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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. - 2019

Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

Note: i) PART - A is compulsory. **Two** marks for each question.
ii) PART - B: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.

Q. No.	Questions	Marks
	I : PART - A	**10**
I a.	Define Principle of Superposition.	2
b.	How the stresses and load carried by each member of composite bar is calculated.	2
c.	When the maximum bending moment occurs in Simply supported beams?	2
d.	Explain Neutral axis and section modulus.	2
e.	How to find the Moment of Inertia in Unsymmetrical I-Section.	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	The ultimate stress for a hollow steel column which carries an axial load of 1.9 MN is 480 N/mm^2. If the external diameter of the column is 200 mm, determine the internal diameter. Take the factor of safety as 4.	8
b.	A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown in Fig. 1(b). Calculate the force P_2 necessary for equilibrium, if P_1 = 45 kN, P_3 = 450 kN and P_4 = 130 kN. Determine the total elongation of the member, assuming the modulus of elasticity to be 2.1×10^5 N/mm^2.	10
c.	Derive an equation for Volumetric Strain of a cylindrical rod.	10
	UNIT - II	**18**
2 a.	Two brass rods and one steel rod together support a load as shown in the Fig. 2(a). If the stresses in brass and steel are not to exceed 60 N/mm^2 and 120 N/mm^2, find the safe load that can be supported. Take E for steel = 2×10^5 N/mm^2 and for brass = 1^10^5 N/mm^2. The cross-sectional area of steel rod is 1500 mm^2 and of each brass rod is 1000 mm^2.	9
b.	A steel tube 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 tightened tightly home on the projecting parts of the rod. If the temperature of the assembly is raised to 50°C, calculate the stress induced in copper and steel. Take E for steel and copper as 200 GN/mm^2 and100 GN/mm^2 respectively. The value of coefficient of linear expansion for steel and copper is given as 12×10^{-6} per°C and 18×10^{-6} per°C respectively.	9

Contd…2

c. A rectangular bar of cross-sectional area of 11000 mm^2 is subjected to a tensile load P as shown in Fig. 2(c). 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. 9

UNIT - III **18**

3 a. A cylindrical shell is 3 m long, and is having 1 m internal diameter and 15 mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the shell if it is subjected to an internal fluid pressure of 1.5 N/mm^2. 7

b. A simply supported beam of length 10 m carries the uniformly distributed load and two point loads as shown in Fig. 3(b). Draw the SF and BM diagram for the beam. Also calculate the maximum bending moment. 11

c. A beam of length 12 m is simply supported at two supports which are 8 m apart, with an overhang of 2 m on each side as shown in the Fig. 3(c). The beam carries a concentrated load of 1000 N at each end. Draw SF and BM diagrams. 7

UNIT - IV **18**

4 a. With a neat sketch, derive an expression for Bending Equation. 9

b. Calculate the maximum stress induced in a cast iron pipe of external diameter 40 mm, of internal diameter 20 mm and of length 4 meter when the pipe is supported at its ends and carries a point load of 80 N at its centre. 9

c. A symmetrical I–Section has flanges of size 200 mm x 10 mm and its overall depth is 400 mm. Thickness of web is 8 mm. If the permissible stress is 150 N/mm^2, find the moments of resistance. Compare it with equivalent section of same area but, 9

i) Square section

ii) Rectangular section with depth twice with width

iii) Circular section

UNIT - V **18**

5 a. A Simply supported beam of 6 m span is subjected to a concentrated load of 18 kN at 4 m from left support. Calculate, 8

i) The position and the value of maximum deflection

ii) Slope at mid-span

iii) Deflection at the load point

b. Derive Torsional Equation. 10

c. A built up I section has an overall depth of 400 mm, width of flanges 300 mm, thickness of flanges 50 mm and web thickness 30 mm. It is used as a beam with simply supported ends and it deflects by 10 mm when subjected to a load of 40 kN/m length. Find the safe load if this I-section is used as a column with both ends hinged. Use Euler's formula. Assume a factor of safety 1.75 and take $E = 2\times10^5$ N/mm^2. 10

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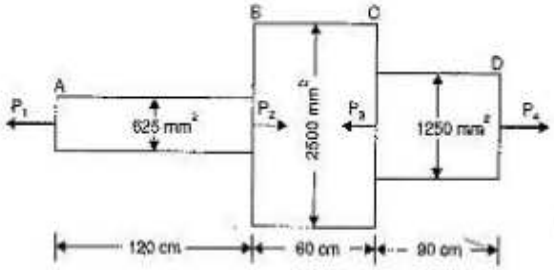

Fig. 1(b)

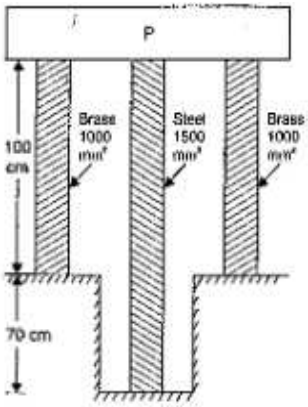

Fig. 2(a)

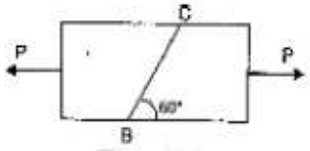

Fig. 2(c)

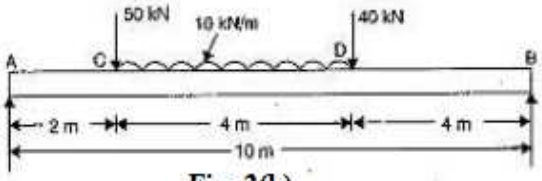

Fig. 3(b)

Fig. 3(c)

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