Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree (S,FE) Examination June 2022 (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 The state of stress at a point is given by $\begin{bmatrix} 70 & -40 & 20 \\ -40 & 10 & 20 \\ 20 & 20 & -20 \end{bmatrix}$ all in kPa. Find the magnitude of principal stresses, direction of maximum principal stress, maximum shear stress, octahedral normal and shear stresses. 10

2 a) Derive strain-displacement relationships under small strain theory 5

b) Write Saint Venant's equations of compatibility. What is its significance? 5

3 a) Strain at a point is characterised by the components 6
$\varepsilon_{xx} = 0.001, \varepsilon_{yy} = -0.003, \varepsilon_{zz} = 0, \gamma_{xy} = 0, \gamma_{yz} = 0.003, \gamma_{xz} = -0.002$
Determine the stress matrix for an isotopic material if $E = 207 \times 10^6$ kPa, $G = 80 \times 10^6$ kPa, Poisson's ratio $= 0.3$

b) Differentiate between plane stress and plane strain conditions with examples 4

4 a) With the help of a suitable example describe about principle of St. Venant's end effects 5

b) Investigate whether the following polynomial is permissible as an Airy's stress function $\varphi = A(xy^2 - \frac{3}{4}xyh^3)$. If Permissible, derive the expressions for stress components. 5

PART B

Answer any three questions. Each question carries 10 marks

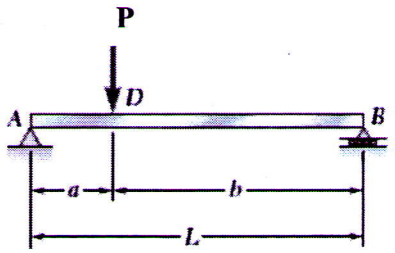
5 a) Write the differential equations of equilibrium in polar coordinates for axisymmetric problems 3

b) Determine the radial stress and circumferential stress across the section of a pipe 7

of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure of 8 N/mm^2. Also sketch the radial pressure distribution and hoop stress distribution across the section.

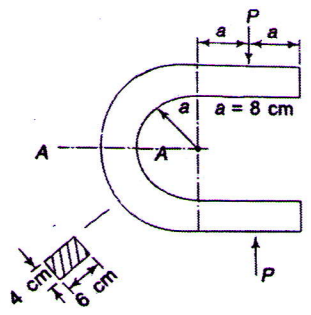
6 Derive the governing differential equation for the case of a rotating circular disk of mass density 'ρ' kg/m^3 and rotating at angular velocity 'ω' rad/s. Obtain radial and circumferential stresses for the case of a solid disk. 10

7 a) Obtain the strain energy of the beam AB loaded with a point load P shown in fig. 6



b) Derive the expressions for strain energy when an elastic member is subjected to (i) Axial force (ii) Torsion 4

8 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



PART C

Answer any four questions. Each question carries 10 marks.

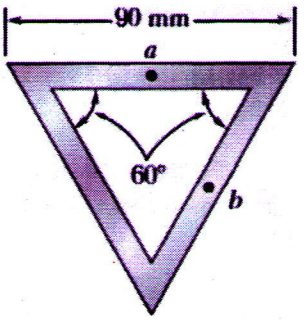
9 a) State and prove Maxwell's Reciprocal theorem 5

b) State and explain Minimum Potential energy theorem 5

10 Consider the torsion of general prismatic bar and derive the expression for stress components and boundary condition to be satisfied by the warping function ψ from the fundamentals using St. Venant's method. Also derive the expression for torsion in terms of torsional rigidity of the shaft. 10

11 What is fictitious load method? Determine the slope at the end of a cantilever beam of length L and subjected to an end load P. 10

12		Using Prandtl's method, derive the expression for stress components, angle of twist per unit length and maximum shear stress for an elliptical cross section bar subjected to torsion	10
13	a	Explain about shear flow	3
	b	A torque T=750 kN m is applied to the hollow shaft (shown in figure) has a uniform wall thickness of 8 mm. Neglecting the effects of stress concentrations, determine the shear at points *a* and *b*	7



14		Derive the expression for maximum stress and angle of twist per unit length for torsion of a thin rectangular section	10

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