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

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Civil Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Strength of Materials

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting at least **ONE** full question from each unit.*
ii) Missing data, if any, may be assumed suitably and clearly mentioned.

UNIT - I

1 a. Define stress, strain, upper and lower yield stress, breaking stress. 4

b. Derive expression for change in length 'δl' of a bar of varying diameter from d_1 to d_2 and length l. 8

c. A mild steel specimen tested under tension test and following results were obtained,

i) Diameter of specimen 20 mm

ii) Length of specimen 0.2 m

iii) Extension under a load of 10 kN is 0.032 mm

iv) Load at yield point is 82 kN at C (lower yield point)

v) Maximum load is 133 kN 8

vi) Length of specimen after failure is 0.252 mm

vii) Diameter of neck is 12.6 mm

Calculate;

I) Young's modulus II) Yield stress III) Ultimate stress IV) % Elongation

V) % Reduction in area VI) Working stress, if factor of safety is 2.

2 a. List and define elastic constants with equations. 5

b. Derive relationship between E and K [Young's modulus and Bulk modulus]. 7

c. A steel rail is 30 m long at a temperature of 20ºC. Estimate the elongation when the temperature increases to 80ºC.

Calculate the thermal stress developed in the rail if, 8

i) No expansion joint is provided

ii) A gap of 10 mm is provided for expansion, E = 200 GPa, $\alpha = 12x10^{-6}$/ºC.

UNIT - II

3 a. Define principal stress and principal planes (directions). 4

b. In a two dimensional stress system (2D stress system), Derive expression for normal and tangential component of stresses ton a given plane. 8

c. At a certain point in piece of elastic material there are normal tensile stresses f_x = 120 MPa, f_y = 60 MPa. In addition there is a positive shearing stress (Left up right down) q = 80 MPa. Determine; 8

i) The magnitude and directions of the principal stresses

ii) The magnitude and direction of the maximum shearing stress

iii) The normal and shearing stress on a plane inclined at 30° to the direction of 120 MPa.

4 a. Derive an expression for circumferential stress (f_1) and longitudinal stress (f_2) in the case of thin cylinder. 4

b. Derive expressions for change in diameter, change in length and change in volume of a thin cylinder. 8

c. A thick cylinder of 400 mm material diameter and 100 mm thickness contains a fluid at a pressure of 80 N/mm^2. Find the maximum and minimum hoop stresses across the section. Also sketch the radial and hoop stress distribution across the section. 8

UNIT - III

5 a. Define bending moment, shear force, BMD and SFD. 4

b. Derive relationship between intensity of uniformly distributed load w, shear force F and bending moment M. 6

c. Draw BMD and SFD for the beam shown in Fig. Q. 5(c). 10

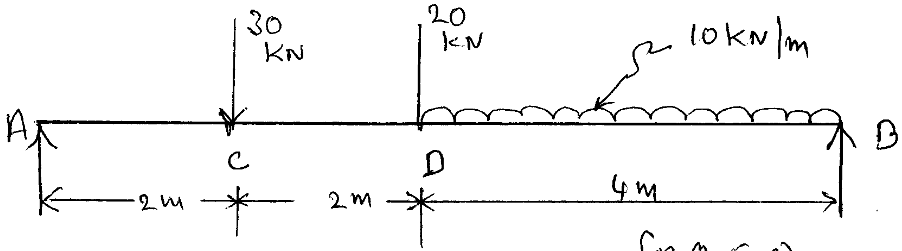

fig Q.5.c)

6 a. Define point of contra flexure, bending moment (Hogging and sagging bending moment) and shear force (positive and negative shear force). 4

b. For a simply supported beam carrying uniformly distributed load ω/m over entire span l, Show that maximum B.M, $M_{\max} = \dfrac{\omega l^2}{8}$ at $x = \dfrac{l}{2}$ from either support. 6

c. Draw BMD and SFD for the beam shown in Fig. Q 6(c). Find the point of contra flexure and maximum bending moment. 10

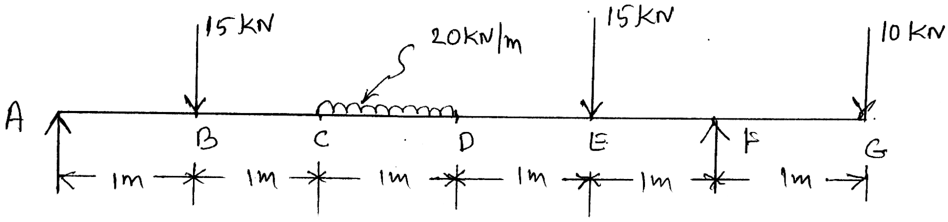

Fig Q 6.c)

UNIT - IV

7 a. State assumptions mode while deriving (Bernauli) bending equation. 3

b. Derive bending equation (Bernauli equation) with usual notations. 7

c. A wooden beam 10 m long 360 mm deep and 300 mm wide is simply supported and loaded with a uniformly distributed load. Find the safe total load. Factor of safety = 6, maximum shear intensity of the material is = 60 MPa. 10

8 a. Draw shear stress variation diagram for various standard sections (including triangle, rhombus and T - Section). 3

b. Show that maximum shear stress is 1.5 times average shear stress for a rectangular section. 7

c. A T-Section beam shown in Fig. Q 8(c) is subjected to a shear force of 9 kN at a section. Determine the amount of maximum intensity of shear stress and draw the distribution of shear stress across the depth of the section. 10

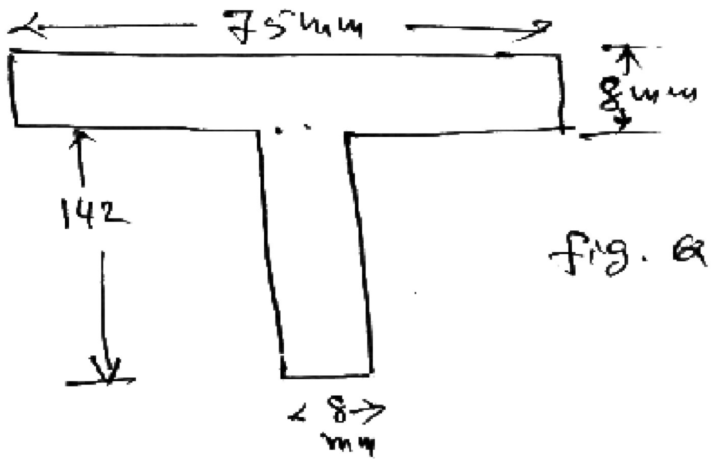

fig. Q. 8. c)

UNIT - V

9 a. State assumptions made while deriving deflection equation. 3

b. Derive deflection equation with usual notations. 7

c. A simply supported beam has a span of 6 m. It carries two concentrated loads of 40 kN and 10 kN at distance of 2 m and 4 m from left hand support. Find the deflection under the 40 kN load and the position and magnitude of maximum deflection. E = 200 GPa and $I = 40 \times 10^{-6}\ m^4$. 10

10 a. Derive torque equation with usual notations. 7

b. State assumptions made while deriving torque equation. 3

c. Calculate the dimensions of a hollow steel shaft to transmit 600 kW at a speed of 120 r.p.m. the maximum torque being 1.12 times the mean (12% extra). The internal diameter of the shaft is 60% of the outside diameter and the greatest intensity of shear stress in the steel is limited to 28 MN/m^2. 10

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