MAJOR COURSE- MJ 1	Mechanics	(Theory Credit -03) (Total Marks=60+15)

Course Objective:

The objective of this course is to introduce students to the fundamental concepts and principles of classical mechanics, focusing on dynamics, work-energy relations, rotational motion, elasticity, fluid dynamics, gravitation, oscillations, and the basics of relativity. By the end of the course, students will develop a deep understanding of the physical laws governing motion and forces and be able to apply mathematical methods to solve complex physical problems. The course will also emphasize real-world applications and provide a foundation for more advanced studies in physics.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. **Understand and apply Newton's laws of motion** to describe the dynamics of particles and systems, including systems of variable mass.
2. **Analyze and solve problems related to the center of mass**, momentum conservation, and the motion of systems in inertial and non-inertial reference frames.
3. **Describe and solve problems in rotational dynamics**, including the concepts of angular momentum, torque, moment of inertia, and energy considerations in rotating systems.
4. **Apply principles of work and energy** to a wide range of mechanical systems, including both conservative and non-conservative forces, and understand the role of energy conservation in various mechanical contexts.
5. **Study elastic and fluid systems**, including the behavior of materials under stress (elasticity), and fluid dynamics with applications to capillary flow and Poiseuille's law.
6. **Understand the fundamentals of gravitation and central force motion**, including the laws of planetary motion, satellite orbits, and Kepler's laws.
7. **Examine oscillatory motion** in both undamped and damped systems, including the resonance phenomenon and real-world examples of oscillations.
8. **Explore the basic concepts of special relativity**, including Lorentz transformations, time dilation, length contraction, and the energy-momentum relation, and apply these to understand relativistic phenomena such as the Doppler effect.

Course Contents:

Fundamentals of Dynamics (08 HRS):

Reference frames: Inertial and non-inertial frames, Galilean transformations and invariance. Review of Newton's laws. Dynamics of a system of particles, center of mass, and conservation of momentum. Motion of a variable-mass system (rocket motion). Fictitious forces in non-inertial frames: Centrifugal and Coriolis forces with applications.

Work, Energy, and Collisions (06 HRS):

Work-energy theorem. Conservative and non-conservative forces with examples (gravity, friction). Potential energy and energy diagrams. Conservation of energy. Elastic and inelastic collisions in one and two dimensions, center of mass and laboratory frames.

Rotational Dynamics (06 HRS):

Angular momentum and torque. Conservation of angular momentum. Rotation about a fixed axis, moment of inertia (rectangular, cylindrical, and spherical bodies). Kinetic energy of rotation. Rolling motion.

Elasticity and Fluid Motion (04 HRS):

Elastic constants and their relations. Twisting torque on a cylinder or wire. Bending of beams, cantilever, flexural rigidity. Poiseuille's equation for capillary flow.

Gravitation and Central Force Motion (07 HRS):

Newton's law of gravitation. Gravitational potential and field. Motion under a central force: two-body problem and reduction to an equivalent one-body problem. Energy equation and energy diagram. Kepler's laws and their derivation. Satellite motion, geosynchronous orbits.

Oscillations (07 HRS):

Simple harmonic motion (SHM): Energy considerations, time-averaged values. Damped oscillations: Equation of motion, solutions, and physical interpretation. Forced oscillations: Transient and steady states, resonance, quality factor. Real-world examples of resonance.

Relativity (07 HRS):

Michelson-Morley experiment and its implications. Postulates of special relativity. Lorentz transformations, length contraction, time dilation, velocity transformation, and mass-energy equivalence. Relativistic Doppler effect and kinematics. Energy-momentum transformation.

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. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
5. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
8. Concept of Physics, H C Verma
9. Properties of matter D S Mathur
10. Mechanics & Electrodynamics, by Brijlal & Subramaniam.
11. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education

MAJOR COURSE- MJ 1	Mechanics	(Practical Credit-01) (Total Marks=25)

1. To determine the height of a building using a Sextant.
2. To study the Motion of Spring and calculate (a) Spring constant (b) g (c) Modulus of rigidity.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine g and velocity for a freely falling body using Digital Timing Technique
5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Young's Modulus of a Wire by Optical Lever Method.
7. To determine the elastic Constants of a wire by Searle's method.
8. To determine the value of g using Bar Pendulum.
9. To determine the value of g using Kater's Pendulum.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.