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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (R,S) Examination November 2024 (2019 Scheme)

Course Code: MRT205

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1 What you mean by stress invariants? (3)

2 Write down the Cauchy's equation and mention each term in that equation terms. (3)

3 Draw the stress-strain diagram for a ductile material and mark its salient points. (3)

4 Write the relations between elastic constants E, G and K, and Poisson's ratio (ν) (3)

5 List any three assumptions in the theory of torsion (3)

6 Discuss the relation between load, shear force and bending moment. (3)

7 What is Macaulay's method? Where is it used? (3)

8 Differentiate resilience, proof resilience and modulus of resilience. (3)

9 Write down the relationship between the hoop stress and longitudinal stress in the case of a thin cylinder subjected to internal pressure. (3)

10 Explain the importance of Slenderness ratio in the case of a column? (3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11 At a point P, the stress components are $\sigma_x = \sigma_y = \sigma_z = 0$, $\tau_{xy} = \tau_{xy} = \tau_{xy} = 1$. All the units are in kPa. Determine the stress invariants, principal stresses and its directions for the given state of stress. (14)

12 The state of plane stress at a point is given by σ_{xx} = 100 MPa, σ_{yy} = 70 MPa and τ_{xy} =45 MPa. Find (i) Principal stresses and principal planes and (ii) Maximum shear stress using Mohr's circle method. (14)

Module 2

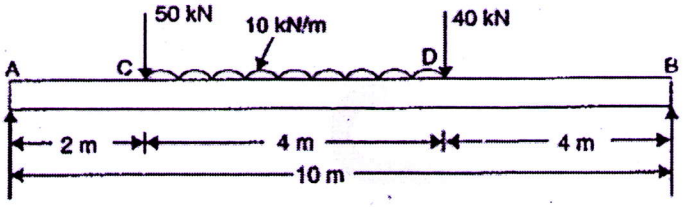
13 A load of 2 MN is applied on a short concrete column 500 mm ×500 mm. The column is reinforced with four steel bar of 10 mm diameter, one in each corner. (14)

Find the stresses in the concrete and steel bars. Take E for steel as 2.1×10^5 N/mm^2 and for concrete as 1.4×10^5 N/mm^2.

14 A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If, at a temperature of 10 °C there is no longitudinal stress, calculate the stress in the rod and tube when the temperature is raised to 200 °C. Take E for steel and copper as 2.1×10^5 N/mm^2 and 1×10^5 N/mm^2 respectively. The value of the coefficient of linear expansion for steel and copper is given as 11×10^{-6} and 18×10^{-6} per °C respectively. (14)

Module 3

15 Draw the shear force and bending moment diagram for a simply supported beam of length 10 m, carries the uniformly distributed load and two point loads as shown in Figure. Also determine the maximum bending moment. (14)



16 (i) A hollow circular shaft of 120 mm external diameter transmits 350 kW power at 200 rpm. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 65 N/mm^2. (7 mark) (14)

(ii) Calculate the maximum stress induced in a cast iron pipe of external diameter 30 mm, internal diameter 20 mm and length 4 m when the pipe is supported at its ends and carries a point load of 80 N at its centre. (7 mark)

Module 4

17 A beam of length 6 m simply supported at the ends A and B is loaded with two point loads of 60 kN and 70 kN at a distance of 1 m and 4 m from the left end. Determine the position and magnitude of maximum deflection using Macaulay's Method. Take E = $2\text{x}10^5$ N/mm^2 and I = 85×10^6 mm^4 (14)

18 (i) Derive an expression for strain energy stored in a body when the load is applied gradually. (7 mark) (14)

(ii) State and prove Castigliano's second theorem. (7 mark)

Module 5

19 (i) What are the limitation of Euler's formula (5 mark) (14)

(ii) A hollow tube having 6 m length, 50 mm external diameter, and 5 mm thick is used as a strut with both ends hinged. Find crippling load and safe load taking factor of safety as 4. Take $E=2x10^5$ N/mm^2. (9 mark)

20 (i) A thin cylindrical pressure vessel of 1m diameter is subjected to an internal pressure of 3 N/mm^2. If the thickness of the vessel is 50 mm, find the hoop stress, longitudinal stress and the maximum shear stress. (7 mark) (14)

(ii) Write a short note on any two theories of failure (7 mark)

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