B 02000ME202052002 Pages: 3

Reg No.:_______________ Name:_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree (S,FE) Examination August 2021 (2015 Scheme)

Course Code: ME202

Course Name: ADVANCED MECHANICS OF SOLIDS

Data books are not permitted to use

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions. Each question carries 10 marks.

1 a) The stress tensor at a point with reference to axes (X, Y, Z) is given by the array $\begin{bmatrix} 4 & 1 & 2 \\ 1 & 6 & 0 \\ 2 & 0 & 8 \end{bmatrix}$ MPa. Show that the stress invariants remain unchanged by transformation of the X and Y axes by 45^0 about the Z-axis. (Note: The Z-axis remains same before and after transformation.) 7

b) What is hydrostatic and deviatoric state of stress? List their properties. Show how to separate them from a stress matrix. 3

2 a) Write down the relation for strain in terms of displacement 3

b) Derive the six compatibility equations in Cartesian coordinates 7

3 a) Derive the relation between E, K and ν for an elastic solid. 4

b) For steel, the following data is applicable: $E = 207 \times 10^6$ kPa and $G = 80 \times 10^6$ kPa. For the given stress matrix at a point, determine the strain matrix. 6

$$\sigma_{ij} = \begin{bmatrix} -68.4 & 0 & -160 \\ 0 & -708.4 & 24 \\ -160 & 24 & -228.4 \end{bmatrix} \text{x } 10^3 \text{ kPa}$$

4 Explain the use of polynomials in stress analysis using any three suitable examples 10

PART B

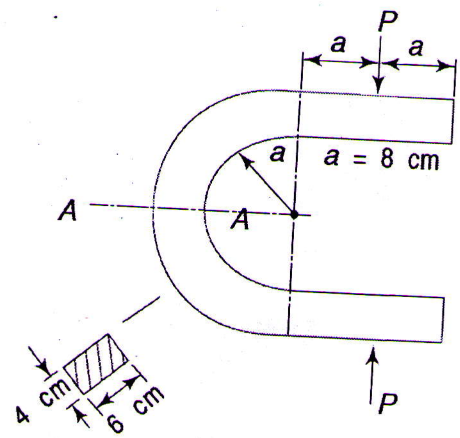
Answer any three questions. Each question carries 10 marks

5 Derive the equations for radial and hoop stresses on a rotating disc. 10

6 A thick-wall cylinder is made of steel (E = 200 GPa and ν = 0.29), has an inside diameter of 20 mm and has an outside diameter of 100 mm. The cylinder is subjected to an internal pressure of 300 MPa. Determine the stress components σ_r, 10

and σ_θ at r = a = 10 mm, r = 25 mm, and r = b = 50 mm.

7 Determine the maximum tensile and maximum compressive stresses across the section AA of the member loaded, as shown in figure. Load P = 19620 N. 10

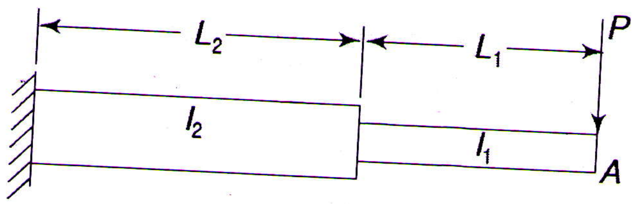


8 Derive the equation for strain energy of a body subjected to i. Axial load, ii. Bending load, iii. Shear load and iv. Torque. 10

PART C

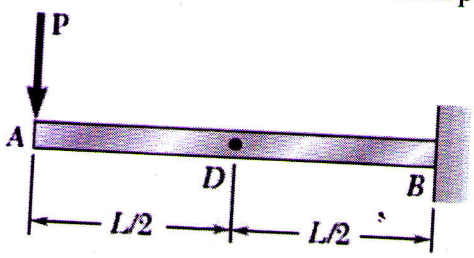
Answer any four questions. Each question carries 10 marks.

9 For the cantilever of total length L shown in figure, determine the deflection at end A. Neglect shear energy. 10



10 a) State and explain Castigliano's second theorem 4

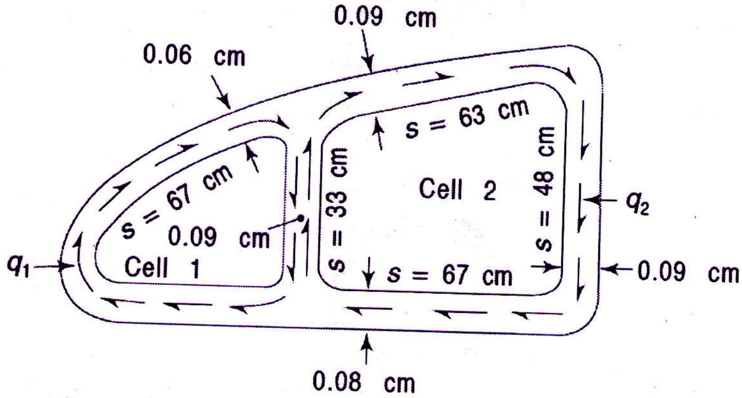
b) For the prismatic beam shown, determine the deflection at point D 6



11 Derive the equations for equilibrium condition, boundary condition and Torque using St. Venant's method for torsion of non-circular cross-sections. 10

12 Compare Prandtl's and St. Venant's methods using torsion of a circle as the example. 10

13 Figure shows a two-cell tubular section as formed by a conventional airfoil shape and having one interior web. An external torque of 10000 Nm is acting in a clockwise direction. Determine the internal shear flow distribution. The cell areas are as follows: $A_1 = 680\ cm^2$, $A_2 = 2000\ cm^2$. The peripheral lengths are indicated in figure. 10



14 Derive the equation for Torque, Angle of Twist and Shear stresses for torsion of a thin rectangular section. 10