Engineering Mechanics

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Course Objectives:

- Explain the effect of force and moment in the different engineering applications.
- Teach center of gravity and moment of inertia of solids and surfaces.
- Familiarize frictional forces in mechanical applications.
- Analysis of rigid bodies under dynamic conditions.

UNIT I: **08 hours**

Introduction to Engineering Mechanics: Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems couple, moment of a force Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

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

- Resolve the forces in mechanical systems. (L2)
- Identify the moments and forces. (L3)
- Draw free body diagram. (L3)

UNIT II: **10 hours**

Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

Virtual Work: Equilibrium of ideal systems, work done by a force, work done by a couple, principle of virtual work.

Learning Outcomes:

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

- Identify different types of trusses. (L2)
- Analyze the plane trusses by method of joints and the method of sections. (L4)
- Demonstrate equilibrium of ideal system. (L2)
- Estimate the work done by a force and work done by a couple. (L3)

UNIT III: **10 hours**

Properties of Surfaces and Volumes: Centroid and centre of gravity, derivation of centroids from first moment of area, centroids of composite sections, centre of gravity of common volumes – cylinder, cone, sphere, theorem of Pappus – guidinus.

Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes – thinplates, thin rod, cylinder, cone, sphere, rectangular prism, radius of gyration.

Learning Outcomes:

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

- Identify the centre of gravity of composite sections. (L3)
- Determine the centre of gravity of common solids. (L3)
- Determine moment of inertia for composite volumes. (L3)

UNIT IV: **10 hours**

Kinematics: Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, and motion under gravity – projectilemotion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, rotation of a rigid body about a fixed axis, introduction to plane motion.

Learning Outcomes:

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

- Write equations of motion for rigid bodies. (L3)
- Find velocity and acceleration in rectilinear and curvilinear motions. (L4)
- Trace the path of projectile. (L3)

UNIT V: **08 hours**

Kinetics: Principles of dynamics - Newton'sLaws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.

Ideal Systems: Principle of conservation of energy and applications.

Learning Outcomes:

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

- ApplyD'Alembert's principle in rectilinear translation. (L3)
- Relate principle of work and energy in dynamic systems. (L3)
- Make use of principle of momentum and impulse to dynamic bodies. (L4)

Text books:

1. N H Dubey, Engineering Mechanics: Statics and Dynamics, McGraw Hill, 2014.
2. S Timoshenko, DH Young, JV Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 2013.
3. S SBhavikatti, Engineering Mechanics, 4/e, New Age International, 2008.

Reference Books:

1. Basudeb Bhattacharya., Engineering Mechanics, 2/e, Oxford University Press (India), 2015.
2. Irving Shames, G.K.M Rao, Engineering Mechanics: Statics and Dynamics, 4/e, Pearson, 2009.
3. K.L. Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010.

Course Outcomes:

Upon successful completion of the course, the students will be able to

- Resolve forces and couples in mechanical systems. (L3)
- Identify the frictional forces and its influence on equilibrium. (L3)
- Find the centre of gravity and moment of inertia for various geometric shapes. (L3)
- Develop equations for different motions. (L4)
- Determine the displacement, velocity and acceleration relations in dynamic systems. (L4)
- Relate the impulse and momentum. (L4)