ENGINEERING MECHANICS

Course Code: 22ME1103

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Course Outcomes: At the end of the course, the student will be able to
CO1: explain free body diagrams and analyze forces and couples in mechanical systems. **CO2:** analyze ideal trusses and analyze mechanical systems with friction
CO3: determine the center of gravity and moment of inertia for various geometric shapes **CO4:** analyze motion of bodies from the kinematics perspective
CO5: apply Newton's laws and principles of energy and momentum to dynamic systems

UNIT- I **10 Lectures**

Introduction to Mechanics: principle of transmissibility, composition and resolution of forces, parallelogram law, triangle law, types of force systems - concurrent coplanar forces, resultant of coplanar force system, moment of a force, couple, Varignon's theorem, Free Body Diagrams.

Learning Outcomes: At the end of this unit, the student will be able to
1. analyze forces and moments in mechanical systems (L4)
2. describe moments and forces (L2)
3. illustrate force system on a body with the help of free body diagram (L3)

UNIT- II **11 Lectures**

Trusses: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections. Virtual work, simple applications.
Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction, free body diagrams involving frictional forces.

Learning Outcomes: At the end of this unit, the student will be able to
1. calculate forces in links of plane trusses by method of joints (L3)
2. determine forces in links of plane trusses by method of sections (L3)
3. analyze frictional forces of bodies in a plane (L4)

UNIT- III **9 Lectures**

Center of gravity: Centroid and center of gravity, derivation of centroids from the first moment of area, centroids of composite sections, center of gravity of simple volumes - cylinder, cone, sphere, theorems of Pappus-Guldinus.
Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, radius of gyration, polar moment of inertia, mass moment of inertia of simple volumes -thin plate, thin rod, cylinder, cone, sphere, rectangular prism.

Learning Outcomes: At the end of this unit, the student will be able to
1. determine the centroid of composite sections (L3)
2. determine center of gravity of simple solids (L3)
3. calculate area and mass moment of inertia for composite areas and volumes respectively (L3)

UNIT- IV **9 Lectures**

Kinematics : Rectilinear and curvilinear motion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, kinematics of rigid bodies, rotation of a rigid body about a fixed axis.

Learning Outcomes: At the end of this unit, the student will be able to

1. calculate velocity and acceleration in rectilinear and curvilinear translation (L3)
2. determine the magnitude of the velocity and acceleration of rigid bodies (L3)
3. calculate velocity and acceleration in rotation (L3)

UNIT- V **9 Lectures**

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle, principle of work and energy.

Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse.

Learning Outcomes: At the end of this unit, the student will be able to

1. apply D'Alembert's principle to convert a problem of dynamics to statics (L3)
2. apply principle of work and energy to dynamic systems. (L3)
3. calculate motion characteristics of bodies using the principle of momentum and impulse (L3)

Text Books:

1. N H Dubey, *Engineering Mechanics: Statics and Dynamics*, McGraw Hill Education (India) Pvt. Ltd., 2014.
2. S Timoshenko, DH Young, Sukumar Pati, JV Rao, *Engineering Mechanics (in SI units)*, 5th Edition, McGraw-Hill, 2013.

Reference Books:

1. Basudeb Bhattacharya., *Engineering Mechanics*, 2nd Edition, Oxford University Press (India), 2015.
2. Hibbeler RC, *Engineering Mechanics: Statics and dynamics*, 14th Edition, Pearson Education, 2016.
3. Irving Shames, GKM Rao, *Engineering Mechanics: Statics and Dynamics*, 4th Edition, Pearson, 2009.