U.S.N

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. - 2015

Strength of Materials

Time: 3 hrs *Max. Marks: 100*

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

UNIT - I

1 a. Derive the expression for the deformation of a body due to self weight. 6

b. A load of 5 kN is to be raised with the help of a steel wire. Find the minimum diameter of the steel wire, if the stress is not to exceed 100 MPa. 4

c. In a tension test on a mild steel rod of 12 mm diameter using a 200 mm gauge length extensometer, the following observations were made:

Load at yield point = 28.5 kN; Ultimate load = 55 kN Breaking load = 42 kN; Extension under load of 17 kN = 0.15 mm length between the gauge marks after fracture = 242 mm. Diameter at the neck = 8.66 mm. Calculate; (i) Young's modulus (ii) yield stress ultimate stress normal and true stress at breaking point (iii) % elongation (iv) % reduction in area. 10

2 a. Define the following terms :

(i) Young's modulus (ii) Bulk modulus (iii) Volumetric strain 6

(iv) Hooke's law (v) Factor of safety.

b. A brass rod 2.4 m long is placed between and perpendicular to two rigid vertical walls 2.43 m apart. The temperature of the rod is raised until the rod is fixed between the walls and has a compressive stress of 21 MN/m^2. The rod is restrained from bending. What is the rise in temperature? E = 105 GN/m^2; α_s = 11.8 x 10^{-6}/°C. 6

c. A metal cube of 100 mm sides is subjected to a system of force 200 kN(T), 250 kN(C), 300 kN(T) along *x*, *y* and *z* axes respectively. Calculate the change in volume of the cube if μ = 0.26 and E = 220 GPa. 8

UNIT - II

3 a. Define the following terms : 3

(i) Compound stresses (ii) Major principal stress (iii) Minor principal stress.

b. Show that the sum of normal stresses on any two planes at right angles in a general 2D stress system is a constant. 6

c. An element has a tensile stress of 600 MN/m^2 and a compressive stress of 400 MN/m^2 acting on two mutually perpendicular planes. It has 2 equal shear stresses of 200 MN/m^2 on these planes as shown in Fig. Q 3(c). Find; 11

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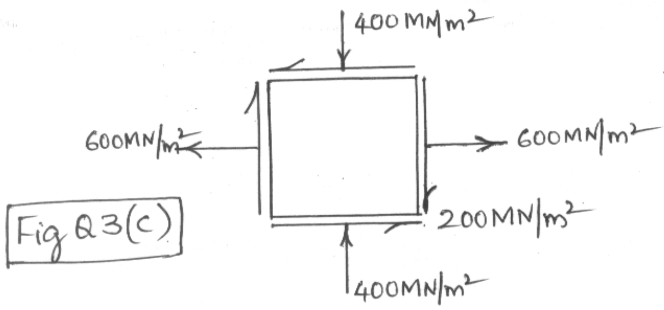
i) The magnitude and direction of the principal stresses.

ii) The magnitude and direction of max shear stress.



4 a. With usual notations prove lames equation for thick cylinders. 8

b. Derive the expressions for circumferential stress and longitudinal stress in a thin cylinder. 6

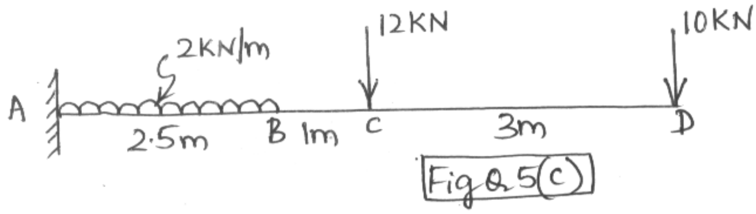
c. A thin cylinder of 1 m dia, 4 m long and of metal thickness 15 mm is subjected to an internal pressure of 3 MN/m^2. Determine; (i) Change in dia (ii) Change in length (iii) Change in volume ; if μ = 0.25 ; E = 2x10^5 MPa. 6

UNIT - III

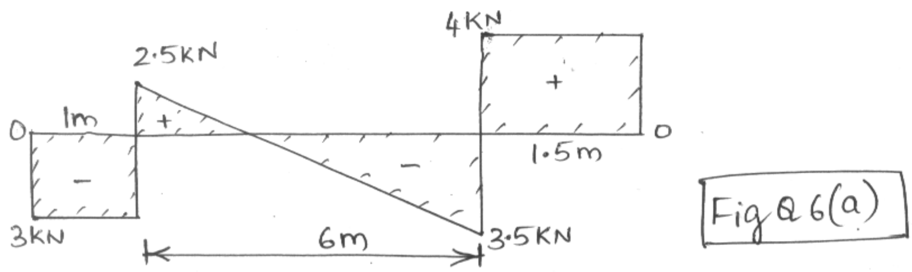
5 a. Derive the relationship between shear force, bending moment and rate of loading. 6

b. Draw BMD and SFD for a simply supported beam carrying a UDL of W/m throughout the entire span. 6

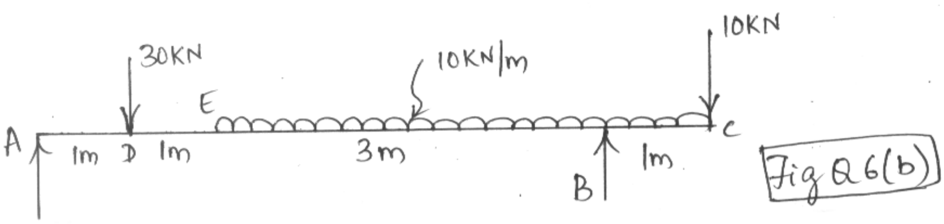
c. Sketch BMD and SFD for the cantilever beam shown in Fig. Q 5(c). 8



6. a. From the given SFD, develop the loading diagram and then draw the BMD with calculations. [Refer Fig. Q 6(a)] 10



b. Sketch BMD and SFD for the loaded beam indicating salient features. [Refer Fig. Q 6(b)] 10



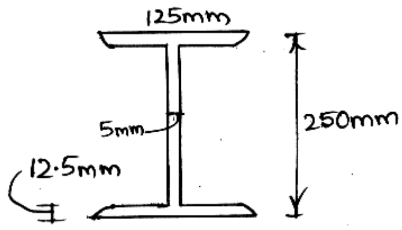
UNIT - IV

7 a. State the assumptions made in the theory of simply bending. 4

b. With usual notation, PT. $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$. 6

c. A beam of an I section shown in Fig. Q 7(c) has overall depth of 250 mm, flanges are 125 mm, 12.5 mm thick and the web is 5 mm thick. The beam rests freely on supports of 6 m apart. Find the maximum load that may be applied at a point of 1.5 m from the left end of support without producing a maximum flange stress greater than 80 MN/m^2. 10

Fig Q 7(c)



8 a. Derive the differential equation for deflection. 8

b. Determine the slope at point C and the deflection at point D for the beam loaded shown in Fig. Q 8 (b). 12

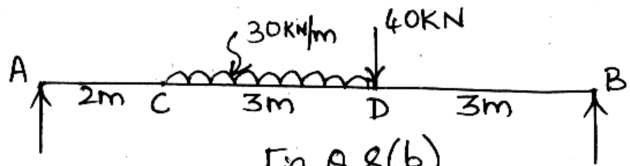


Fig Q 8(b)

UNIT - V

9 a. State the assumptions made in pure torsion theory. 4

b. Define the following terms : 6

i) Torsional rigidity ii) Polar modular iii) Power transmitted by a shaft.

c. Find the maximum stress in a propeller shaft with a 400 mm external and 200 mm internal diameter, when subjected to a twisting moment of 4650 Nm. If the modulus of rigidity C = 82 GN/m^2, how much is the twist in a length 20 times the diameter? 10

10 a. Define effective length of a column and slenderness ratio. 2

b. Derive the equation for crippling load by Euler's formula for a column with both the ends are fixed. 10

c. A hollow cast iron column fixed at the both ends is 6 m long, its external dia is 20 cm and thickness of metal is 2.5 cm. Find the maximum allowable axial load on it. Use Rankine's formula and FOS = 5. σ_c = 560 N/mm^2. Constant 'a' for cost iron with hinged end is $\frac{1}{1600}$. 8

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