Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree Regular and Supplementary Examination December 2022 (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	Write a note on stress invariants.	(3)
2	Define the term 'state of stress at a point' in terms of rectangular co-ordinate system,	(3)
3	Explain generalised Hooke's law.	(3)
4	Define the terms Modulus of Elasticity, Poisson's ratio and complementary shear stresses.	(3)
5	Define coefficient of thermal expansion and thermal stresses.	(3)
6	Discuss about the assumptions in the theory of simple bending.	(3)
7	Explain Castigliano's first theorem.	(3)
8	Define the terms resilience, proof resilience and modulus of resilience.	(3)
9	Derive the expression for circumferential stress in a thin cylindrical vessel.	(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	(a) Derive Cauchy's stress equation. (8) (b) A rectangular steel bar is subjected to three mutually perpendicular normal stresses of σ_{xx} = 70 N/mm^2, σ_{yy} = 55 N/mm^2, σ_{zz} = 30 N/mm^2 and τ_{xy}= 40 N/mm^2. Determine the normal and shear stresses on a plane equally inclined to the three axes. (6)	(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. Also evaluate the principal stresses and the inclination of principal planes, maximum shear stress and inclination of maximum shear stress planes.	(14)

Module 2

13 (a) A rod is 2m long at a temperature of 10^0 C. Find the expansion of the rod, when the temperature is raised to 120^0C. If the rod is fixed at both the ends find the stress induced in the material of the rod when (i) supports are rigid and (ii) supports yield by 0.5mm. Take E = 1.1 × 10^5 N/mm^2 and α=0.000012/^{0} C (10)

(b) Draw the stress strain diagram for a ductile material and explain the salient points? (4)

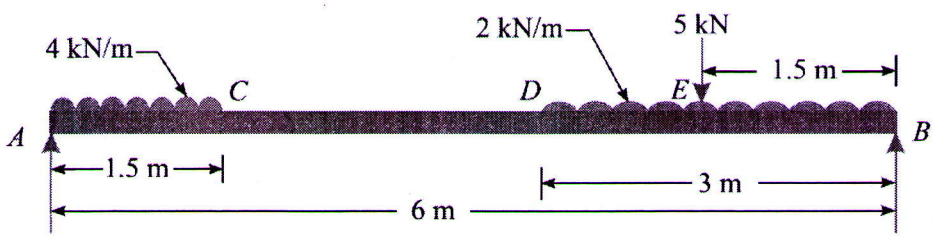
14 (a) Define the elastic constants and derive the relationship between Modulus of elasticity, modulus of rigidity and bulk modulus. (7)

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

Module 3

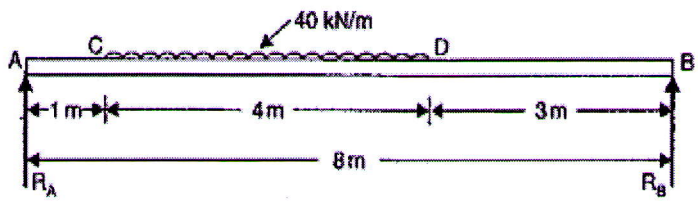
15 Determine the diameters of a hollow steel shaft of diameter ratio 0.6 which will transmit 30 kW at 1600 rpm. Also find the length of the shaft if the twist must not exceed 1° over the entire length. The maximum shear stress is limited to 60 N/mm^2. Take the modulus of rigidity = 8 × 10^4 N/mm^2. (14)

16 A simply beam of span 6 m carries loads as shown in figure. Draw the shear force and B.M. diagrams. (14)



Module 4

17 A beam of length 8m is simply supported at its ends. It carries a uniformly distributed load of 40kN/m as shown in the figure. Using Macaulay's method determine the deflection of the beam at its midpoint and also 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) A tensile load of 60kN is gradually applied to a circular bar of 4cm diameter and 5m long. If the value of E = 2×10^5 N/mm^2. Determine stretch in the rod, stress in the rod, strain energy absorbed by the rod. (9)

b) A steel rod is 2 m long and 50 mm in diameter. An axial pull of 100 kN is suddenly applied to the rod. Calculate the instantaneous stress induced and also the instantaneous elongation produced in the rod. Take E = 200 GN/m^2 (5)

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 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. (14)

i) Both the ends are hinged.

iii) Both the ends are fixed.

iii)One end hinged and the other end fixed