

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Model Question Paper

ME 202 : Advanced Mechanics of Solids

Max Marks: 100

Duration: 3 hrs

(Assume missing data if any ; Contains 3 Pages)

PART A

(Answer any **three** questions)

1 a. Define stress vector? (2 marks)

b. The state of stress at a point is given by the following components.

$$\sigma_x = 2, \quad \sigma_y = 4, \quad \sigma_z = 1$$

$$\tau_{xy} = 3, \quad \tau_{yz} = \tau_{zx} = 0$$

Determine the magnitudes of all principal stresses? (8 marks)

2. Components of displacement field in a body, in cartesian coordinates, are given by

$$u = 0.15 x^2 y + 0.03$$

$$v = 0.005 y^2 + 0.03 x z$$

$$w = 0.003 z^2 + 0.001 y z + 0.005$$

Find the strain tensor at point (1, 0, 2) ? (10 marks)

3 a. State generalized Hooke's law? (3 marks)

b. State St. Venants principle for end effects with an example? (4 marks)

c. Write down boundary condition equations for stress analysis problem? (3 marks)

4 a. Derive compatibility equation in terms of stress for the case of plane stress without body force? (10 marks)

(3 x 10 = 30 marks)

PART B

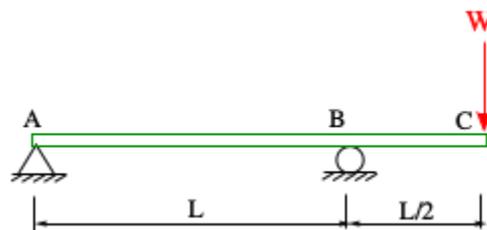
(Answer any **three** questions)

5. For a stress function in polar coordinates, $\Phi = r^2 \cos\theta$, determine the stress components? (10 marks)
- 6 a. Write down the general expressions for stress distribution in a thick cylinder? (2 marks)
- b. Applying boundary conditions in the above equations, determine the stresses at inside and outside surfaces of the cylinder, when it is subjected to a internal pressure of 10 MPa. Take internal and external diameters of the cylinder, respectively as 100 mm and 200 mm. (8 marks)
7. A cantilever of length 2 m, having rectangular cross-section $40 \times 80 \text{ mm}^2$, is kept with its longer edge vertical. It carries an inclined load W at the free end. The angle of inclination of the load to the vertical axis is 25° . What is the maximum value of load W that can be applied if the maximum tensile stress is not to exceed 200 MPa? (10 marks)
- 8 a. What is strain energy of deformation? (2 marks)
- b. A cantilever of length L carries a uniformly distributed load of intensity w / unit length. Determine the total strain energy due to bending moment? (8 marks)
- (3 x 10 = 30 marks)

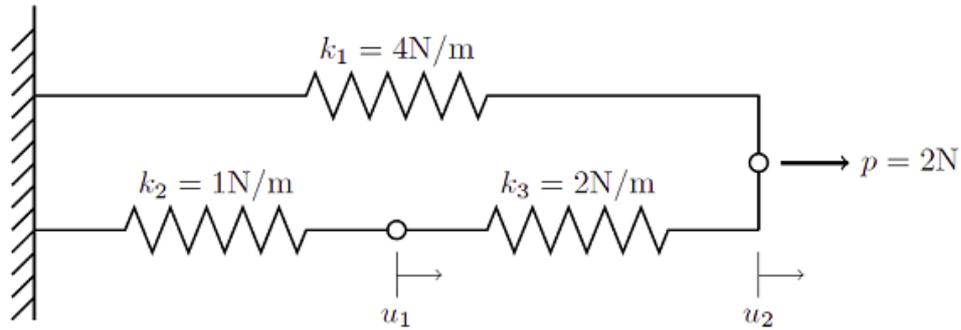
PART C

(Answer any **four** questions)

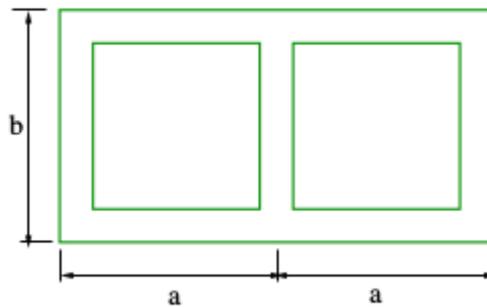
9. A simply supported beam with overhang is loaded as shown. Using the theorem of Castigliano, find the vertical deflection of point C? (10 marks)



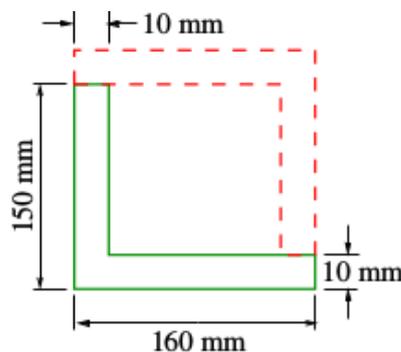
10. Using principle of minimum potential energy theorem, determine the displacements u_1 and u_2 of the spring system shown? (10 marks)



11. Using St. Venant's theory of torsion, show that simple torsion theory for circular cross-sections is exact? (10 marks)
12. Apply Prandtl torsion theory to thin rectangular sections and derive the expressions for approximate formula for shear stress distribution? (10 marks)
13. Determine the torsional shear stresses for the section shown, when it is subjected to a twisting moment T ? Assume uniform thickness, t . (10 marks)



14. An angle section shown below is subjected to a torque $T = 50$ kN-m. Find the maximum shear stress? If another angle section is welded to the previous one as shown, find the reduction in maximum shear stress? (10 marks)



(4 x 10 = 40 marks)
(Total : 100 marks)