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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree (S,FE) Examination December 2020

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME, MP, MA, MT, AU, PE, SF)

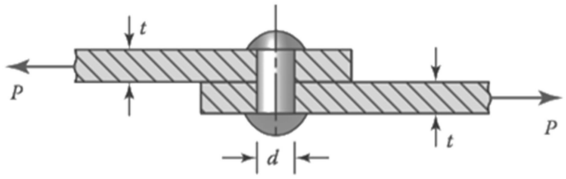
Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks Marks

1 a) Draw the stress strain curve of mild steel bar under tension test and mark all salient points. (3)

b) Calculate the normal stress in the plate, shear stress and bearing stress in the rivet for a load P=10 kN, d=18mm, t=9mm and width of the plate=54mm. Find also the maximum load P which can be safely applied for the riveted joint assuming that the rivet and the plate are made of same steel and the permissible values for normal, shear and bearing stresses are 120 MPa, 60 MPa and 200 MPa respectively. (7)



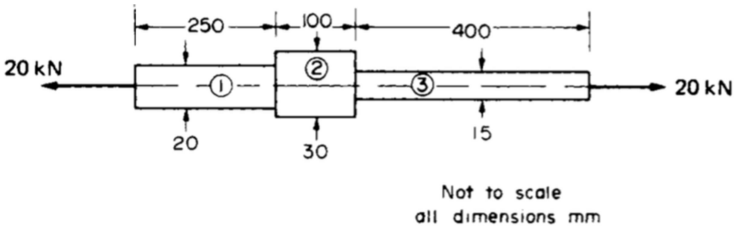
2 a) Explain principle of super position. (3)

b) Explain how orthotropic materials are different from anisotropic materials. (2)

c) Define and explain the terms: i) Shear strain ii) Lateral strain and iii) Poisson's ratio (5)

3 a) A horizontally kept bar of circular cross section with area 10 mm^2 is axially loaded with 10kN in the X direction. Write the stress tensor for a point in the bar. (2)

b) Determine the stress in each section of the bar shown in figure when subjected to an axial tensile load of 20 kN. The central section is 30 mm square cross-section; the other portions are of circular section; their diameters being indicated. What will be the total extension of the bar? For the bar material E = 210 GN/m^2. (8)



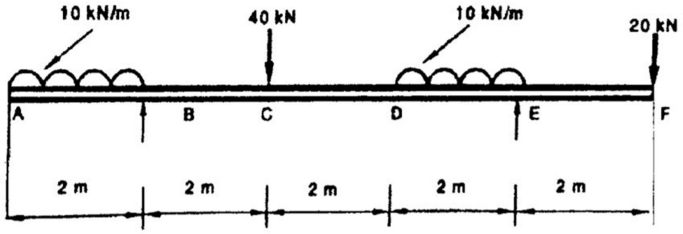
4 a) State the assumptions made in deriving the torsion formula of circular shafts. (3)

b) A solid circular shaft transmits 75kW power at 200 rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1^0 in 2 metres length of shaft, and shear stress is limited to 50N/mm^2. Take G=1x10^5 N/mm^2 (7)

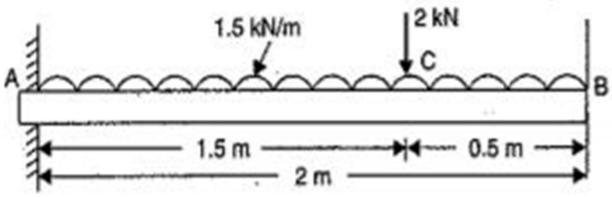
PART B

Answer any three full questions, each carries 10 marks

5 Draw the SFD and BMD for the overhanging beam shown in figure. (10)



6 a) A cantilever of length 2m carries a uniformly distributed load of 1.5kN/m run over the whole length and a point load of 2kN at a distance of 0.5m from the free end. Draw the shear force and bending moment diagrams of the cantilever shown in figure. (7)



b) Explain point of inflection. (3)

7 Prove the relation $\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$. State the assumptions made in the theory of pure bending. (10)

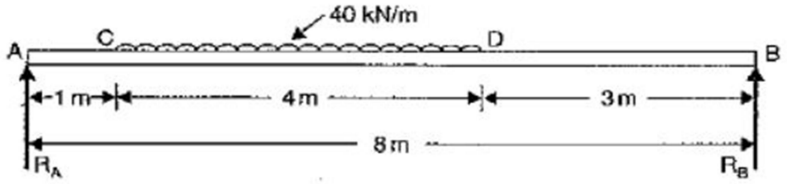
8 a) Explain how beams of uniform sections can be designed in practice. (4)

b) A simply supported wooden beam of span 1.3m having a cross section of 150 mm wide and 250 mm deep carries a point load at the centre. The permissible stresses are 7 N/mm^2 in bending and 1 N/mm^2 in shearing. Calculate the safe load W. (6)

PART C

Answer any four full questions, each carries 10 marks.

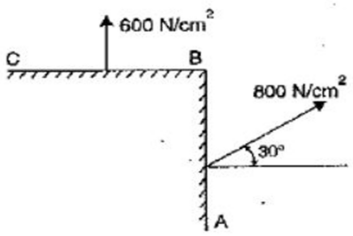
9 A beam of length 8 m is simply supported at its ends. It carries a uniformly distributed load of 40KN/m as shown in figure. Determine the deflection of the beam at its midpoint using Macaulay's method. Take $E=2x10^5$ N/mm^2 and $I=4.3x10^8$ mm^4 (10)



10 The intensity of resultant stress on a plane AB at a point in a material under stress is 800 N/cm^2 and it is inclined at 30^0 to the normal to that plane. The normal component of stress on another plane BC at right angles to plane AB is 600 N/mm^2. Determine i) Resultant stress on the plane BC (10)

ii) Principal stresses and their directions

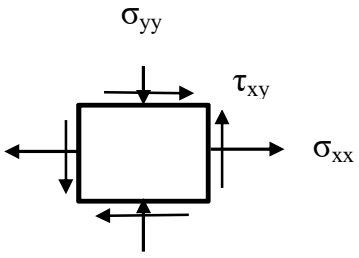
iii) Maximum shear stress



11 a) Explain moment-area method used in beams. (3)

b) Prove the relation $M = EI\frac{d^2y}{dx^2}$, where M= bending moment, E=Young's modulus and I- Moment of Inertia. (7)

12 Determine the principal stress, maximum in-plane shear stress and average normal stress using Mohr circle method. Specify the orientation of the element in each case. σ_{xx}=350 MPa (Tensile), σ_{yy}=200 MPa (Compression) τ_{xy}=500 MPa. (10)



13 A rectangular column of cross section 300mm x 400mm carries an eccentric point load of 360 kN on one diagonal at a distance of quarter diagonal length from a corner. Calculate the stresses on all four corners. (10)

14 a) A simply supported beam of length 4 m is subjected to a UDL of 30 kN/m over the whole span and deflects 15 mm at the centre. Determine the crippling load when this beam is used as a column with one end fixed and other end hinged. (6)

b) Define slenderness ratio. Explain the limitations of Euler's formula for long columns. (4)

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