Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S,FE) Examination December 2025 (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 equality of cross shears.	(3)
2	Explain stress tensor	(3)
3	Explain Poisson's ratio	(3)
4	Explain Hooke's law using stress-strain diagram	(3)
5	Define Section modulus and flexural rigidity	(3)
6	What are the assumptions made in the theory of simple bending	(3)
7	Explain Castigliano's Second Theorem.	(3)
8	Write the equation for strain energy stored in a body when the load is applied suddenly.	(3)
9	What you mean slenderness ratio? What is the effective length of columns with both ends fixed?	(3)
10	Write the expression for hoop stress and longitudinal stress in the case of a thin cylinder subjected to internal pressure.	(3)

PART B

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

Module 1

11	Determine the stress invariants, principal stresses and its directions for the given state of stress. The stress components are $\sigma_x = \sigma_y = \sigma_z = \tau_{xy} = \tau_{xy} = \tau_{xy} = 1$. All the units are in kPa.	(14)
12	The stresses at a certain point in a strained material on two planes at right angle each other are 40 N/mm^2 and 20 N/mm^2 (both are tensile). The shear stress is 20 N/mm^2. Find the principal stresses and location of principal planes using Mohr's circle method.	(14)

Module 2

13 Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50 cm apart. Diameters and lengths of each rod are 2 cm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod. Take E for steel = 2×10^5 N/mm^2 and E for copper =1×10^5 N/mm^2. (14)

14 A steel rod of 20 mm diameter passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly home on the projecting part of the rod. If the temperature of the assembly is raised by 50 °C, calculate the stress developed in copper and steel. Take E for steel and copper as 200 GN/mm^2 and 100 GN/mm^2. Thermal expansion for steel and copper are 12×10^{-6} and 18×10^{-6} per °C respectively. (14)

Module 3

15 Draw the shear force and bending moment diagram for a cantilever of length 2 m carries a uniformly distributed load of 1.5 kN/m run over the whole length and a point load of 2 kN at a distance of 0.5 m from the free end. (14)

16 Determine the diameter of a solid steel shaft which will transmit 90 kW at 160 rpm. Also find the length of the shaft if the twist must not exceed 1° over the entire length. The maximum shear stress is limited to 60 N/mm^2. Take the value of modulus of rigidity = 8×10^4 N/mm^2 (14)

Module 4

17 A beam of length 8 m is simply supported at its ends carries a uniformly distributed load (UDL) of 10 kN/m for a distance of 4 m. The UDL is located between 1 m away from the left end and 3 m away from right end. Using Macaulay's method determines the position and magnitude of maximum deflection. Given E = 2×10^5 N/mm^2 and I = 4.3×10^8 mm^4. (14)

18 A tensile load of 60 kN is applied to a circular bar of 40 mm diameter and 4 m length. Find stress, extension in the rod and strain energy absorbed by the rod if (i) load is applied gradually (ii) suddenly. (14)

Module 5

19 (i) List the different theories of failure and explain any two (7 mark) (14)

(ii) A solid circular bar 4 m long and 100 mm in diameter is used as a strut,

determine the crippling load for the conditions (i) Both the ends are fixed. (ii) Both the ends are hinged. Take E=2 x 10^5 N/mm^2. (7 mark)

20 (i) A cylindrical pipe of diameter 2 m and thickness 20 mm is subjected to an internal pressure of 1.2 N/mm^2. Determine the hoop stress and longitudinal stress developed in the pipe. (7 mark) (14)

(ii) Derive an expression for Euler's crippling load for the long column which is hinged at both ends. (7 mark)

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