JYOTHI ENGG. COLLEGE LIBRARY THRISSUR RURAL EDUCATIONAL TRUST LEAD KINDLY LIGHT CHERUTHURUTHY

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree (R, S) Examination November 2024 (2019 Scheme)

Course Code: RAT 303

Course Name: SOLID MECHANICS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	Define stress at a point?	3
2	Define principal stresses and principal planes.	3
3	Draw the stress strain curve for ductile material and mark its salient points.	3
4	Define the terms i) poisons ratio ii) Hooke's law and iii) Young's Modulus	3
5	Draw the variation of normal stress and shear stress in a rectangular beam in the direction normal to neutral axis.	3
6	What is flexural rigidity? What is its significance?	3
7	List the conditions while solving a problem to find slope and deflection using Macaulay's method.	3
8	Derive an expression for the strain energy when a body subjected to bending moment.	3
9	Explain slenderness ratio and its necessity for estimating the crippling load ?	3
10	Explain the Haigh's theory of failure.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) The state of stress at a point is given by 7

σ_{xx} = 100 N/mm^2	σ_{yy} = 0 N/mm^2	σ_{zz}= 100 N/mm^2
τ_{xy}= 20N/mm^2	T_{xz}= 0 N/mm^2	T_{yz}= 20 N/mm^2

Find its principal stresses.

b) Determine the strain tensor at (2, 2, 2) for displacement field is given by $u = 3x-2z^2$; $v = x-3y^2$; $w = 2z-2y^2$. 7

OR

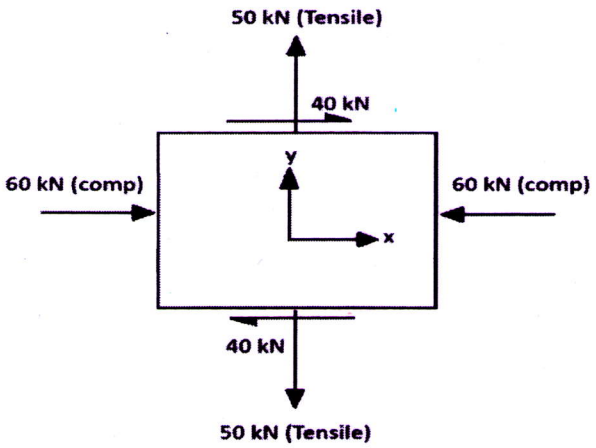
12 a) A plane element subjected to stresses as shown in the figure, Determine the following using Mohr's circle method: 14

(i) Principal stresses

(ii) Principal planes

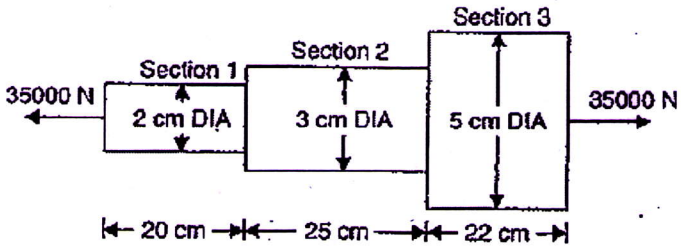
(iii) Maximum shear stress

(iv) Shear planes



Module -2

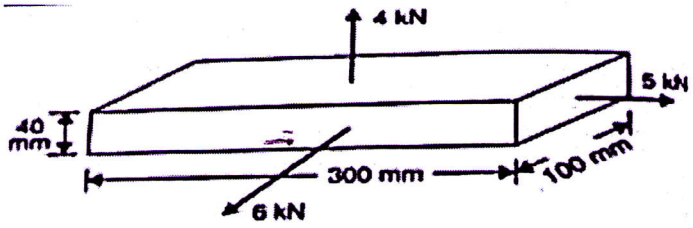
13 a) An axial pull of 35000 N is acting on a bar consisting of three lengths as shown in figure. If the Modulus of Elasticity is 2.1 $x10^5$ N/mm^2, Calculate (i) the stresses in each section (ii) total extension of the bar 9



b) Write down two relationships between the elastic constants E, G, υ and K 5

OR

14 a) A metallic bar 300 mm x 100 x 40 mm is subjected to a force of 5 kN, 6 kN and 4 kN along x, y and z directions respectively as shown in figure. Determine the change in volume of the rectangular slab. Take E = 2x10^5 N/mm^2 and poisons ratio 0.25. 6



b) A steel rod of length 4 m held between two supports at the end. Calculate the stress induced with change in temperature of 40° C 8

a) If the support doesn't yield

b) If the support yields by 0.5 mm.

Take E_s = 1.5 x 10^5 N/mm^2 and α_s = 18 x 10^{-6} /°C

Module -3

15 a) A simply supported beam of length 8 m carries three-point loads of 8 kN, 4 kN and 10 kN at 2m, 5m and 6m respectively from the left end. Draw the shear force and bending moment diagram. 14

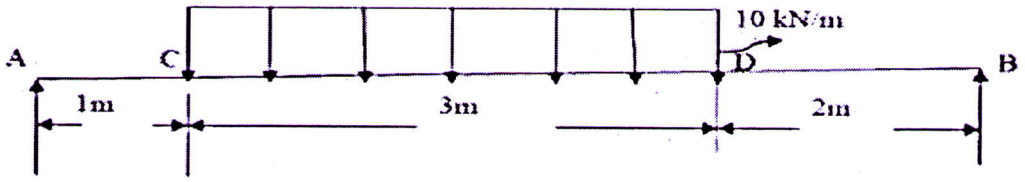
OR

16 a) Determine the minimum diameter of the solid shaft and a hollow shaft with thickness 10 mm and span 6m to transmit a power of 40 kW at 400 rpm. If the permissible shear stress for shaft material is 80 N/mm^2. 7

b) A cantilever beam with span 3 m and cross-section 200 mm x 300 mm is to carry a uniform distributed load of 'W' N/m on the entire length. If the bending stress is limited to 3MPa, determine the maximum uniform distributed load that can be applied on the beam? 7

Module -4

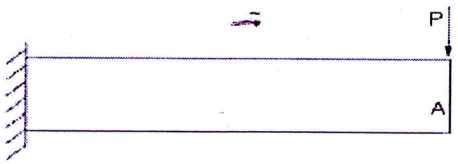
17 a) A beam AB is 6m long and has a moment of inertia of 450 x 10^6 mm^4. It is supported at A and B and carries a uniform distributed load of 10 kN/m as shown in figure. Determine the slope at A and the maximum deflection. Take E=200 kN/mm^2 14



OR

18 a) State and explain Castigliano's second theorem? 4

b) Use Castigliano's method to determine the deflection at the free end of a cantilever beam of length 1.5 m where a concentrated load of P= 2kN is applied as shown in figure. Take the value of EI = 5kN. 10



Module -5

19 a) Compare the strength of a solid steel column to that of a hollow steel column of same area of cross-section. If internal diameter of hollow column is 2/3rd of its external diameter and are having same length and end conditions. Use Euler's approach 5

b) Find the crippling load using Rankine's theory for a hollow cast iron column of 200 mm outer diameter and 150 mm inner diameter. The column is 4m long, fixed at both ends. Take the crushing limit as 490 N/mm^2 and the Rankine constant as (1/6500). 9

OR

20 a) A ductile rod of with yield stress 280 MPa subjected to axial tensile load of 30 kN and shear load of 15 kN. Determine the required diameter according to Maximum principal stress theory and Maximum shear stress theory. Consider factor of safety 2. 8

b) Explain the Guest's theory, Saint Venant's theory and Henkey Von Mises theories of failure 6

***