Total No. of Questions—12] [Total No. of Printed Pages—8+1

Seat No.	

S.E. (Civil) (First Semester) EXAMINATION, 2014

STRENGTH OF MATERIALS

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer to the two sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of electronic non-programmable calculator is allowed.

(*v*) Assume suitable data, if necessary.

(*vi*) Answer Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I and Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12** from Section II.

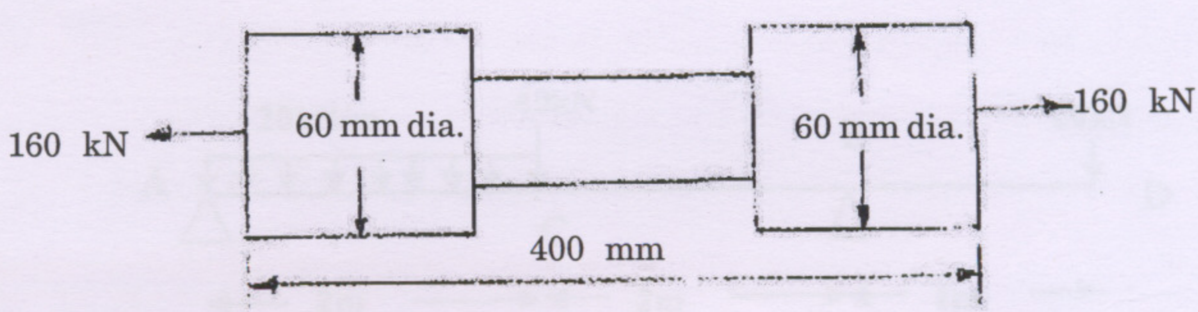
SECTION I

1. (*a*) In a tensile test on a steel tube of external diameter 24 mm and internal diameter 16 mm, an axial load of 2 kN produced an elongation of 0.004 mm in a length of 80 mm, while the outer diameter suffered a compression of 0.003 mm. Calculate the value of Poisson's Ratio. E, G and K. [9]

(*b*) A member formed by connecting a steel bar 300 mm long and 2500 mm^2 area above aluminium bar 380 mm long and 10000 mm^2 area. Assuming that bars are prevented from side way buckling, calculate magnitude of force P that will cause the total length of members to decrease by 0.25 mm. Modulus of elasticity for steel and aluminium are 2.1×10^5 N/mm^2 and 7×10^4 N/mm^2 respectively. [9]

Or

2. (*a*) A bar as shown in Fig. 1 is subjected to tensile load of 160 kN. If the stress in the middle portion is limited to 150 N/mm^2, determine diameter of middle portion. Find the length of middle portion if total elongation of bar is to be 0.2 mm. $E = 2.1 \times 10^5$ N/mm^2.



[9]

Fig. 1

(*b*) The steel rod of 20 mm diameter passes centrally through a copper tube of internal diameter 40 mm and external diameter 50 mm. The tube is closed at the end rigidly. If the temperature of assembly is rised by 50°C, calculate stresses developed in both materials. Take Modulus of Elasticity of steel and copper as 200 GN/m^2 and 100 GN/m^2 and coefficient of thermal expansion as 12×10^{-6} per °C and 18×10^{-6} per °C respectively. [9]

3. (*a*) Draw SFD and BMD for overhanging beam as shown Fig. 2. Locate the point of contra flexure. [8]

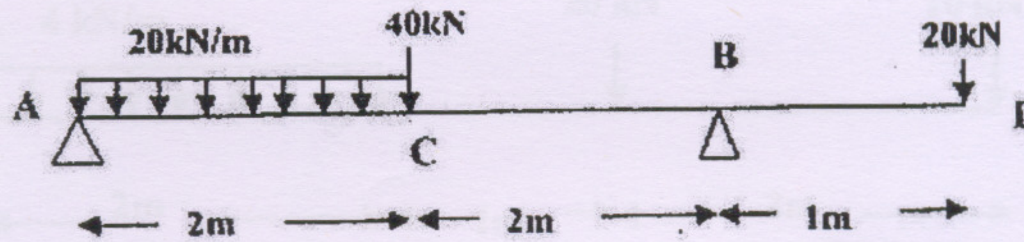


Fig. 2

(*b*) Fig. 3 shows SFD for a beam which rest on two supports, one being at left hand end. From given SFD, plot the loading diagram and BMD. [8]

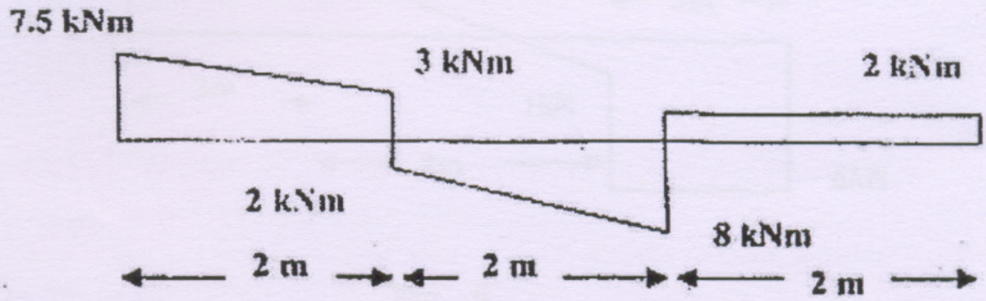


Fig. 3

Or

4. (*a*) Draw SFD and BMD for cantilever beam loaded as shown in Fig. 4. [8]

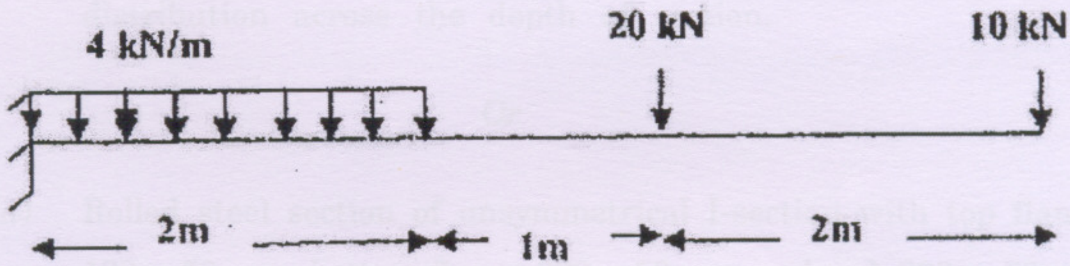


Fig. 4

(b) Fig. 5 shows SFD of a loaded beam. Plot loading diagram and BMD. [8]

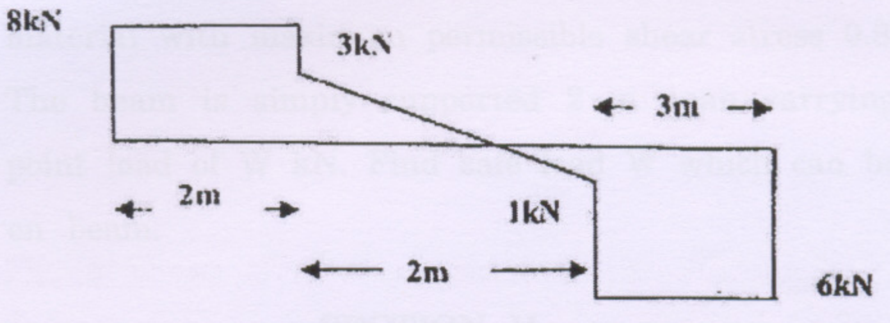


Fig. 5

5. (a) A hollow square section with outer and inner dimensions of 50 mm and 40 mm respectively is used as a cantilever beam of span 1 m. The maximum permissible stress in material is 35 N/mm^2. What maximum concentrated load it can support at free end without failure. [8]

(b) A T-section with 100 × 12 mm flange and 88 × 12 mm web is subjected to a shear force of 20 kN. Draw shear stress distribution across the depth of section. [8]

Or

6. (a) Rolled steel section of unsymmetrical I-section with top flange 100 × 50 mm, bottom flange 200 × 50 mm and web 200 × 50 mm thick is subjected to flexural stresses. Maximum bending stress should not exceed 40 mpa. Find moment the beam can resist safely. [8]

(*b*) A beam consist of three pieces each of size 50 × 100 mm arranged such that width of beam is 100 mm and depth of beam becomes 150 mm. The joints are connected with sticking material with maximum permissible shear stress 0.8 N/mm^2. The beam is simply supported 2 m span carrying central point load of W kN. Find safe load W which can be applied on beam. [8]

SECTION II

7. (*a*) A hollow circular shaft 200 mm external diameter in thickness of metal 25 mm is transmitting power at 200 rpm. The angle of twist over a length of 2 m was found to be 0.5°. Calculate power transmitted and maximum shear stress induced in the section. Modulus of rigidity is 84 kN/m^2. [9]

(*b*) The maximum stress produced by a pull in a bar of length 1 m is 150 N/mm^2. The areas of cross-section and lengths are as shown in Fig. 6. Calculate the strain energy stored in the bar if E = 2 × 10^5 N/mm^2. [9]

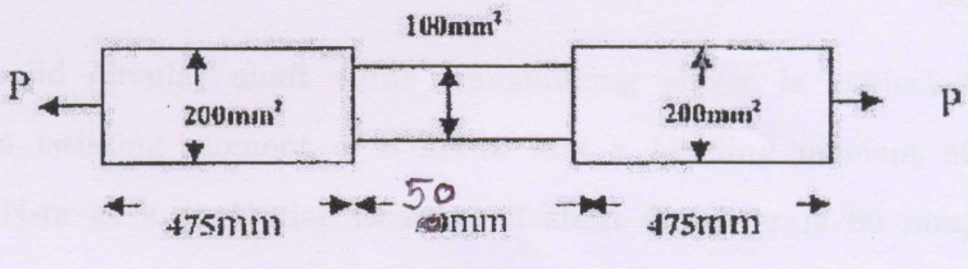


Fig. 6

Or

8. (*a*) A hollow shaft is to transmit 3750 kW at 240 rpm. If internal diameter is 0.8 times external diameter and maximum shear stress developed is limited to 160 N/mm^2, find size of shaft. [9]

(*b*) A load of 100 N falls freely through a height of 20 mm on a collar rigidly attached at the bottom end of vertical rod of 1500 mm and having areas of cross-section 150 mm^2. The upper end of rod is fixed. Determine maximum instantaneous stress and maximum instantaneous elongation of rod. Take $E = 2 \times 10^5$ N/mm^2. [9]

9. (*a*) At a point in a body subjected to two mutually perpendicular directions, the stresses are 80 N/mm^2 tensile and 40 N/mm^2 tensile. Above stresses are 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 45° with the axis of major tensile stress. [8]

(*b*) A solid circular shaft while transmitting power is subjected to a twisting moment of 8 kN-m and a bending moment of 5 kN-m at a particular location. If shaft diameter is 80 mm, compute principal stresses and maximum shearing stress. [8]

Or

10. (*a*) At a point in a material, there are normal stresses 30 N/mm^2 and 60 N/mm^2, both tensile, with a shearing stress of 22.5 N/mm^2. Find value of principal stresses and inclination of principal planes to direction of 60 N/mm^2 stress. [8]

(*b*) Explain in detail the maximum shear stress theory of failure. [8]

11. (*a*) Calculate the buckling load for a strut of a T-section having flange width 100 mm, overall depth 100 mm and thickness of web and flange are 10 mm. A strut is 3 m long and hinged at both ends. Take $E = 2 \times 10^5$ N/mm^2. [8]

(*b*) A chimney shaft 40 m high tappers from 4 m external diameter at base to 2 m diameter at top with uniform internal diameter of 2 m. The wind pressure acting on the flat surface is 2000 N/m^2. Determine the distribution of stresses on the base. Total weight of chimney is 3000 kN. Assume wind coefficient as 0.8. [8]

Or

12. (*a*) The external and internal diameters of a hollow cast iron column are 50 mm and 40 mm respectively. If the length of column is 3 m and both ends are fixed, determine the crippling load using Rankine's formula. Take $f_c = 550$ N/mm^2 and $a = 1/1600$ in Rankine's formula. [8]

(*b*) A square column of 80 × 80 mm section has a circular hole of 35 mm diameter bored centrally. A 200 kN force is applied at an eccentricity of 20 mm with respect to yy-axis. Find out maximum and minimum stresses in the cross-section. [8]