

Course Code	Course Name	Credits
26PH001	MECHANICS AND PROPERTIES OF MATTER	04

### Course Objectives

- To know the fundamentals of kinematics and dynamics of an object in different coordinate systems
- To understand the techniques for studying motion of an object in different systems
- To apply the fundamental concepts of vector for solving complex problems in mechanics.
- To study the properties of matter leads to information this is of practical value to both the physicist and the engineers.
- To recall about bending moments, beam deflection, energy of bending, and Cornu's method for measuring  $\mu$ .

### Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand about moment of inertia and its physical significance.
- Gain the knowledge about Newtonian mechanics of systems.
- Understand about various dynamics.
- Gain the knowledge of properties of matter.
- Gain the knowledge of theories of bending beam.

### Unit 1 - Kinematics and Dynamics (12 Hrs.)

Kinematic equation - plane polar coordinates-circular motion and straight-line motion - Newton's laws - applications of Newton's laws - astronaut's tug of war, Freight train - Constraints - wedge and block - masses and pulley - contact forces - block and string - normal force and friction- block and wedge with friction.

### Unit 2 – Momentum (12 Hrs.)

System of particles - Bola, center of mass - drum major's baton, non-uniform rod, conservation of momentum - Three body system, impulse -rubber ball rebound, flow of mass- spacecraft, rocket in free space and gravitational field, momentum transport to the surface.

### Unit 3 - Work and Energy (12 Hrs.)

Equation of motion in one dimension - mass thrown upward, simple harmonic oscillator - work energy theorem in one dimension - Vertical motion in an inverse square field - work energy theorem - escape velocity, Applying the work energy theorem - inverted pendulum- work done by a central force - Potential energy - Energy diagrams – Power.

### Unit 4 – Elasticity (12 Hrs.)

Stress and Strain - Stress - strain curve - Hooke's Law and Elastic Moduli - Poisson's ratio - Relation between elastic constants - Torsion of a Cylinder - Measurement of modulus of rigidity: Statical & Dynamical method - Measurement of moment of inertia by the torsional pendulum method - Potential Energy due to Deformation.

### Unit 5 - Bending of Beams (12 Hrs.)

Internal bending moment - Beam bent by a constant couple - Cantilever - supported beam - energy of bending - beam rigidly fixed at both ends - Asymmetrically bent beam - Cornu's method of measuring  $\mu$  - Uniform bending and Non-uniform bending - theory and experiments.

### Reference Books:

1. Kleppner.,&Kolenkow. (2017). An introduction to Mechanics, (1st Ed.). McGraw-Hill.
2. Kittel, C., Knight, W., Helmholtz.,Ruderman., & Moyer. (2017). Mechanics, (2nd Ed.). McGraw-Hill.
3. SatyendraNathMaiti, Debi Prasath Raychaudhuri. (2008). Classical mechanics and general properties of Matter, (2nd Ed.). New Age International Publishers.
4. D.S. Mathur (2010), Elements of Properties of Matter. S. Chand & Company.

### Websites and eLearning Sources:

1. [https://onlinecourses.nptel.ac.in/noc23\\_mm08/preview](https://onlinecourses.nptel.ac.in/noc23_mm08/preview)
2. <https://scienceinfo.com/viscosity-definition-types-significance-applications/>
3. <https://youtu.be/eE7Ox8Rb0FE?si=JKMsByz5rgyFeuAj>

**COs and Bloom's Taxonomy Mapping – 26PH001**

<b>Course Outcomes</b>	<b>On completing U.G. program the students will be able to</b>	<b>BTL</b>
<b>CO1</b>	Recall and describe fundamental concepts, laws, and equations of mechanics, including rotational motion and harmonic oscillations.	K1, K2
<b>CO2</b>	Apply Newton's laws, energy, and momentum conservation principles to solve problems involving systems of particles.	K3
<b>CO3</b>	Analyze rotational dynamics of rigid bodies and compare methods for determining moment of inertia.	K4
<b>CO4</b>	Evaluate elastic properties of materials and justify the applicability of elasticity theories in practical situations.	K5
<b>CO5</b>	Design and perform experiments related to elasticity and bending of beams, and interpret the results.	K6

**BTL K1 and K2 – remembering and understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6- Create**

**Relationship Matrix – 26PH001**

<b>Course Outcomes</b>	<b>Programme Outcomes (POs)</b>						<b>Programme Specific Outcomes (PSOs)</b>						<b>Mean Score of Cos</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	<b>PSO6</b>	
<b>CO1</b>	3	2	1	1	1	1	3	3	1	1	1	1	1.58
<b>CO2</b>	3	2	3	1	1	1	2	2	3	2	1	1	1.83
<b>CO3</b>	3	3	2	1	1	1	2	2	3	2	2	1	1.92
<b>CO4</b>	2	2	2	2	1	1	2	1	2	3	3	1	1.83
<b>CO5</b>	3	2	3	1	1	2	2	2	3	2	2	3	2.17
<b>Total</b>													1.87

Mean Score: 3- High, 2- Medium/Moderate, 1-Low

