Course Syllabi: UES010 : Solids and Structures (L : T : P :: 3 : 1 : 2)

1. Course number and name: UES010 Solids and Structures

2. Credits and contact hours: 4.5 and 6

3. Text book, title, author, and year

Text Books / Reference Books

- *Popov, E.P. and Balan, T.A., Engineering Mechanics of Solids, Prentice Hall of India (2012).*
- *Singh, D.K., Mechanics of Solids, Pearson Education (2008).*
- *Shames, I. H. and Pitarresi, J. M., Solid Mechanics, Prentice Hall of India (1996).*
- *Crandall, S.H., Dahl, N.C. and Lardner, T.J., An Introduction to Mechanics of Solids, McGraw Hill International, Tokyo(1969).*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Elastic Plastic Behavior

Axial Stress and Strain: Concept of stress, strain, elasticity and plasticity; one-dimensional stress-strain relationships; Young's modulus of elasticity, shear modulus and Poisson's ratio; two-dimensional elasticity; isotropic and homogeneous materials; ductile and brittle materials; statically determinate and indeterminate problems, compound and composite bars; thermal stresses. Torsion of shafts; buckling of struts, concept of factor of safety.

Shear Force and Bending Moment Diagrams: Types of load on beams, classification of beams; axial, shear force and bending moment diagrams: simply supported, overhung and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment, equation of condition, load function equation, qualitative analysis for two-dimensional frames.

Bending & Shear Stresses in beams: Derivation of flexural formula for straight beams, concept of second moment of area, bending stress calculation for beams of simple and built up sections, Flitched beams. Shear stress formula for beams, shear stress distribution in beams

Transformation of Stress and Strain: Transformation equations for plane stress and plane strain, Mohr's stress circle, relation between elastic constants, strain measurements, strain rosettes.

Deformations: Governing differential equation for deflection of straight beams having constant flexural rigidity, double integration and Macaulay's methods for slopes and deflection, unit load method for deflection of trusses

Laboratory Work

Experimental Project Assignment: Students in groups of 4/5 will do projects:

1. Calculation of tensile strength using UTM.
2. Buckling of struts.
3. Experimental verification of Theory of bending (calculation of bending stress and deflections at various points in the beam theoretically and verifying the same experimentally) and indirect evaluation of the modulus of elasticity.

4. Torsion: Study the behavior of circular shafts under torsion and analysis of failure and indirect evaluation of the modulus of rigidity.

Micro Project:
Model Bridge Experiment: This will involve construction of a model bridge using steel wire and wood.

5. **Specific goals for the course**
After completion of this course, the students will be able to:
   - Evaluate axial stresses and strains in various determinate and indeterminate structural systems.
   - Draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of loads.
   - Calculate load carrying capacity of columns and struts and their buckling strength.
   - Evaluate various kinds of stresses (axial, bending, torsional and shearing) in various structural elements due to different type of external loads.
   - Determine deformations and deflections in various kinds of beams and trusses.

6. **Brief list of topics to be covered**
   - Axial stress and strain
   - Shear force
   - Bending moment
   - Bending and shear stress in beams