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

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; Dec - 2016/Jan - 2017

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. State Hooke's Law. Sketch the typical stress-strain diagram for mild steel indicating all salient points and zones. 5

b. The safe stress for a hollow steel column which carries an axial load of $2.1x10^3$ kN is 125 MN/m^2. If external diameter of column is 30 cm, determine the internal diameter. 5

c. An axial pull of 35000 N is acting on a bar consisting of three lengths as shown in Fig. 1. If the young's modules = $2.1x10^5$ N/mm^2. Determine;

i) Stress in each section ii) Deformation of each section and total deformation. 10

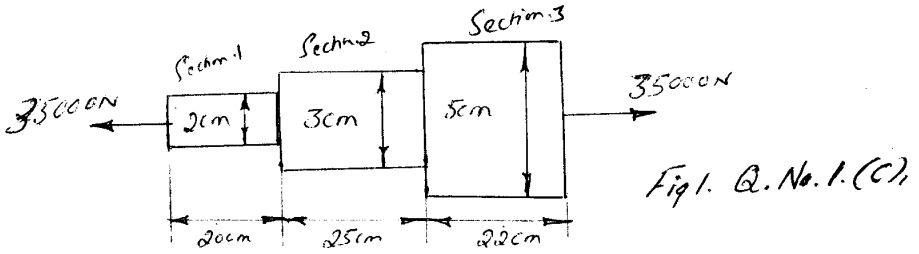

Fig 1. Q. No. 1. (c)

2 a. Derive an expression for extension of uniformly taping circular bar subjected to axial load. 10

b. A bar of 20 mm diameter is tested in tension, it is observed that when a load of 37.7 kN is applied the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0036 mm. Find Poison's ratio and elastic constants. 8

c. Name four Elastic constants. 2

UNIT - II

3 a. A load of 2 MN is applied on a short. Concrete column 500 mm x 500 mm. The column is reinforced with 4 steel bars of 10 mm diameter, one in each corner. Find stresses in concrete one steel bars and also load taken by them respectively. Take E for steel $2.1x10^5$ N/mm^2 and for concrete $1.4x10^4$ N/mm^2. 8

b. A compound bar is made up of a central aluminium plate 24 mm width and 6 mm thick to which steel plates of 24 mm wide and 9 mm thick are connected rigidly on each side. The length of compound bar at a temperature 20ºC is 100 mm. If temperature of assembly is raised by 80ºC. Determine the stress in each of the material. If at new temperature a compressive load of 20 kN is applied to the composite bar. What are final stresses in steel and aluminum bar? What are final stresses in steel and aluminium? 12

Contd.....2

Given: $E_s = 2x10^5$ N/mm^2 $E_A = \frac{2}{3}x10^5$ N/mm^2.

$\alpha_s = 12x10^{-6}/^oC$ $\alpha_A = 23x10^{-6}/^oC$

4 a. What are Principal stresses and Principal planes? 4

b. At a point in a loaded elastic member, there are normal stresses of 60 MPa and 40 MPa (tensile) respectively, at right angles to each other with positive shear stress of 20 MPa. Draw Mohr's circle diagram and find; 16

i) Principal stresses and their planes ii) Maximum Shear Stress and its plane

Check the answer analytically.

UNIT - III

5 a. Derive relationship between load intensity, shear force and bending moment. 6

b. Draw the Shear force and bending moment diagram of a cantilever beam loaded as shown in Fig. 2. And locate point of contra flexure, if any. 14

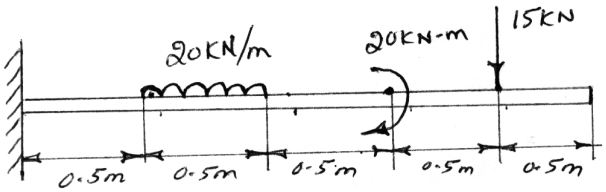

Fig 2, Q. No. 5.(b),

6 a. What is point of contra flexure? 2

b. For the beam shown in Fig. 3. Determine the magnitude of the load P acting at C. Such that the reaction at support A and B are equal. Draws shear force and bending moment diagram, indicating the values at salient points. Locate the point of contra-flexure, if any. 18

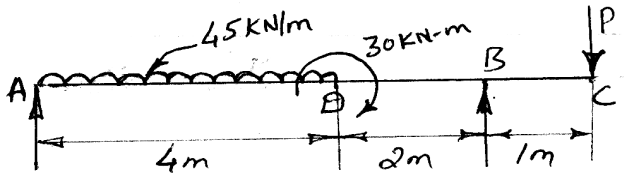

Fig. 3, Q. No. 6.(b)

UNIT - IV

7 a. List assumptions made in simple bending theory and establish the relationship between bending stress and radius of curvature and comment on stress distribution. 10

b. A Uniform I-Section beam is 200 mm wide and 400 mm deep with a flange thickness of 20 mm and web thickness of 10 mm. The beam is simply supported over a span 10 m. It carries a udl of 40 kN/m. Determine the bending stress in beam. Draw the I-section from given data. 10

Contd.....3

8 a. A beam 6 m long, simply supported at its ends, is carrying a point load of 50 kN at its centre. The moment of inertia of beam it given by $78x10^6$ mm^4. If E for material of beam is $2.1x10^5$ N/mm^2. 6

Calculate;

i) Deflection at centre of beam ii) Slope at supports.

b. A beam of length 6 m is simply supported at its ends and carries 2 point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from left support find:

i) Deflection under each load

ii) Maximum deflection 14

iii) The point at which maximum deflection occurs.

Given:

$E = 2x10^5$ N/mm^2 and $I = 85x10^6$ mm^4.

UNIT - V

9 a. Define circumferential stress and longitudinal stress and derive an expression 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 40 N/mm^2. If the allowable stress in the material is 120 N/mm^2. Find the required wall thickness of cylinder. 10

10 a. A hollow shaft, having an internal diameter 40% of its external diameter, transmits 562.5 kW power at 100 rpm. Determine external diameter of the shaft, if the shear stress is not to be exceed 60 N/mm^2 and the twist in a length 2.5 m should not exceed 1.3 degree. 10

Assume maximum torque = 1.25 mean torque

and modulus of rigidity = $9x10^4$ N/mm^2

Comment and select best design.

b. A solid round bar 3 m long and 5 cm in diameter is used as a strut. Taking a factor of safety of 4. Determine safe load for the following end conditions, 10

i) One end of strut is fixed and other end is free

ii) Both the ends of strut are fixed

iii) One end is fixed and other is hinged.

Take $E = 2x10^5$ N/mm^2.

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