Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree (S, FE) Examination June 2024 (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 rectangular co-ordinate system	(3)
2	Write a note on Mohr's circle of stresses	(3)
3	Explain generalised Hooke's law	(3)
4	Define the terms young's modulus and poisson's ratio	(3)
5	Define torsion,torsional rigidity and polar moment of inertia	(3)
6	List any three important assumptions in the theory of torsion	(3)
7	Discuss about castigliano's first theorem	(3)
8	Define the terms resilience,proof resilience,modulus of resilience	(3)
9	Discuss saint-venant's theory of failure	(3)
10	Define the terms column,strut and crippling load	(3)

PART B

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

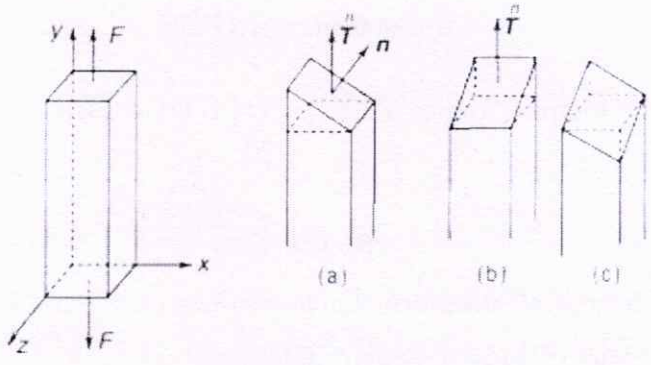
Module 1

11	A rectangular steel bar having a cross-section 2 cm x 3 cm is subjected to a tensile force of 6000 N (612.2 kgf). If the axes are chosen as shown in fig shown below, determine the normal and shear stresses on a plane whose normal has the following direction cosines:	(14)

(ii) $n_x = n_z = \frac{1}{\sqrt{2}}, n_y = 0$

(iii) $n_x = 0, n_y = n_z = \frac{1}{\sqrt{2}}$

(iii) $n_x = n_y = n_z = \frac{1}{\sqrt{3}}$



12 a) Explain the procedure for constructing Mohr's circle with an example. (7)

b) At a point P, the rectangular stress components are (7)

$\sigma_x = 1, \sigma_y = -2, \sigma_z = 4, \tau_{xy} = 2, \tau_{yz} = -3$, and $\tau_{xz} = 1$

all in units of kPa. Find the principal stresses and check for invariance.

Module 2

13 A steel rod of length 6.0 m and diameter 20 mm is fixed between two rigid supports. (14)
Determine the stress in the rod when the temperature increases by 80°C. If

a) the ends do not yield

b) the ends yield by 1 mm

(Take E = 2.0 x 10^6 kg / cm^2 and $\alpha = 12 \times 10^{-6}$ per°C)

14 a)In a tension test on a 25mm diameter rod it is observed that an extension of 0.25mm occurs over a gauge length of 300mm and correspondingly the diameter decreases by 0.00595 mm when a load of 100kN is applied .Determine the three modulus of elasticity and poisson's ratio. (7)

b) A steel flat 150mm wide 15mm thick and 6m long carries a pull of 270kN.Find the extension in length and contraction in width and thickness under the pull given poisson's ratio =0.3 and E = 2 x 10^4 kN/mm^2 Also calculate the change in volume? (7)

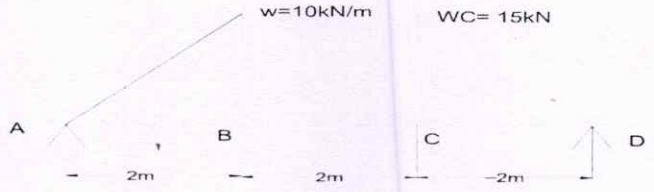
Module 3

15 Determine the diameter of a solid steel shaft which will transmit 90 kW at 160 rpm. (14)

80

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.

16 a) Draw Shear force diagram and bending moment diagram for the beam shown in figure (9)



b) Compare the stiffness of a hollow shaft of diameter ratio 0.75 to that of a solid shaft by considering the permissible shear stress. Both the shafts are of same material, of same length and weight. (5)

Stiffness of hollow shaft is [1-(0.75)^4] times stiffer than solid shaft

Module 4

17 a) State and prove reciprocal theorem (8)

b) A tensile load 80kN is applied suddenly to a circular bar of 50mm diameter and 4m long. Determine i) maximum instantaneous stress induced ii) instantaneous elongation in the bar iii) strain energy absorbed in the bar E =2x 10^5N/mm^2 (6)

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 = 2×10^5 N/mm^2 and I = 85×10^6 mm^4.

Module 5

19a Find the Eulers load for a hollow cylindrical steel column of 40mm external diameter and 3mm thick Take its length of the column as 2.5m and hinged at its both ends Take E= 200Gpa . also determine the crippling load by Rankine's formula using constants Fd = 330Mpa and α = 1/7500 (9)

19b Explain the limitation of Euler's formula (5)

81

20 A solid round bar 3m long and 5cm in diameter is used as a strut, determine the crippling load. Take $E=2x10^5 N/mm^2$.

a) One end hinged and other end fixed (5)

b) One end is fixed and other end is free. (5)

c) Both the ends are fixed. (4)