Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S,FE) Examination May 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 Define the term 'state of stress at a point' in terms of polar co-ordinate system. (3)

2 Write a note on stress invariants. (3)

3 Write the constitution equation connecting the relationship between strain and stress components? (3)

4 Explain Lateral strain, linear strain and volumetric strain. (3)

5 What are the sign conventions for shear force and bending moment in general? (3)

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

7 Write the expression for strain energy on a body subjected to uniaxial normal stress. (3)

8 State Castigliano's Second Theorem. (3)

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

10 Explain Saint Venant's theory of failure. (3)

PART B

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

Module 1

11 At a point P in a body, σ_x = 10,000 N/cm^2 (1020 kgf/cm^2), σ_y = –5,000 N/cm^2 (–510 kgf/cm^2), σ_z = –5,000 N/cm^2, $t_{xy} = t_{yz} = t_{zx}$ = 10,000 N/cm^2. Determine the normal and shearing stresses on a plane that is equally inclined to all the three axes. (14)

12 A point in a body is subjected to the following stresses σ_{xx} = 80 N/mm^2(T), σ_{yy}= 40 N/mm^2 (C) and τ_{xy} = 60 N/mm^2. Evaluate analytically the normal and shear stress on a plane inclined at 30° with the direction of the minor normal stress. (14)

Also evaluate the principal stresses and the inclination of principal planes, maximum shear stress and inclination of maximum shear stress planes.

Module 2

13 (a) Define the elastic constants and derive the relationship between Modulus of elasticity, modulus of rigidity and bulk modulus. (7)

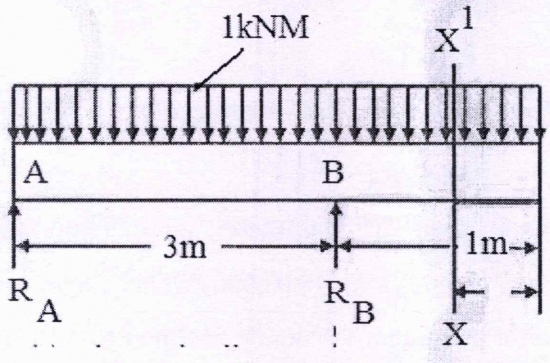
(b) Determine the Poisson's ratio and bulk modulus of a material, for which modulus of elasticity is 1.2×10^5 N/mm^2 and modulus of rigidity is 4.8×10^4 N/mm^2. (7)

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. Assume as E =1×10^5 N/mm^2 (14)

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. Take C = 1×10^5N/mm^2 (14)

16 A simply supported beam overhanging on one side is subjected to a uniform distributed load of 1 kN/m. Sketch the shear force and bending moment diagrams and find the position of point of contra-flexure. (14)



Module 4

17 Find an expression for strain energy stored in a body when

a) The load is applied gradually (7)

b) The load is applied suddenly (7)

18 A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1m and 3m respectively from the left support.(Using Macaulay's Method) (14)

Find:

(i) Deflection under each load.

(ii) Maximum deflection

(iii) The point at which maximum deflection occurs. Given $E = 2\times 10^5 N/mm^2$ and $I = 85 \times 10^6\ mm^4$

Module 5

19 (a) Derive an expression for the Euler's crippling load for a long column with both ends fixed. (9)

(b) Derive Rankine column formula (5)

20 a) A cylindrical cells 3 m long closed at the ends having 1m of internal diameter is subjected to an internal pressure of 1.5 MPa. If the thickness of the shell wall is 15mm. Find the circumferential, longitudinal stress and maximum shear stress. Find the change in diameter, length and volume of the shell. E=2x10^5 N/mm^2 and 1/m=0.3 (9)

b) Derive and expression for crippling load for a column with one end fixed and other end free (5)

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