May- 2014 (CBSG) PROD

S.E-III (Prod) Strength of Materials

QP Code : **NP-18675**

(3 Hours) [Total Marks : 80

N. B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **three** out of remaining **five** questions.
(3) **Assumptions** made and **symbols** used should be **clearly** stated.
(4) **Figures** to the **right** indicate **full** marks.

1. (a) Define and explain the following :- 5
   (i) Section modulus
   (ii) Complimentary shear.
   (b) State the assumptions made in theory of bending and derive the relation :- 5

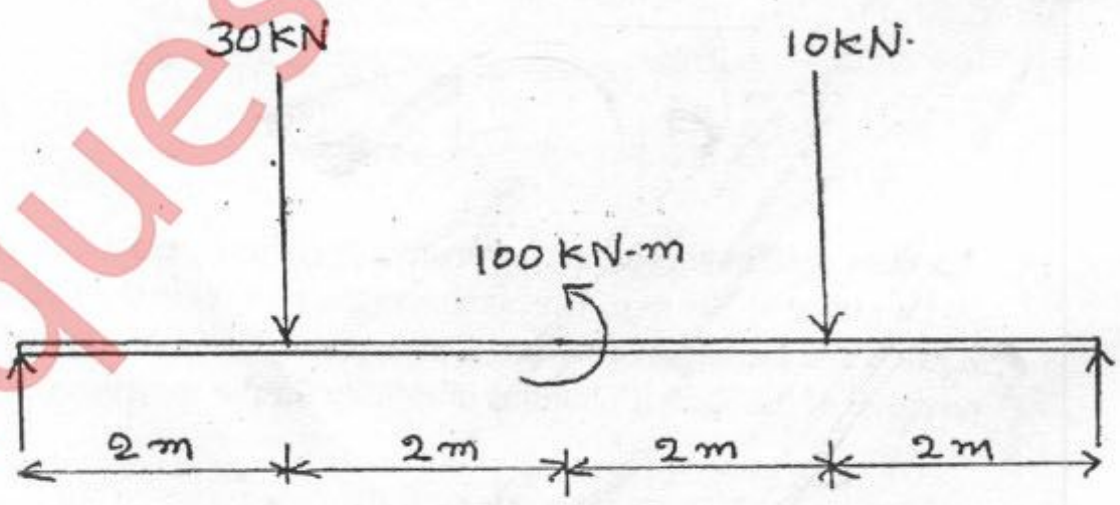
$$\sigma = \frac{My}{I}$$

   (c) Prove that shear stress distribution for rectangular section :- 5

$$\tau_{max} = \frac{3}{2}\tau_{mean}$$

   (d) A cantilever of length 2 meter long carries a udl of 1.5 kN/m run over a length of 1.6 m from the free end. Draw shear force and bending moment diagram for the beam. 5

2. (a) A steel tube of 20 mm internal diameter and 30 mm external diameter encases a copper rod of 15 mm diameter to which it is rigidly joined at each end. If the temperature of the assembly is raised by 80°C. Calculate the stress produced in the tube. $E_{Steel} = 2 \times 10^5$ N/mm^2, $E_{Copper} = 1 \times 10^5$ N/mm^2 coefficient of linear expansion of steel and copper are 11×10^{-6} per °C and 18×10^{-6} per °C respectively. 10
   (b) Draw SFD and BMD with all the salient features :- 10



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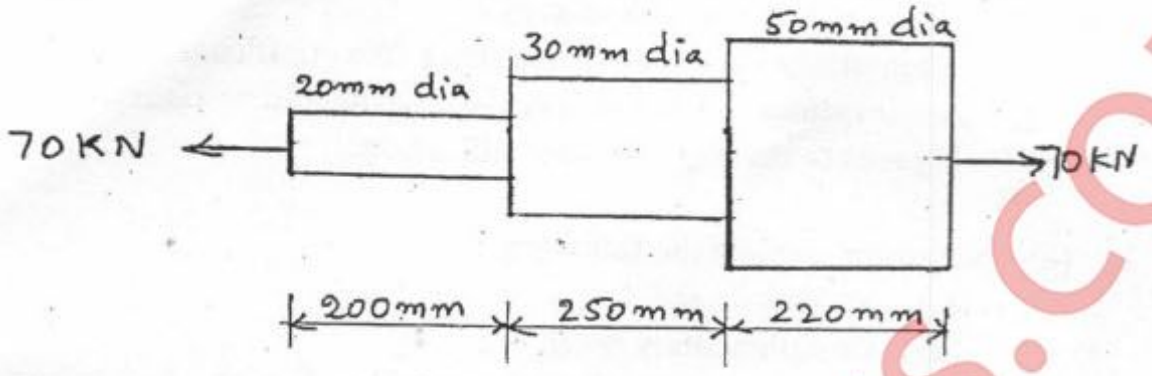
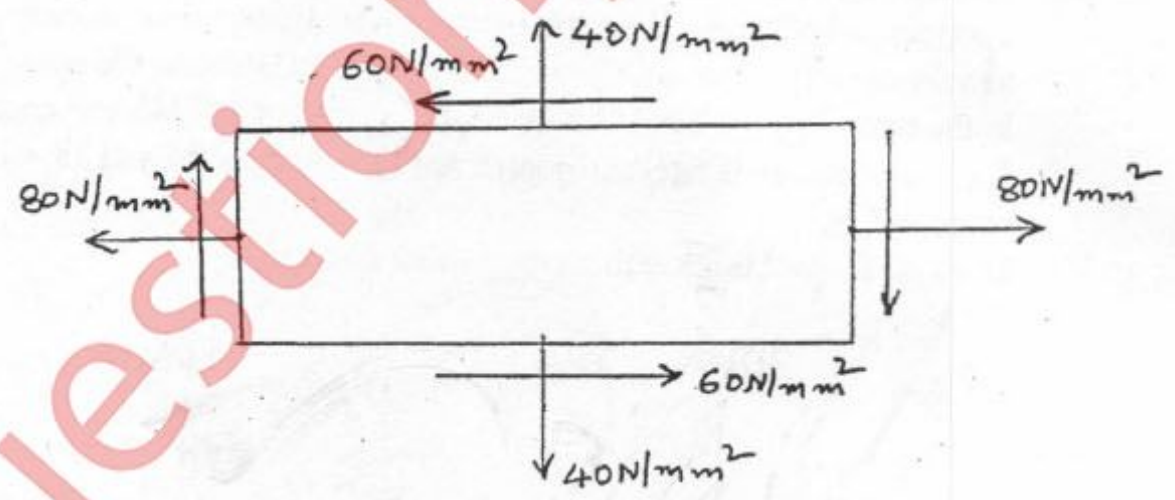
3. (a) Find the stress in each section and total extension of the bar shown in Fig. Q3a. EI = 2.1×10^5 N/mm^2. **10**



(b) A square chimney 24 m high has an opening of 1.25 m × 1.25 m inside. The external dimensions are 2.5 m × 2.5 m. The chimey is subjected to horizontal intensity of wind pressure 1.3 kN/m^2 and specific weight of masonary is 22 kN/m^2. Calculate maximum and minimum stress intensities at the base of the chimney. **10**

4. (a) At a point in a strained material, the stress are 80 N/mm^2 tensile and 40 N/mm^2 tensile in two mutually perpendicular directions. Each of the above stress is accompanied by a shear stress of 60 N/mm^2. Determine the normal stress, shear stress and resultant stress on an oblique plane inclined at an angle of 30° with the axis of minor tensile stress. **10**



(b) A hollow shaft having internal diameter 40% of its external diameter transmits 60 kw power at 200 rpm. The maximum shear stress in the shaft is limited to 70G Pa and the angle of twist is 3.8° in a length of 4 m. Determine external diameter of the shaft if modulus of rigidity for the shaft material is 82 G Pa. **10**

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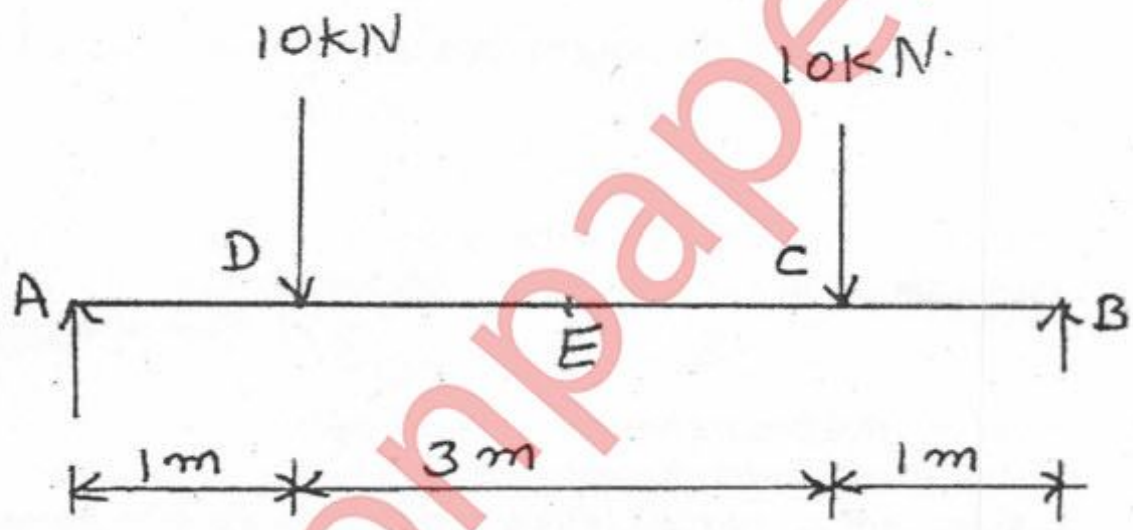
5. (a) The shear force acting on a beam of I section with unequal flanges is 50 kN. The I - section has the top flange 200 mm × 50 mm, bottom flange of 130 × 50 mm. Calculate shear stress at neutral axis and also draw the shear stress distribution along the depth of the section. **10**

   (b) A cast iron beam is of T-section having flange 100 mm × 20 mm and web of 20 × 80 mm; total depth of 100 mm. The beam is simply supported on a span of 8 m. The beam carries a uniformly distributed load (udl) of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses. **10**

6. (a) A simply supported beam 5 m long carries concentrated loads of 10 kN each at points 1 m from ends. Calculate deflection under each load and the deflection at the centre. **10**
   Take : EI = 1.2×10^4 kN-m^2.



   (b) A 1.5 m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking factor of safety of 3, Calculate the safe load using :- **10**

   (i) Rankine's formula take yield stress F_C = 560 N/mm^2 and $\alpha = \frac{1}{7600}$.

   (ii) Euler's formula. Younger modulus for CI - 1.2×10^5 N/mm^2.
