Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S,FE) Examinations June 2026 (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 Express the stress invariants in terms of Cartesian components of stress and principal stress. (3)

2 Define the term 'state of stress at a point' in terms of rectangular co-ordinate system. (3)

3 Distinguish between the states of plane stress and plane strain. (3)

4 Explain generalised Hooke's law. (3)

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

6 Define coefficient of thermal expansion and thermal stresses. (3)

7 Explain Castigliano's first theorem. (3)

8 Express the strain energy for a cantilever beam subjected to a transverse point load at free end. (3)

9 Compare the strength of a thin spherical vessel and a thin cylindrical vessel on the basis of hoop stress. (3)

10 Define crippling load and write the limitations of Euler's column formula. (3)

PART B

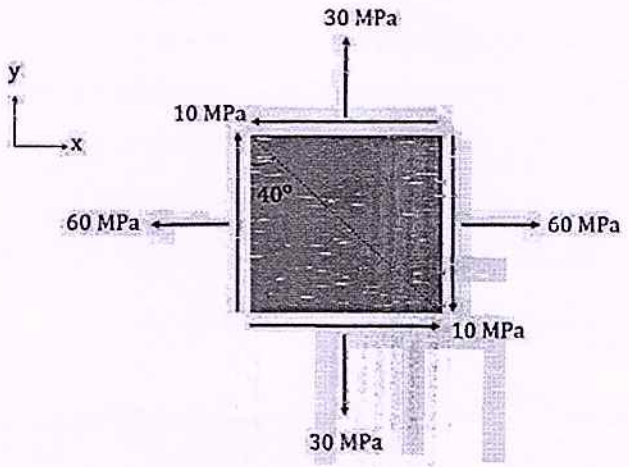
Answer any one full question from each module. Each question carries 14 marks

Module 1

11 For the state of plane stress shown in the figure: (14)

i) Draw the Mohr's circle and indicate the points that represent stresses on face X and on face Y.

ii) Using the Mohr's circle, determine the normal and shear stress on the inclined plane shown in the figure and label this point as N on the Mohr's circle.



12 Explain; (14)

(a) the principal planes

(b) the principal stresses

(c) the orientation of the planes of maximum in-plane shearing stress

(d) the maximum in-plane shearing

Module 2

13 a) A steel tube with 2.4 cm external diameter and 1.8 cm internal diameter encloses a copper rod 1.5 cm diameter to which it is rigidly joined at each end. If at a temperature of 10°C, there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. (9)

ES = 210,000 N/mm^2, αs = 11 × 10^{-6}/°C, EC = 100,000 N/mm^2,

αC = 18 × 10^{-6}/°C

b) Draw stress-strain curve of a mild steel and explain its salient points (5)

14 Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30mm and of length 1.5m if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm^2 . (14)

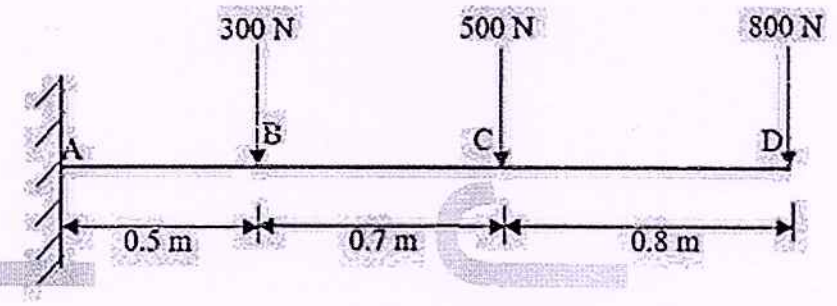
Assume as E = 1x10^5 N/mm^2

Module 3

15 A solid circular shaft transmits 75kW power at 200 rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1° in 2m length and the shear strength is limited to 50 N/mm^2. (14)

Take C = 1x10^5 N/mm^2

16 Draw SFD and BMD of a Cantilever beam carrying loads as shown in the figure (14)



Module 4

17 a) A horizontal girder of steel having uniform section is 14 m long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends respectively. Moment of inertia for the section of the girder is 16×10^8 mm4 and Es = 210 kN/mm^2. Calculate the deflection of the girder at points under the two loads and maximum deflection using Macaulay's method. (8)

b) Derive the expressions for elastic strain energy in terms of applied load/moment and material property for the cases of i) Axial force ii) Bending moment. (6)

18 A beam of length 7m simply supported at the ends A and B is loaded with two point loads of 60kN and 70kN at a distance of 1.2m and 4m from the left end. Determine the position and magnitude of maximum deflection. Take E = $2x10^5$ N/mm^2 and I = 8500cm^4 (14)

Module 5

19 a) A cylindrical shell 3m long closed at the ends has an internal diameter of 1m and wall thickness 15mm. Calculate the circumferential and longitudinal stresses induced and also the change in dimensions of the shell, if it is subjected to an internal pressure of 1.5MPa. Take E = 2×10^5 N/mm^2 and = 0.3. (9)

b) Derive Euler's formula for a column with both ends hinged. (5)

20 A solid round bar 3m long and 5cm in diameter is used as a strut, determine the crippling load. Take E=2 x 10^5 N/mm^2. i) Both the ends are hinged. ii) Both the ends are fixed. iii)One end hinged and the other end fixed (14)

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