FACULTY OF ENGINEERING

Code No: G-5022/N/AICTE

B.E. (Civil) III - Semester (AICTE) (Main & Backlog) (New) Examination, February/ March 2025

## Subject: Solid Mechanics

Time: 3 Hours

Max. Marks: 70

Note: (i) First question is compulsory and answer any four questions from the remaining six questions. Each question carries 14 Marks.

(ii) Answer to each question must be written at one place only and in the same order as they occur in the question paper.

(iii) Missing data, if any, may be suitably assumed.

1. a) Differentiate between true stress strain curve and nominal stress strain curve.

   b) For a material, the bulk modulus of elasticity is twice its modulus of rigidity, then calculate Poisson's ratio of the material.

   c) A body is subjected to direct stress 'σ' along one plane. Then which planes carry maximum shear stress.

   d) When a cantilever beam of uniform cross section is loaded, the bending moment along length $M(x) = 20x^2+5x+15$ kN-m, x is the distance in m measured from free end of cantilever, then find the Shear force at 3m from free end.

   e) State the assumptions of simple bending theory.

   f) Draw the shear stress distribution diagram of + shaped beam section.

   g) For a hollow circular shaft of internal diameter 'd' and external diameter 'D' subjected to torsion 'T', then calculate maximum shear stress.

2. a) Draw stress strain curve of mild steel subjected to axial load. Explain the specific features of mild steel through stress strain curve.

   b) Derive the expression for stress due to strain energy stored in a body of length 'l' and area 'A' subjected to impact load 'P' applied through height 'h'.

3. a) A simply supported beam AB of span 8m is subjected to a u.d.l of 10 kN/m on the entire span. The beam has two overhangs of 2m each on either side, a point load of 15 kN is acting at the extreme left end and a clockwise couple of 20 kNm is acting at the extreme right support. Draw the shear force and bending moment diagrams. Also find point of contraflexure, if any.

   b) A uniform T section beam is 120 mm wide and 135 mm deep with a flange thickness of 35 mm and a web thickness of 15 mm. If the limiting bending stresses for the material of the beam are 85 MPa in compression and 155 MPa in tension, find the maximum u.d.l that the beam can carry over a simply supported span of 8m.

4. a) Determine the direction and magnitude of each of the principal stress of a rectangular block material is subjected to tensile stresses 170 N/mm² and 75 N/mm² on a two mutually perpendicular planes accompanied by a shear stress of 85 N/mm².

   b) Derive the expression for radial pressure and hoop stress, i.e. Lame's equations for thick cylinder.

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5. a) A Short column of rectangular cross-section 120mm x 100mm carries a load of 70kN at a point 35mm from the longer side and 55mm from the shorter side. Determine the maximum compressive and tensile stresses in the section

   b) A solid shaft of 150mm diameter is to be replaced by a hollow shaft of the same material with internal diameter equal to 60% of the external diameter. Find the saving in material, if maximum allowable shear stress is same for both the shafts.

6. a) Derive the expression for deflection of open coiled helical spring of mean radius 'R', spring wire diameter 'r', Axial load on the spring 'W', angle of helix 'α', number of turns of coil 'n'.

   b) Derive torsional equation with usual notations.

7. a) A cantilever beam is loaded as shown in Figure. Draw shear force and bending diagram indicating the values at the significant points.
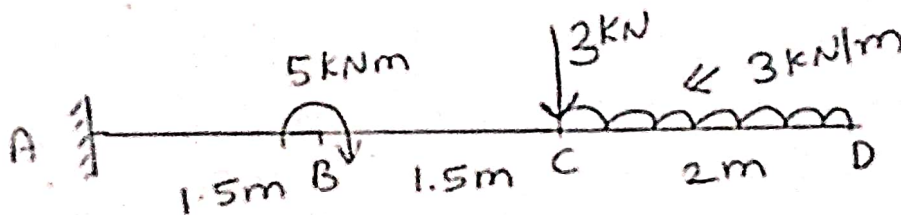
   b) Derive the expression for normal stress, shear stress and resultant stress on an oblique plane inclined at an angle 'θ' with vertical axis in a biaxial direct stress system having direct stress σx, σy acting along x and y directions respectively.