Preparation of extension board.

Tutorial Assignment—II

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.

Reference Books:

1. A Text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A Text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.

Department of Physics
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Lesson Plan
for
B.Sc. Semester-II
Subject: Physics
Paper Name: Mechanics
Paper Code: Minor: PHYS2021

Credits: Theory-03, Practicals-01
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.

Module-I **Fundamentals of Dynamics** (6 lectures)
Contents 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.
Module Objectives: In this module, Newtonian mechanics is developed from Galilean transformation. Three laws of motion and their implications are discussed. Finally, Newtonian framework is being used to solve different problems.

Lecture Serial	Topics of Discussion
Lecture-1	Review of basic ideas of Classical mechanics: Applicability, Limitation, Historical ideas
Lecture-2	Newton's laws of motion 1: Three laws with their importance. How 1st law is not a byproduct of 2nd law? Inertial frame as a fundamental idea of classical dynamics. Galilean transformation
Lecture-3	Newton's laws of motion 2: Problem solving using Newton's laws: Free body diagram
Lecture-4	Newton's laws of motion 3: Third law of motion and conservation of linear momentum
Lecture-5	Motion of a projectile in Uniform gravitational field and rocket motion.
Lecture-6	Dynamics of system of particles: Center of mass and its usefulness

Module-II **Work and Energy** (4 lectures)
Contents 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.
Module Objectives: Force and Energy in Mechanics. Conservative and non-conservative forces and their implication. Energy diagram as a qualitative tool to analyze motion.

Lecture Serial	Topics of Discussion
Lecture-1	Work-Kinetic Energy Theorem as general consequence of Newton's laws of motion.

Lecture-2	Conservative and non- conservative forces. Examples of both. Path independence of work done under conservative force field.
Lecture-3	Idea of potential energy in context of conservative forces and conservation of mechanical energy for conservative forces.
Lecture-4	Energy diagram as a tool of analyzing particles in conservative force field.

Module-III **Collisions** (3 lectures)
Contents Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.
Module Objectives: Theories Elastic and inelastic collision are discussed in this module.

Lecture Serial	Topics of Discussion
Lecture-1	Theory of collision and its significance in terms of modern aspects of Physics.
Lecture-2	Elastic, inelastic and partially elastic collisions. Co-efficient of restitution in this aspect.
Lecture-3	Laboratory frame and COM frame for analysis of collision.

Tutorial Assignment—I

Module-IV **Rotational Dynamics** (8 lectures)
Contents 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 spherical bodies.Kinetic energy of rotation. Motion involving both translation and rotation.
Module Objectives: Angular momentum being a key physical quantity is discussed in this module and its conservation principle is highlighted. Also, moment of inertia and its tensorial form is discussed in some detail which leads to concepts like principal axes of inertia and ellipsoid of inertia.

Lecture Serial	Topics of Discussion
Lecture-1	Rotational dynamics and key ideas about them.
Lecture-2	Angular momentum and Torque as key concepts in rotational dynamics.
Lecture-3	Angular momentum of a particle and system of particles and its conservation.
Lecture-4	Orbital and Spin angular momentum and their connection to orbital and Spin components of torque.
Lecture-5	Rotation about a fixed axis.Moment of Inertia tensor.
Lecture-6	Calculation of moment of inertia. Parallel axis and Perpendicular axis theorem
Lecture-7	Calculation of moment of inertia for rectangular, cylindrical and spherical bodies
Lecture-8	Kinetic energy of rotation. Ellipsoid of inertia. Motion involving both translation and rotation.

Module-V **Elasticity** (4 lectures)
Contents 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.

Module Objectives:
1. This module gives knowledge about different elastic constants and relation between them 2. one can get knowledge about twisting torque on a cylindrical wire and Torsional pendulum

Lecture Serial	Topics of Discussion
Lecture-1	Elastic constants: Hooke's law, stress-strain diagram, Youngs modulus, Bulk modulus, Rigidity modulus Poisson's ratio and relation between them
Lecture-2	Torsion of a wire: Work done in deforming a wire, Torsional Pendulum, Twisting torque on a Cylindrical Wire.
Lecture-3	Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane
Lecture-4	Bending of Beams: A concentrated load W is applied at the midpoint.

Tutorial Assignment—II

Module-VI **Gravitation and Central Force Motion** (4 lectures)
Contents Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Gravitational potential and the gravitational field due to a spherical shell and a solid sphere
Module Objectives: This unit gives idea about Gravitational potential energy and one can gain idea how to find Potential and field due to spherical shell and solid sphere inside and outside of it.

Lecture Serial	Topics of Discussion
Lecture-1	Basic theory of Gravitation: Law of gravitation.
Lecture-2	Gravitational potential energy. Inertial and gravitational mass.
Lecture-3	Potential and field due to spherical shell and solid sphere
Lecture-4	Potential and field inside and outside of a spherical shell and solid sphere and their graphical variation with distance

Module-VII **Motion of a particle under a central force field** (6 lectures)
Contents 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).
Module Objectives: 1. This unit delivers idea about the motion of a particle under central force field and the energy equation and energy diagram. 2. One can get idea about equation and types of orbits of a particle depending upon its energy. 3. One can also get knowledge about Kepler's Laws. 4. Basic idea about communication satellite can also be obtained.

Lecture Serial	Topics of Discussion
Lecture-1	Two-body problem and its reduction to one-body problem and its solution
Lecture-2	Central force: Definition and general properties, Form of equation of motion.
Lecture-3	The energy equation and energy diagram: Effective potential, Motion of a particle in inverse square field, Equation of orbit.
Lecture-4	Kepler's Laws: Kepler's Laws and their proofs

Lecture-5	Satellite in circular orbit and applications: Communication Satellites
Lecture-6	Geosynchronous orbits. Weightlessness, Basic idea of global positioning system (GPS).

Tutorial Assignment—III

Module-VIII **Oscillations** (6 lectures)
Contents Simple Harmonic Oscillations: Differential equation of SHM and its solution, Kinetic energy, potential energy, Total energy and their time-averaged values. Damped oscillation, Forced oscillations: Transient and steady states, Resonance, Sharpness of resonance, Power dissipation and Quality Factor, Compound pendulum.
Module Objectives: In this module, students will learn the motion of a simple harmonic oscillator and analyze the same in different domains.

Lecture Serial	Topics of Discussion
Lecture-1	Simple Harmonic Oscillations: definition, different examples
Lecture-2	Differential equation of SHM and its solution: $x(t) = A \sin(\omega t+\phi)$ significance of A and ϕ
Lecture-3	Energy of Simple harmonic oscillator: Kinetic energy, potential energy, total energy and their time-average values
Lecture-4	Damped oscillation: Solutions for (i) over, (ii) critical and (iii) under damping and its interpretation
Lecture-5	Forced oscillations: Transient and steady states
Lecture-6	Resonances: Amplitude resonance, velocity resonance. Power dissipation and Quality Factor

Module-IX **Non-Inertial Systems** (4 lectures)
Contents 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.
Module Objectives: In this module, non-inertial frames will be discussed and physics in the same will be highlighted via Galilean transformations

Lecture Serial	Topics of Discussion
Lecture-1	Non-inertial frames and fictitious forces as their by-product.
Lecture-2	Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.
Lecture-3	Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.
Lecture-4	Apply the ideas of non-inertial frames to explain Foucault's pendulum and hence understand the rotation of earth.

Tutorial Assignment—IV

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.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
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3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
6. An Introduction to Classical Mechanics, R G Takwale & P S Puranik, TMG Hill.
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10. Advanced Acoustics, D P Roychaudhuri and P Banerjee, The New Book Stall, 2009

Practical

Course Object:

1.To gain practical knowledge by applying the experimental methods to correlate with the theory of classical mechanics.

2. To apply the analytical techniques and graphical analysis to the experimental data.

Contents
1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (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.

Lab:
1. . To study the Motion of Spring and calculate (a) Spring constant, (b) g and (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.
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8. To determine the value of Young's Modulus by Flexure method.

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