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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec - 2017 / Jan - 2018

Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. With a block diagram, explain stress-strain diagram in ductile material. 5

b. An axial pull of 35000 N is acting on a bar consisting of three lengths as shown in Fig. 1(b). If the Young's modulus is $2.1x10^5$ N/mm^2, determine stress in each section and total extension. 8

c. Derive an expression for uniformly varying rectangular bar. 7

2 a. Derive an expression for Young's modulus in terms of Bulk modulus. 8

b. A steel rod 5 m long and 30 mm in diameter is subjected to an axial tensile load of 50 kN. Determine the change in length diameter and volume of the rod. Take E = $2x10^5$ N/mm^2 and Poisson's ratio = 0.25. 7

c. A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Calculate Young's modulus, Poisson's ratio and Bulk modulus. 5

UNIT - II

3 a. Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50 cm apart. Diameters and lengths of each rod are 2 cm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take $E_S = 2x10^5$ N/ mm^2 and $E_C = 1x10^5$ N/ mm^2. 10

b. A steel rod of 20 mm diameter passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The nuts are lightly on the projecting parts of the rod. If the temperature of the assembly is raised by 50°C, calculate the stresses developed in copper and steel. Take E_S = 200 GN/m^2 and E_C = 100 GN/mm^2 and $\alpha_S = 12x10^{-6}$/°C and $\alpha_C = 18x10^{-6}$/°C. 10

4 a. A rectangular bar of cross sectional area of 11000 mm^2 is subjected to a tensile load 'P' as shown in Fig.4. (a). The permissible normal and shear stresses on the oblique plane BC are given as 7 N/mm^2 and 3.5 N/mm^2 respectively. Determine the safe value of 'P'. 6

b. A point in a strained material is subjected to stresses as shown in Fig. 4(b). Using Mohr's circle method, determine the normal and tangential stresses across the oblique plane. Check the answer analytically. 14

UNIT - III

5 a. Calculate the change in diameter, change in length and change in volume of a thin cylindrical shell 100 cm diameter, 1 cm thick and 5 m long when subjected to internal pressure of 3 N/mm^2. Take the value of $E = 2x10^5$ N/mm^2 and Poisson's ratio, 1/m = 0.3. 9

b. Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure of 8 N/mm^2. Also sketch the radial pressure distribution and hoop stress distribution across the section. 11

6 a. A cantilever 1.5 m long is loaded with a UDL of 2 kN/m over a length of 1.25 m form the free end. If also carries a point load of 3 kN at a distance of 0.25 m from the free end. Draw the SFD and BMD for the cantilever. 8

b. Draw the SF and BMD for the over-hanging beam carrying UDL of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig.6 (b). Locate the point of contra flexure. 12

UNIT - IV

7 a. Define pure or simple bending, and explain the theory of pure bending. 6

b. Derive an expression for relationship between bending moment and radius of curvature. 7

c. A beam is simply supported and carries a UDL of 40 kN/m over the whole span. The section of the beam is rectangular having depth of 500 mm. If the maximum stress in the material of the beam is 120 N/ mm^2 and moment of Inertia of the section is $7x10^8$ mm^4, find the span of the beam. 7

8 a. An I-section shown in Fig.8 (a) is simply supported over a span of 12 m. If the maximum permissible bending stress is 80 N/ mm^2, what concentrated load can be carried at a distance of 4 m from one support? 10

b. A cast iron beam is of T-section as shown in Fig.8 (b). The beam is simply supported on a span of 8 m. The beam carries a UDL of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses. 10

UNIT - V

9 a. A simply supported beam of 6 m span is subjected to a concentrated load of 18 kN at 4 m form left support. Calculate the position and the value of maximum deflection, slope at mid span and deflection at the load point. 10

b. A beam AB is 6 m long and has a moment of inertia of $450x10^6$ mm^4. If is supported at A and B carries a UDL of 10 kN/m from C to D as shown in Fig 9(b). Calculate slope and A, Deflection at mid span and maximum deflection. 10

10 a. With a neat sketch, derive torsional equation. 8

b. Calculate the critical load of a strut which is made of a bar, circular in S/C and 5 m long which is pin jointed at both ends. The same bar when simply supported gives a mid-span deflection of 10 mm with a load of 10 N at the centre. 4

c. Determine the buckling load for a strut of T-section, the flange width being 100 mm, overall depth 80 mm both flange and stem 10 mm thick, the strut is 3 m long and is hinged at both ends. Take E = 200 GN/m^2. 8

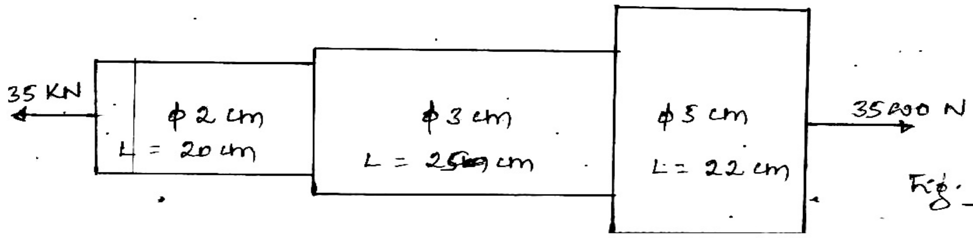

Fig. 1(b)

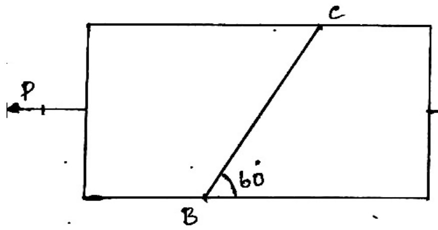

Fig. 4(a)

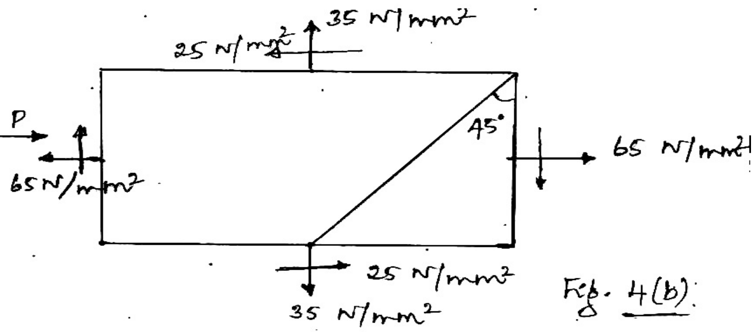

Fig. 4(b)

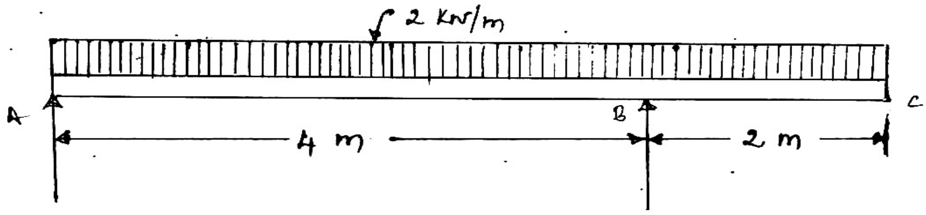

Fig. 6(b)

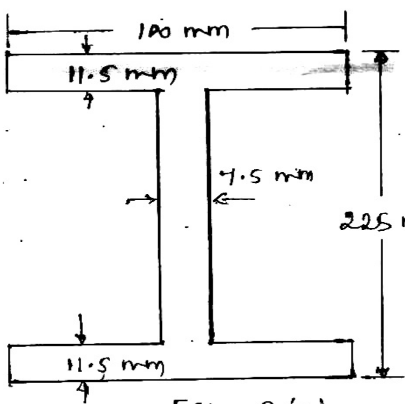

Fig. 8(a)

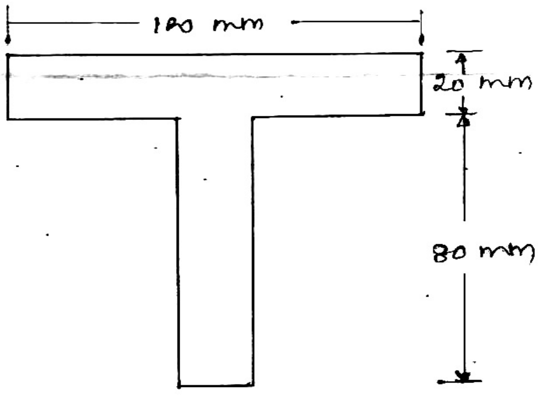

Fig. 8(b).

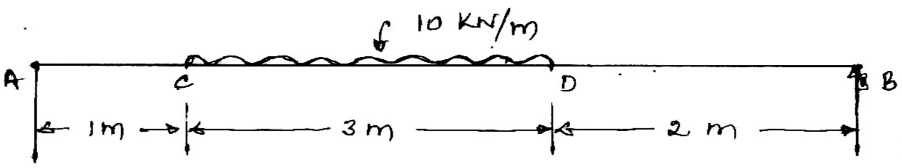

Fig. 9(b)

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