

# CBCS SCHEME

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15AE34

## Third Semester B.E. Degree Examination, Dec.2018/Jan.2019 Mechanics of Materials

Time: 3 hrs.

Max. Marks: 80

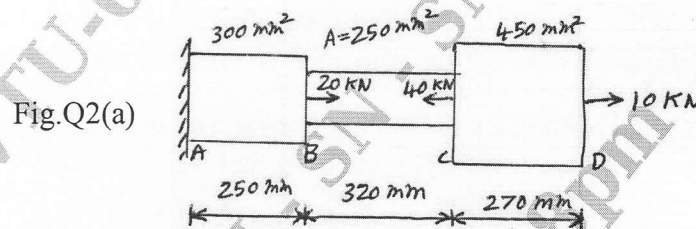
Note: Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- a. Obtain the stress components acting on an arbitrary face of tetrahedron. (10 Marks)  
b. Explain Lamé's ellipse. (06 Marks)

OR

- a. A stepped bar has a fixed support at one end and loads acting are as shown in fig. Q2(a). Determine the stresses and deformations induced in each portion. Also find the net deformation induced. Take  $E = 200\text{GPa}$ . (10 Marks)



- b. A thick walled cylindrical pressure vessel has inner radius of 150mm and outer radius of 185mm. Draw a sketch showing the radial pressure and hoop stress distribution in the section of the cylinder wall, when an internal pressure of  $10\text{MN/m}^2$  is applied. (06 Marks)

### Module-2

- a. What are the Euler – Bernoulli assumptions and its implications? (06 Marks)  
b. An I section beam with flange dimension  $180\text{mm} \times 15\text{mm}$  and web dimension  $15\text{mm} \times 280\text{mm}$  is subjected to a bending moment of 120 kN-m and a shear force of 60kN. Determine the bending stress and shear stress distribution along the depth of the section. (10 Marks)

OR

- a. What is three dimensional beam theory? Give its kinematic description. (08 Marks)  
b. Explain the procedure to obtain the orientation of the principal centroidal axis of bending. (08 Marks)

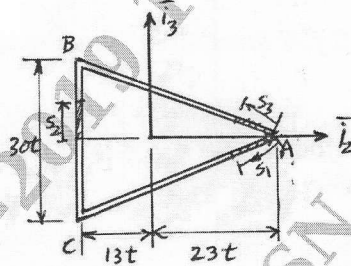
### Module-3

- a. Find the diameter of the shaft required to transmit 60 KW at 150 rpm if the maximum torque is 25% more than the mean torque for a maximum permissible shear – stress of  $60\text{MN/m}^2$ . Find also the angle of twist for a length of 4m. Take  $G = 80\text{GPa}$ . (10 Marks)  
b. Explain Prandtl's stress function. (06 Marks)

OR

- 6 a. Determine the shear flow distribution in an open triangular section as shown in Fig. Q6(a). The section is open at point A and subjected to a vertical shear force  $V_3$ . The width and height of the section are specified in terms of wall thickness. The upper and lower halves are right triangles, whose side lengths have ratios 5:12:13. (10 Marks)

Fig.Q6(a)

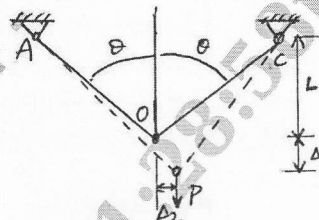


- b. Explain the procedure to determine the shear flow distribution over the open cross-section of a thin walled beam subjected to transverse shear forces. (06 Marks)

#### Module-4

- 7 a. Discuss the relationship between the equations of elasticity and virtual work principles. (06 Marks)
- b. Obtain the joint deflection in a simple 2 bar truss shown in fig.Q7(a). Use unit load method. The truss member stiffnesses are  $K_A = (EA/L)_A$  and  $K_C = (EA/L)_C$ . (10 Marks)

Fig.Q7(b)



OR

- 8 a. Define i) Castiglione's theorem ii) Clapeyron's theorem iii) Maxwell's theorem. (06 Marks)
- b. Derive expressions for slope and deflection at the free end of a cantilever beam of length L carrying point load W at its free end and using Castiglione's theorem. (10 Marks)

#### Module-5

- 9 a. A hollow steel tube of 50mm in diameter and 3mm thickness encloses centrally a solid copper bar of 35mm diameter. The bar and the tube are rigidly connected together at the ends at a temperature of  $20^{\circ}\text{C}$ . Find the stresses in each metal when heated to  $170^{\circ}\text{C}$ . Also find the increase in length, if the original length of assembly is 350mm. (10 Marks)
- b. Explain Tresca's and Von Mises criterions. (06 Marks)

OR

- 10 a. Explain Kirchhoff Plate theory and mention its assumptions. (08 Marks)
- b. What are the constitutive laws for laminated composite plates? (08 Marks)

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