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

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; Dec - 2017/Jan - 2018

Mechanics of Materials

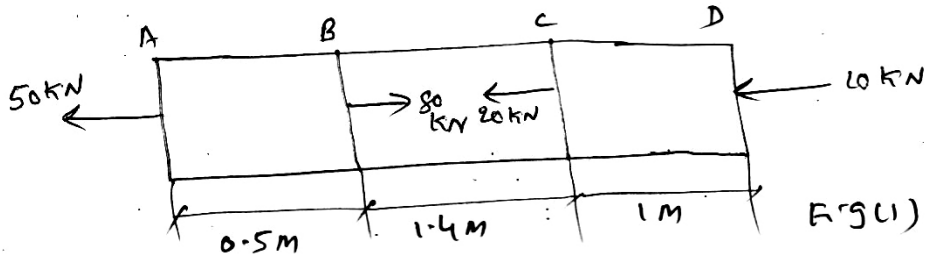
Time: 3 hrs *Max. Marks: 100*

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

UNIT - I

1 a. Explain with neat sketch the stress strain curve for a mild steel specimen. 5

b. A cross section bar having cross sectional area 300 mm^2 is subjected to axial forces as shown in Fig (1). Find the total elongation of the bar, Take E = 84 GPa.



8

c. A steel plate of thickness 16 mm tapers uniformly from 80 mm at one end to 50 mm at the other end in a length of 800 mm. If the plate is subjected to a load of 120 kN, find the expansion of the plate. Take E = $2x10^5$ MPa. 7

2 a. Derive an equation of relationship between Young's modulus (E) and Rigidity modulus(C). 8

b. A bar of certain material 30 mm diameter is subjected a pull of 75 kN. The measured elongation on a gauge length of 220 mm is 0.01 mm and the charge in diameter is 0.0042 mm. Calculate Poisson's ratio, Young's modulus, Shear modulus and Bulk modulus. 12

UNIT - II

3 a. A 15 mm diameter steel rod passes centrally through a copper tube 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 tightened on the processing parts of the rod. If the temperature of the assembly is raised by 60ºC. Calculate the stresses developed in copper and steel. Take E_s = 210 GPa, E_c = 105 GPa, $\alpha_s = 12 \times 10^{-6}$/ºC, $\alpha_C = 17.5x10^{-6}$/ºC. 10

b. A rectangular block of a material is subjected to a tensile stress of 110 N/ mm^2 on one plane and a tensile stress of 47 N/ mm^2 on the plane at right angles to the former as shown in Fig. (2), the above stress is accompanied by a shear stress of 63 N/mm^2. Find the direction and magnitudes of each principal stresses and magnitudes of maximum shear stress, sketch the planes and mark the stresses on the planes. 10

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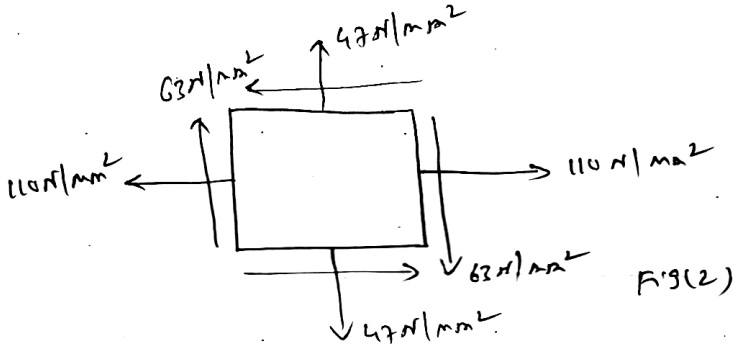
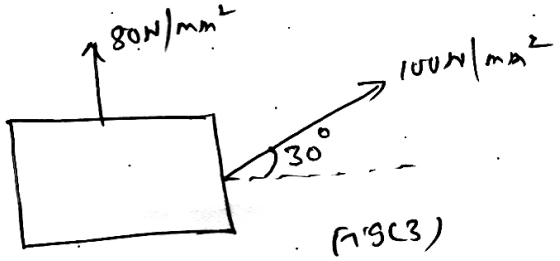


Fig(2)

4 a. A mild steel rod 20 mm in diameter passes centrally through a copper tube whose internal diameter is 21 mm and thickness 4 mm. The composite section is 500 mm long and their ends are rigidly connected. If an axial pull of 50 kN is applied, determine the stresses developed in the two metals and their expansion. Take E_s = 200 GPa, E_C = 100 GPa. 10

b. At a point in a strained material the state of stress is as shown in Fig. (3). Determine the principle stresses and principal planes. 7



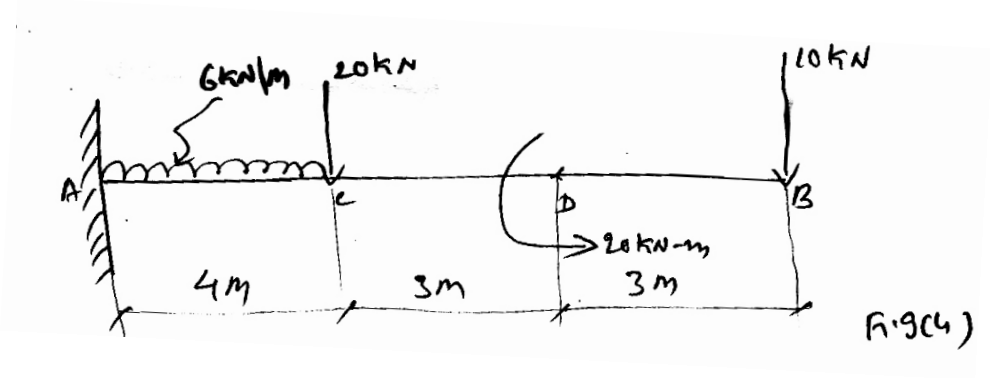
Fig(3)

c. Discuss the steps to be followed for drawing the Mohr's circle diagram. 3

UNIT - III

5 a. Sketch and explain different types of beams. 5

b. Draw SFD and BMD for a cantilever beam loaded as shown in Fig. (4).



Fig(4) 15

6 a. Derive the equations of relationship between shear force, bending moment and loading intensity. 6

b. Draw SFD and BMD for the overhanging beam loaded as shown in Fig. (5) locate the points of contra flexure of any. 14

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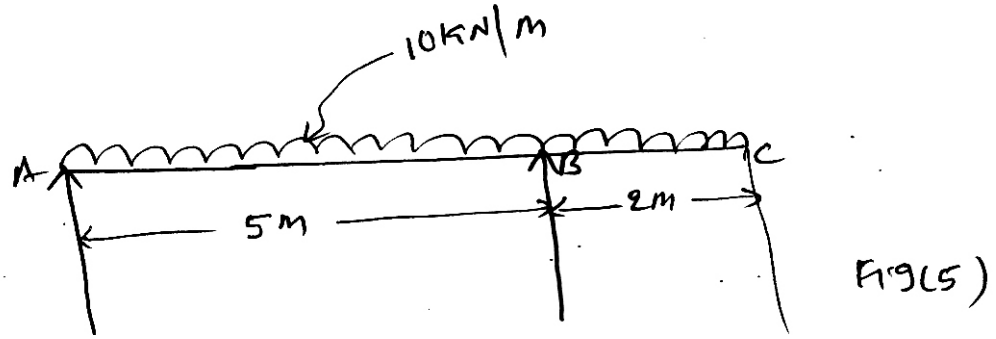

Fig(5)

UNIT - IV

7 a. List the assumptions made in the theory of pure bending. Also show the neutral axis is the centroidal axis. 9

b. A simply supported beam of span 10 m is loaded with a central point load of 50 kN. The cross section of the beam is a rectangle 200 mm wide and 300 mm deep at a cross section distance 3 m from the support. Calculate the bending and shear stress at 100 mm and 150 mm above the neutral axes of the section. 11

8a. Derive the differential equation for deflection $M = EI\frac{d^2y}{dx^2}$. 8

b. A beam of uniform section is 10 m long and is simply supported at the ends. It carries concentrated loads of 100 kN and 60 kN at a distance of 2 m and 5 m respectively from the left end. Calculate the deflection under each load. Find also the maximum deflection. 12

Take I = $18x10^8$ mm^4 and E = 200 kN/ mm^2.

UNIT - V

9 a. What is circumferential stress and longitudinal stress? Also derive the equation for circumferential and longitudinal stress for thin cylinder. 10

b. A thick cylinder of internal diameter 160 mm is subjected to an internal pressure of intensity 40 MPa. Determine the minimum thickness required, if the maximum tensile stress is not to exceed 90 MPa. 10

10 a. A hallow shaft of diameter ratio 2:3 is required to transmit 800 kW at 110 rpm, the maximum torque being 15% greater than the mean torque, the shear stress is not to exceed 50 N/mm^2 and the twist in a length of 3 m is not to exceed 2º. Find the minimum internal and external diameter of the shaft satisfying these conditions. Take modulus of rigidity C = 84 GPa. 9

b. What are the assumptions of Euler's theory for axially loaded elastic column? 5

c. A strut is 4.5 m long is 60 mm in dia. One end of the strut is fixed and the other end is hinged. Find the safe compressive load for the member using Euler's formula allowing a Factor of Safety (FOS) of 3.5. Take E = $2x10^5$ N/mm^2. 6

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