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

Course Code: ME202

Course Name: ADVANCED MECHANICS OF SOLIDS (ME)

Max. Marks: 100

Duration: 3 Hours

PART A

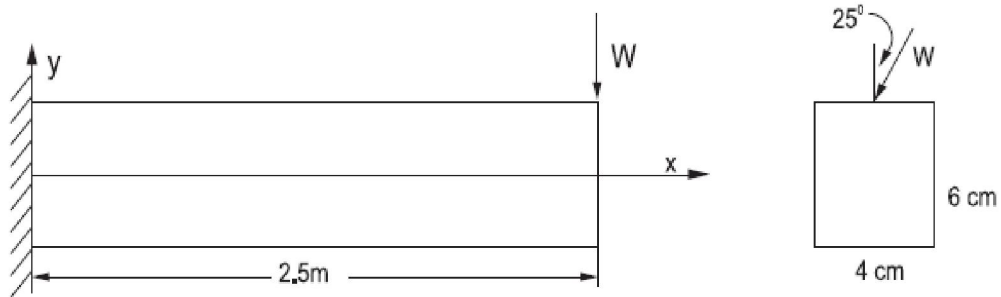
Answer any three questions. Each question carries 10 marks.

- 1 The state of stress at a point is characterised by the components, (10)
 $\sigma_x = 12.31, \sigma_y = 8.96, \sigma_z = 4.34, \tau_{xy} = 4.20, \tau_{yz} = 5.27, \tau_{zx} = 0.84$ MPa.
 Determine the values of principal stresses and maximum shear stress.
- 2 a) State St. Venant's principle for end effects. (3)
 b) Write down the generalized Hooke's law for a linear elastic isotropic material (3)
 c) What is meant by octahedral plane? (2)
 d) What is plane stress? (2)
- 3 a) If the displacement field is given by $U = (x^2 + y)\mathbf{i} + (3 + z)\mathbf{j} + (x^2 + 2 - y)\mathbf{k}$ (5)
 Write down the strain tensor at the point (3,2,-1)
 b) Corresponding to the above, determine the strain in the direction (5)
 $n_x = n_y = n_z = \frac{1}{\sqrt{3}}$
- 4 a) Investigate whether the following polynomial is permissible as an Airy's stress (6)
 function
 $\phi = A \left(xy^2 - \frac{3}{4} xyB^3 \right)$. If permissible, derive the expressions for stress.
 b) Write a note on stress transformation. (4)

PART B

Answer any three questions. Each question carries 10 marks

- 5 a) What is meant by shear centre? (3)
 b) Explain the term "complementary strain energy" (3)
 b) Give the expressions for strain energy due to torsion (4)
- 6 a) Write down the differential equation of equilibrium in polar co-ordinate (5)
 system in 2-dimensions.
 b) What are the initial assumptions taken while solving problems of rotating (5)
 circular discs
- 7 A cantilever of rectangular cross section of breadth 4cm and depth 6cm is (10)
 subjected to an inclined load W at free end as shown in figure. The length of
 cantilever is 2.5m and the angle of inclination of the load with vertical is 25° .
 What is the maximum value of W if the maximum stress due to bending is not
 to exceed 200N/mm^2 .

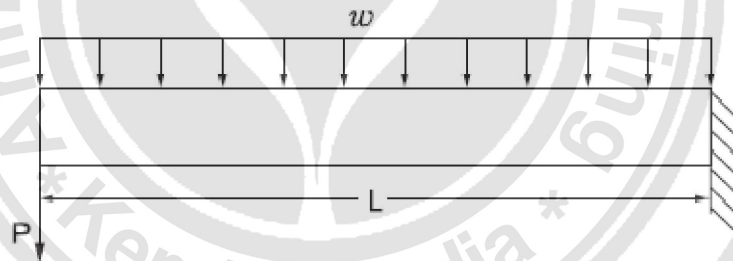


- 8 a) A thick walled tube with an internal radius of 12cm is subjected to an internal pressure of 200MPa. ($E=2.1 \times 10^5 \text{MPa}$) and $\nu = 0.3$). Determine the optimum value of the external radius if the maximum shear stress developed is limited to 350MPa. (6)
- b) Determine the change in internal radius due to the applied pressure. (4)

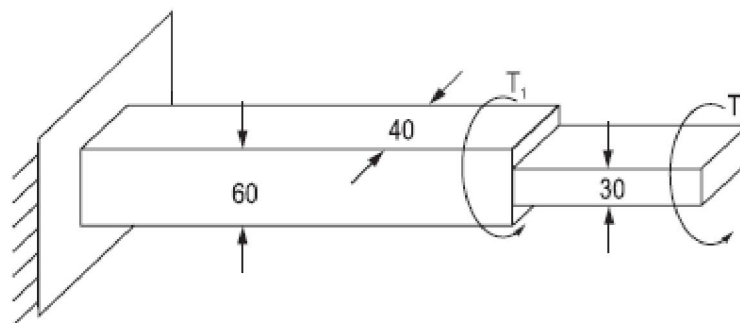
PART C

Answer any four questions. Each question carries 10 marks.

- 9 a) Obtain the general expression for strain energy in terms of components of stress. (5)
- b) Explain the Maxwell reciprocal theorem. (5)
- 10 The cantilever beam supports a uniformly distributed load w and a concentrated load P as shown in figure. Also it is given that $L=2\text{m}$, $w=4\text{kN/m}$, $P=6\text{kN}$ and $EI=5\text{MN}\cdot\text{m}^2$. Determine the deflection at the free end using Castigliano's theorem. (10)



- 11 A rod with rectangular cross section is used to transmit torque to a machine frame (see figure). It has a width of 40mm. The first 3.0m length of rod has a depth of 60mm and the remaining 1.5 m length has a depth of 30mm. The rod is made of steel having $G=77.5 \text{GPa}$. Given $T_1=750\text{Nm}$ and $T_2=400\text{Nm}$, determine the maximum shear stress in the rod. Also determine the angle of twist of the free end. (10)



- 12 a) A shaft of square section of outer side 55mm and inner side 50mm is subjected (10)

to a twisting moment such that the maximum shear stress developed is 250N/mm^2 . What is the torque acting on the shaft and what is the angular twist if the shaft is 1.6 m long and $G=70000\text{N/mm}^2$

- 13 a) Explain membrane analogy (4)
b) What is meant by warping function? (3)
c) Define the term *shear flow*. (3)
- 14 A hollow thin wall torsion member has two compartments with cross sectional dimensions as given in figure. The material is an aluminium alloy having $G=26\text{GPa}$. Determine the torque if the maximum shear stress is 40MPa . (10)

