APPLIED MECHANICS

Course Code: 22CE1103

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Course Outcomes:

At the end of the course, a student will be able to
CO1: Construct FBD of a physical system and analyse the plane trusses (L4)
CO2: Solve problems involving static and kinetic friction (L3)
CO3: Determine the centroid for a given plane shape and find the moment of inertia (L3)
CO4: Determine stresses and strains in given members (L3)
CO5: Determine particle motion and find the frequency of SDOF system (L3)

UNIT-I   (10 Lectures)

EQUILIBRIUM OF FORCE SYSTEM: (coplanar forces only)

Classification of force systems; composition and resolution of forces; Resultants of force systems; Equilibrium of force systems, Moment of a force and couple, Analysis of plane truss by method of joints and method of sections.

Learning outcomes:

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

1. determine the resultant of a force system (L3)
2. determine tension in wires using equilibrium of force system (L3)
3. analyze a simple truss using method of joints or method of sections (L4)

UNIT-II   (10 Lectures)

FRICTION:

Classifications of friction; laws of dry friction, impending motion; FBD for friction problems; Mechanism of static and kinetic friction; Sliding or Tipping investigation; Wedge friction problem, ladder friction

Learning outcomes:

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

1. illustrate FBD for friction problems (L3)
2. determine the coefficient of static, kinetic friction between two surfaces (L3)
3. determine equilibrium position of body on inclined plane under the external forces (L3)

UNIT-III   (10 Lectures)

CENTROIDS AND MOMENT OF INERTIA:

Centroids of linear objects and areas, centroids of composite figures, centroids determined by integration, center of gravity of plate, common 3D objects. Definition of area moment of inertia, polar moment of inertia, radius of gyration, parallel axis theorem, area moments of inertia by integration, area moments of inertia for composite areas.Center of gravity and mass moment of inertia.

Learning outcomes:

At the end of the unit, the student will be able to
1. determine the centroid for different cross sections (L3)

2. determine the radius of gyration for given sections (L3)
3. calculate area moments of Inertia of different cross sections (L3)

UNIT-IV   **(10 Lectures)**

SIMPLE STRESSES AND STRAINS:

Elasticity and Plasticity – Types of stresses and strains – Hooke's law–Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic constants and their relationships. Stress and strains for bars of varying cross sections – composite bars – Temperature effect.

Learning outcomes:

At the end of the unit, the student will be able to
1. determine stresses and strains in axially loaded members (L3)
2. calculate the stresses in composite bars (L3)
3. determine the stresses in bar due to change in temperature (L3)

UNIT-V   **(10 Lectures)**

KINEMATICS AND DYNAMICS:

Rectilinear motion, uniform velocity, uniform acceleration, curvilinear motion, projectile motion, impulse and momentum, principle of Work-energy; energy based equation motion for Spring-mass single degree freedom system (SDOF), undamped free vibration- response and natural frequency. Damping and damped free vibration response.

Learning outcomes:

At the end of the unit, the student will be able to
1. determine the momentum of a particle subjected to external force (L3)
2. calculate the natural frequency of spring mass SDOF system (L3)
3. examine the response of damped SDOF system (L3)

Text Books:

1. Hibbeler RC, *Engineering Mechanics: Statics and Dynamics*, 14th Edition, Pearson Education,2016. (UNITS I, II, III, V)
2. Hibbeler RC, *Mechanics of Materials*, 9th Edition, Pearson Education, 2014. (UNIT IV)

References:

1. Dubey, NH., *Engineering Mechanics Statics and Dynamics*, 1st Edition, Tata McGraw hill Publications, 2013
2. Tayal AK, *Engineering Mechanics: Statics and Dynamics*, 13th Edition, Umesh Publications, Delhi, 2008.
3. Timoshenko SP, Young DH, Rao and Pytel, *Engineering Mechanics*, 5th Edition, McGraw Hill International Edition, 2017.
4. SS Bhavikatti and KG Rajashekarappa, *Engineering Mechanics*, 4th Edition, New Age International Publication, 2004
5. Bansal, R.K., *Introduction to textbook of Strength of Materials*, 5th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2014.
6. Beer, F. and Johnston, *Mechanics of Solids*, 6th Edition, Tata McGraw hill Publications, 2000.

Web References:

1. https://nptel.ac.in/courses/122/102/122102004/
2. https://nptel.ac.in/courses/122/104/122104014/
3. https://nptel.ac.in/courses/112/106/112106286/
4. http://www.nptelvideos.in/2012/11/applied-mechanics.html