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10CV/EV33

**Third Semester B.E. Degree Examination, Dec.2016/Jan.2017**  
**Strength of Materials**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting  
at least TWO questions from each part.**

**PART – A**

- 1 a. Define: i) Volumetric strain; ii) Hooke's law. (04 Marks)
- b. Determine the net elongation of a circular bar of varying cross-section subject to forces as shown in Fig.Q.1(b). (08 Marks)

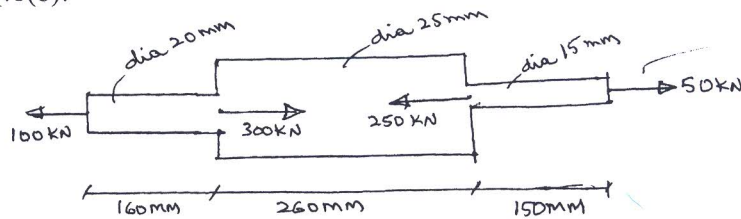


Fig.Q.1(b)

- c. A bar of 30mm diameter is subjected to a pull of 60kN. The measured extension on a gauge-length of 200mm is 0.09mm and the change in diameter is 0.0039mm. Calculate the Poisson's ratio and the values of three elastic constants E, G, K. (08 Marks)
- 2 a. Define: i) Thermal stresses; ii) Factor of safety. (04 Marks)
  - b. Steel rails of a railway line are each 12m long. Determine the minimum gap between the rails so that no stress is developed, when there is a temperature raise of 25°C. Also determine the stress that would be developed in the rails if 40% of the expansion is prevented. Take  $E = 200\text{GPa}$ ,  $\alpha = 12 \times 10^{-6}/^\circ\text{C}$ . (06 Marks)
  - c. A composite tube consists of a steel tube 150mm internal diameter and 10mm thick and outer brass tube 170mm internal diameter and 10mm thick. The composite tube carries an axial load of 1000kN. Find the loads and stresses carried by each material. Also find the extension of the composite tube if the length is 150mm. Take  $E_s = 200\text{GPa}$ ,  $E_b = 100\text{GPa}$ . (10 Marks)
- 3 a. Obtain the expression for normal stress and tangential stress on an oblique plane of a member subjected to an axial pull of P, on a plane inclined at an angle of  $\theta$  to the normal plane. (06 Marks)
  - b. The state of stress at a point in a strained material is as shown in the Fig.Q.3(b). Determine:
    - i) The direction of principal planes.
    - ii) The magnitude of principal stresses.
    - iii) The magnitudes of the maximum shear stress and its direction.
 Verify the results by constructing Mohr's circle. (14 Marks)

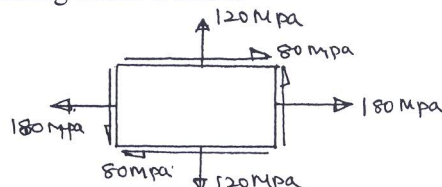


Fig.Q.3(b)

- 4 a. Derive the relationship between load intensity, shear force and bending moment. (05 Marks)  
 b. Draw SFD and BMD for a cantilever beam of span length 'l' carrying a point load  $w$  at its free end. (05 Marks)  
 c. Draw SFD and BMD for a simply supported beam carrying loads as shown in the Fig.Q.4(c). (10 Marks)

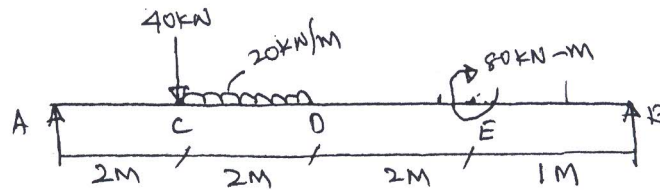


Fig.Q.4(c)

**PART – B**

- 5 a. Define the terms: i) Section modulus; ii) Neutral axis. (04 Marks)  
 b. Derive the equation of simple bending with usual notations. (08 Marks)  
 c. A circular pipe of external diameter 70mm and thickness 8mm is used as a simply supported beam over an effective length of 2.5m. Find the maximum concentrated load that can be applied at the centre of the span if the permissible stress on pipe is  $150 \text{ N/mm}^2$ . (08 Marks)
- 6 a. Derive the differential equation for beam deflection with usual notations. (08 Marks)  
 b. Determine the deflection under the loads for an overhanging beam carrying loads as shown in the Fig.Q.6(b). Take  $E = 200 \text{ GPa}$ ,  $I = 45 \times 10^6 \text{ mm}^4$ . (12 Marks)

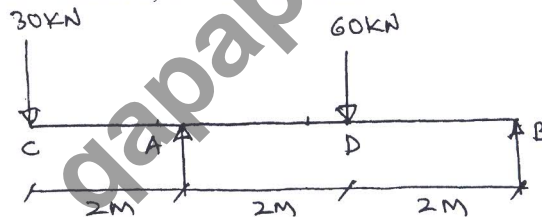


Fig.Q.6(b)

- 7 a. Define: i) Torsional rigidity; ii) Polar moment of inertia. (04 Marks)  
 b. Derive the pure torsion equation with usual notations. (08 Marks)  
 c. The working condition to be satisfied by a solid shaft transmitting power are i) The shaft must not twist more than  $1^\circ$  in a length of 15 times the diameter; ii) The shear stress must not exceed  $80 \text{ MN/m}^2$ . What is the actual working stress and diameter of the shaft to transmit 736 kW power at 200rpm? Take shear modulus as  $80 \text{ GN/m}^2$ . (08 Marks)
- 8 a. Derive an expression for buckling load in a column subjected to an axial compressive load, when both ends of the column are hinged. (08 Marks)  
 b. A hollow cylindrical cast iron column whose external diameter is 200mm and thickness 20mm is 4.5m, long and is fixed at both ends. Calculate the critical load by Euler's formula. Find also the ratio of Euler's load to Rankine's load. Take  $E = 1 \times 10^5 \text{ MPa}$ , Rankine's constant =  $\frac{1}{1600}$  and crushing strength =  $550 \text{ N/mm}^2$ . (12 Marks)

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