

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018**

**Course Code: ME202**

**Course Name: ADVANCED MECHANICS OF SOLIDS (ME)**

Max. Marks: 100

Duration: 3 Hours

*(Data handbooks not permitted)*

**PART A**

*Answer any three questions, each carries 10 marks.*

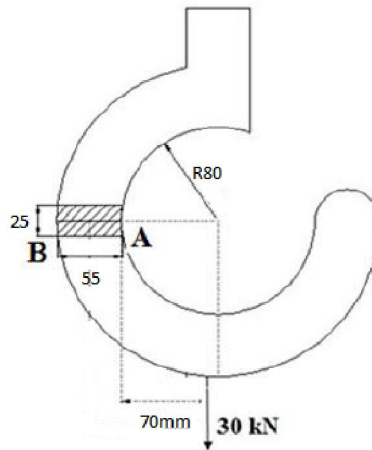
Marks

- 1 a) Define the term “State of stress” at a point. (3)
- b) Derive the Cauchy’s equation for components of traction along the x,y and z direction. Also derive the characteristic equation for the principle stresses and principle plane from Cauchy’s equation. (7)
- 2 The state of stress at a point is given by the Cartesian stress tensor
 
$$\begin{bmatrix} 2 & -1 & 1 \\ -1 & 3 & -1 \\ 1 & -1 & 2 \end{bmatrix} \text{ kPa}$$
 Find the following:
  - a) The three stress invariants (3)
  - b) Characteristic equation (2)
  - c) Principal stresses (2)
  - d) Any one unit normals of the principal planes. (3)
- 3 a) State and explain Generalized Hook’s law (5)
- b) Derive the relationship between stress and strain for an isotropic material in terms of Lamé’s coefficient. (5)
- 4 Derive the expression for stress function and components of stress for the bending of a cantilever with an end load. (10)

**PART B**

*Answer any three questions, each carries 10 marks*

- 5 a) Derive the equation for radial & hoop stress developed in a thick cylinder subjected to both internal and external pressure for a plain stress case. (6)
- b) Plot the variation of radial and hoop stress developed inside the cylinder subjected to only internal pressure (4)
- 6 A disc with a hole has an inner radius of 10 cm and outer radius of 35 cm. If the disc is running at 3500 rpm, determine the following:
  - a) The distributions of radial stress and tangential stress. (4)
  - b) Plot the variation of radial and tangential stress across the radius of the disc. (3)
  - c) Find the maximum values of radial and tangential stress. (3)
 Take Poisson’s ratio is equal to 0.3 and density of steel equal to 8050 kg/m<sup>3</sup>.
- 7 A crane hook of rectangular cross section 25 mm wide and 55 mm deep has an inner radius of curvature 80 mm. The load line is at 70 mm from the inside of the section. Determine the maximum fiber stress induced, if it carries a load of 30kN. (10)

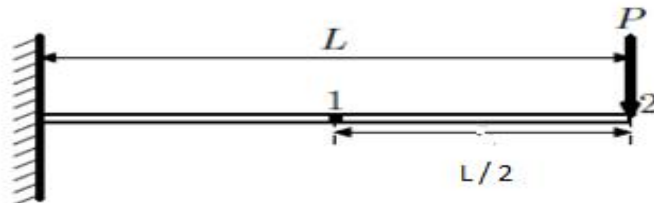


- 8 Derive the equation for strain energy for the below loading conditions:
- Strain Energy under Direct Stress. (2)
  - Strain Energy in Bending of cantilever beam with a point load and simply supported beam with concentrated load. (4)
  - Strain Energy in Torsion. (2)
  - Strain energy for shear stress. (2)

### PART C

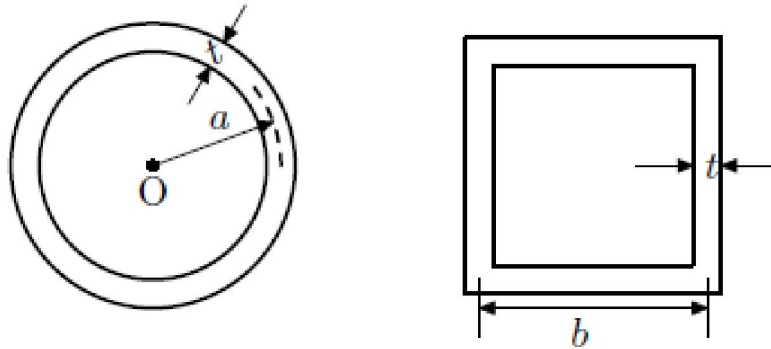
*Answer any four questions, each carries 10 marks.*

- State and prove Castigliano's first theorem. (6)
  - State and explain Minimum Potential Energy theorem. (4)
- State and prove Maxwell's reciprocal theorem. (4)
  - Find the transverse deflection at the point 1 due to the application of a load  $P$  at 2 of the cantilever shown in figure. (6)



- Derive the equation for torsion of an elliptical cross section using Saint Venant's method. Also find the following: (4)
  - Angle of twist per unit length on applying a torque  $T$  (2)
  - Stress components and resultant stress. (4)
- Derive the Torsion equation for a thin walled hollow circular rod subjected to a torque  $T$ . Also state the assumptions used in the derivation. (10)

- 13 Figure shows the cross sections of two tubular rods. The thickness and (10)  
circumference of the two sections are equal. Find the ratio of shear stress induced if:  
i) Equal twisting moment, are applied ii) Equal angle of twist, are applied.



- 14 Derive the equation for torsion of a bar of circular cross section using Prandtl's (10)  
Method. Also find the components of stress and the resultant stress.

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