

**I Year II Semester**

**Code: 20ES2011**

**L T P C**

**3 0 0 3**

**ENGINEERING MECHANICS**

**Course Objectives:**

1. To impart knowledge on the concept of forces and their resolution in different planes, resultant of force system, forces acting on a body, their free body diagrams using graphical methods and to know the concept of friction.
2. To make the students calculate the centre of gravity and moment of inertia of solids and surfaces.
3. To educate the students about kinematics, kinetics, work - energy and impulse - momentum principles.

**Course Outcomes:**

At the end of the Course, Students will be able to:

1. Determine the resultant force and moment for a given force system.
2. Solve the member forces in trusses.
3. Solve the centre of gravity and moment of inertia for various geometric shapes
4. Determine the displacement, velocity and acceleration relations in dynamic systems
5. Apply the concepts of kinematics, kinetics, work - energy and impulse - momentum methods to particle motion

**UNIT I**

**Fundamentals of Mechanics-** Basic concepts, Classification, Force-types, Newton's Laws

**System of Forces-** Classification, Coplanar Concurrent Forces- Resultant, Parallelogram Law of Forces for resultant, Law of transmissibility of forces, Triangle Law, Polygon's Law.

**Moment of Force and its Application-** Varignon's Principle, Couple and Resultant of Coplanar Non- concurrent Force Systems.

**Equilibrium of Systems of Forces-**FreeBody Diagrams, Equations of Equilibrium of Coplanar Systems (Concurrent & Non-Concurrent), Lami'sThorem

**UNIT II**

**Application of Forces-**

**Plane Trusses:** The structural model, simple trusses, analysis of simple trusses: method of joints, method of sections.

**Spatial Systems-**concurrent forces, resultant, Equilibrium of particle in space, Spatial systems for moment of forces

**Friction:** Introduction, limiting friction and impending motion, coulomb's laws of dry friction, angle of friction, angle of repose, coefficient of friction, cone of friction

### UNIT III

#### Properties of Surfaces

**Centroid** of simple figures (from basic principles), derivation of centroids from first moment of area, centroids of composite sections,

**Centre of gravity** of simple body (from basic principles, cylinder, cone), Centre of gravity of composite bodies, Pappus theorems.

### UNIT IV - Moment of Inertia

**Area moment of inertia** Definition- parallel axis theorem, perpendicular axis theorem, AMI for simple and composite shapes, polar moment of inertia

**Mass Moment of Inertia:** Radius of gyration, Moment of Inertia of Masses, Transfer Formula for Mass moments of Inertia, mass moment of inertia of composite bodies.

mass moment of inertia -cylinder, cone, sphere.

### UNIT V

#### Dynamics

**Kinematics:** Plane motion, absolute motion, relative motion, Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion.

**Kinetics:** Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies

**Work – Energy Method:** Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

#### Text Books:

1. Engineering Mechanics- Statics and Dynamics- A. Nelson, Mc Graw Hill publishers.
2. S. Timoshenko, DH Young, JV Rao, Sukumar Pati, Engineering Mechanics (inSI units), 5/e, McGraw Hill, 2013.
3. N H Dubey, Engineering Mechanics: Statics and Dynamics, McGraw Hill, 2014.

#### 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.
4. S SBhavikatti, Engineering Mechanics, 4/e, New Age International, 2008.