Reg No.:_______________ Name:_______________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S, FE) (FT/WP/S1PT) Examinations May/June 2026 (2019 Scheme)

Course Code: MET201

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1	Define state of stress at a point. Represent the 3D stress tensor in Matrix form.	(3)
2	Define direction cosines. Determine direction cosines of an octahedral plane.	(3)
3	State and explain the principle of superposition.	(3)
4	Define and explain the terms (i)Young's modulus (ii) Modulus of rigidity and (iii) Poisson's ratio.	(3)
5	Draw the S.F and B.M. diagrams for a simply supported beam of length L carrying a uniformly distributed load of 'w' per m length over its entire length.	(3)
6	Differentiate between flexural rigidity and torsional rigidity.	(3)
7	Write down the expression for the strain energy stored in a body subjected to (i) shear load (ii) twisting moment.	(3)
8	State reciprocal relation related to influence coefficients.	(3)
9	Define the term equivalent length. What is the effective length of columns with both ends fixed?	(3)
10	State Guest's theory for maximum shear stress.	(3)

PART B

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

Module 1

11a	Stress at a point is given by $\begin{bmatrix} 1 & 2 & 1 \\ 2 & -2 & -3 \\ 1 & -3 & 4 \end{bmatrix}$ k Pa. Determine the principal stresses and any one of the principal planes.	(8)
11b	If the displacement field is $(3x^2 + y)$ **i**+ $(2y^2 + z)$ **j**+ $(4z^2 + x)$ **k**, obtain the displaced position of a point originally at (2,1,1). Also determine the strain tensor at (2,1,1).	(6)

12 For the plane stress condition characterized by σ_{xx} =80 N/mm^2 σ_{yy}=40 N/mm^2, and τ_{xy} = 30 N/mm^2, determine principal stresses and maximum shear stress using the method of Mohr's circle. Also, determine the inclination of the planes on which principal stresses and maximum shear stress act. (14)

Module 2

13a A circular bar of length 800 mm and diameter 40 mm is drilled with a bore for a length of 350 mm from the right side at the centre of the bar. The diameter of the hole drilled is 25 mm. Prepare a sketch. If an axial tensile load of 40 kN is applied, how much is the extension of the bar (E = 2.1 x 10^5 N/mm^2)? (10)

13b With the help of a neat sketch explain stress –strain diagram for brittle material. (4)

14 A composite bar made of brass and steel is fixed between two supports A and C as shown in Fig 1. If the temperature is increased by 80°C, find the stresses induced in the steel and brass section assuming (i) the supports do not yield (ii) the supports yield by 0.15 mm. Take α_s = 12 x10^{-6}/°C, α_b = 19 x10^{-6}/°C, E_s = 200 GPa and E_b = 100 Gpa. (14)

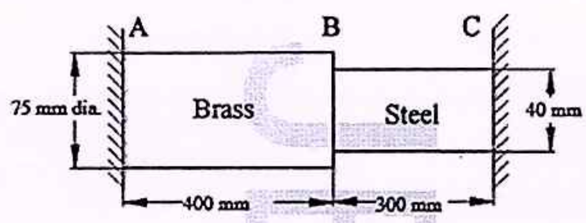

Fig 1

Module 3

15 A simply supported beam of length 6 m carries a uniformly distributed load of 4 kN/m over the central 3 m length and two point loads 3 kN and 4 kN at distances of 1 m and 5 m respectively from the left support. Draw SFD and BMD. Locate the point of maximum bending moment and find out the maximum bending moment. (14)

16a A solid circular shaft and a hollow circular shaft whose inside diameter is 2/3 of the outside diameter, are of the same material, of equal lengths and are required to transmit a given torque. Compare the weights of these two shafts if the maximum shear stresses developed in the two shafts are equal. (10)

16b What are the assumptions taken while deriving Torsion equation (4)

Module 4

17 A beam of 4 m span is simply supported at the ends and is loaded as shown in Fig 2. Determine (i) Deflection at C, (ii) Maximum deflection and (iii) Slope at the end A. Take $E = 2 \times 10^{11}$ N/m^2 and $I = 20 \times 10^{-6}$ m^4. (14)

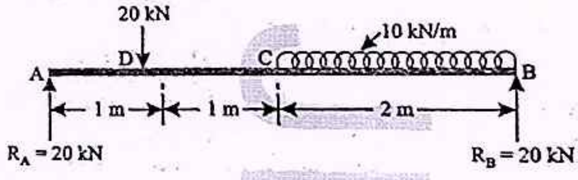

Fig 2

18a For the cantilever beam shown in Fig 3, determine the deflection at the end A. I_1 and I_2 are the moment of inertia of the beam section of length L_1 and L_2 respectively. Neglect shear energy. (9)

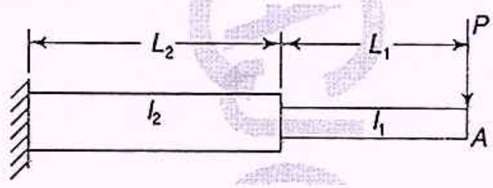

Fig 3

18b Derive strain energy expressions in terms of the geometry, material property and load during (i) Axial loading and (ii) Bending. (5)

Module 5

19a Find the crippling load for a hollow steel column 50 mm internal diameter and 5 mm thick. The column is 5 m long with one end fixed and the other end hinged. Use Rankine's formula and Rankine's constant as 1/7500 and σ_c= 335 N/mm^2. (10)

19b What are the limitations of Euler's Buckling theorem? (4)

20a A mild steel shaft is subjected to a 3500 N-m of bending moment at its critical point and transmits a torque of 2500 N-m. The shaft is made of steel having a yield stress of 230 MPa. Estimate the size of the shaft (FOS = 2) based on the following theories of failure (10)

(i) Maximum normal stress theory

(ii) Maximum shear stress theory

(iii) Distortion energy theory

20b Represent graphically the following theories of failure. (4)

(i) Maximum distortion energy theory

(ii) Maximum principal strain theory

***