Total No. of Questions—**8**] [Total No. of Printed Pages—**7**

Seat No.	

[5152]-119

S.E. (Mechanical/Mechanical-SW/Automobile)

EXAMINATION, 2017

STRENGTH OF MATERIALS

(2012 COURSE)

Time : Two Hours **Maximum Marks : 50**

N.B. :— (*i*) Solve Q. No. **1** or Q. No. **2**, Q. No. **3** or Q. No. **4**, Q. No. **5** or Q. No. **6** and Q. No. **7** or Q. No. **8**.

(*ii*) All the *four* questions should be solved in one answer book and attach the extra supplements if required.

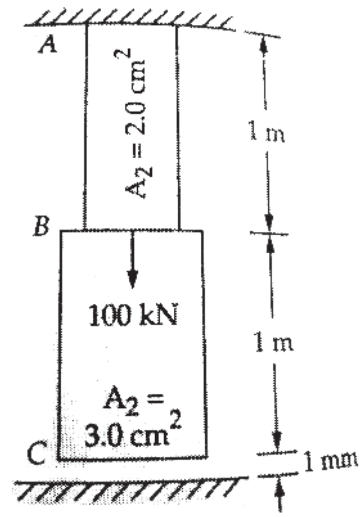
(*iii*) Neat diagrams must be drawn wherever necessary.

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

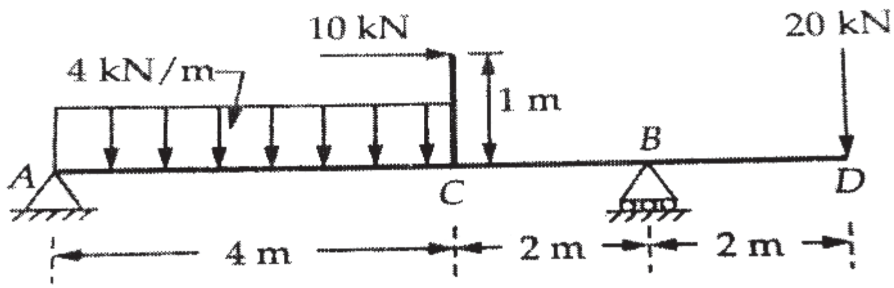
(*v*) Assume suitable data, if necessary.

1. (A) A bar ABC shown in figure consist of two parts, AB and BC, each part being 1 m long and having cross-sectional areas 2 cm^2 and 3 cm^2 respectively. The bar is suspended from A and there is a rigid horizontal support at 2.001 m from A. A force of 100 kN acting vertically downwards is applied at

B. Determine the stresses in parts AB and BC of the bar. Take E = 200 GN/m^2. [6]

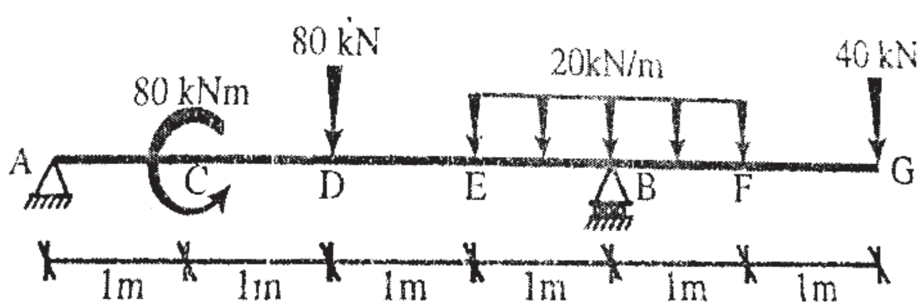


(B) Draw SFD and BMD for the beam shown in the following figure. Also locate the points of contraflexure if any. [6]



Or

2. (A) The beam is supported and loaded as shown in figure. Draw SFD and BMD indicating all important values. [6]

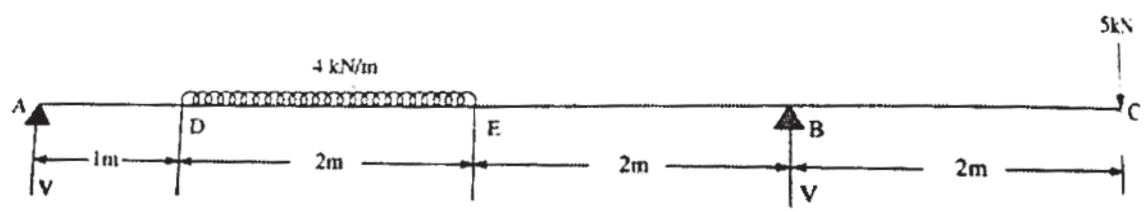


(B) A bar of steel is 40 mm × 40 mm in cross-section and it is 120 mm long. It is subjected to a tensile of 200 kN along the longitudinal axis and tensile loads of 500 kN & 400 kN on the lateral faces.

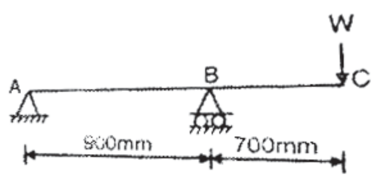
(*i*) Find change in dimensions of the bar and change in volume.

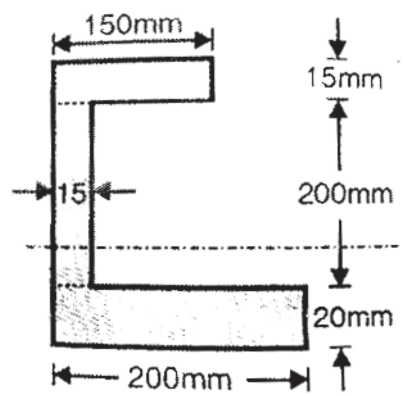
(*ii*) Find also what axial longitudinal tensile load acting alone can produce the same longitudinal strain as above case. Take $E = 2 \times 10^5$ N/mm^2, $\mu = 0.3$. [6]

3. (A) For the loaded beam shown in figure. Find the deflection at free end and the maximum deflection between the supports. Take $E = 200$ kN/mm^2 and $I = 9 \times 10^6$ mm^4. [6]



(B) A simply supported overhang is loaded with point load as shown in figure. A CI beam of C section with top flange 150 mm × 15 mm, bottom flange 200 mm × 20 mm and web 15 mm × 200 mm. The allowable stresses in tension and compression are 120 MPa and 90 MPa. Find the safe value of load 'W' on the overhang. [6]





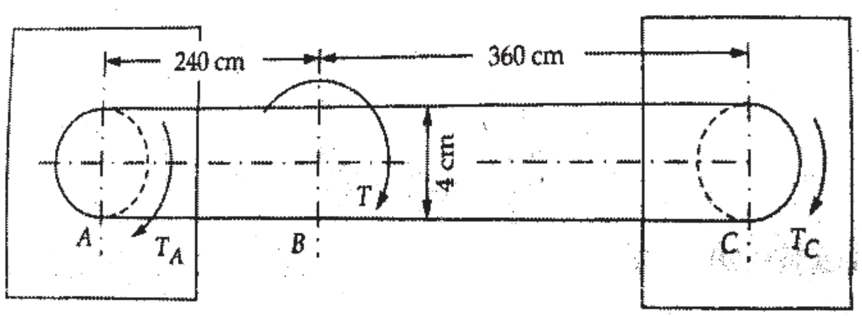
Or

4. (A) A vertical steel rod, 2 m long is fixed at its upper end and a weight sliding freely on the rod falls on the collar fixed firmly at its end. When the weight falls through a height of 15 mm, the maximum stress 60 MPa. What will be the maximum instantaneous stress developed if the same weight had been dropped through height of 25 mm ? E = 210 GPa. [6]

(B) A symmetrical beam of I-section is 200 mm × 400 mm in size, the thickness of flange 20 mm and web is 15 mm. The beam carrying UDL of 25 kN/m over entire length of 5 m. Draw the shear stress distribution diagram over depth of section. Also find the ratio of maximum shear stress to average shear stress. [6]

5. (A) Find Euler's critical load for a hollow cylindrical steel column of 40 mm external diameter and 3 mm thick. Take length of column is 3 m and hinged at its both ends. Also determine crippling load by Rankine's formula. Take α = 1/7500, E = 205 kN/mm^2 and σ_c = 335 N/mm^2. For what length of column would critical load by Euler's and Rankine's formula be equal ? [7]

(B) A 600 cm long solid shaft is fixed at both ends. A torque of 75 kN cm is applied to the shaft at a section of 240 cm from one end. What are the fixing torques set up at the ends of the shaft ? If the diameter of the shaft is 4 cm, calculate the maximum stress developed in the two portions. Also find the angle of twist at the point where the torque is applied. Take G = 75 kN/cm^2. [6]



Or

6. (A) Determine the ratio of the buckling strengths of a solid steel column to that of a hollow column of same material and having same cross-sectional area. The internal diameter of hollow column is half of its external diameter. Both the columns are of the same length and are pinned at both ends. [7]

(B) A hollow shaft of diameter ratio 3/5 is required to transmit 482 KW at 125 rpm. The shearing stress in the shaft must snot to exceed 65 N/mm^2 and the twist in a length of 2 m not to exceed 1 degree. Calculate minimum external diameter of shaft which would satisfy these conditions. Take $G = 8 \times 10^4$ N/mm^2. [6]

7. (A) A bolt is subjected to an axial pull of 12 kN and a transverse shear force of 5 kN. Determine the diameter of the bolt required based on : [6]

(*i*) Maximum principal stress theory

(*ii*) Maximum distortion energy theory.

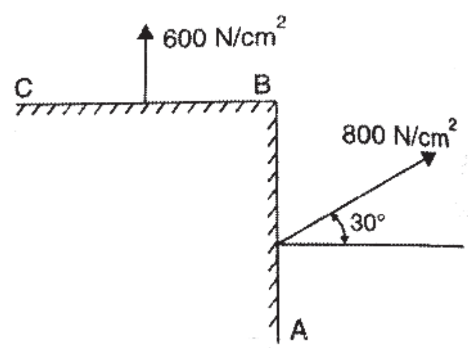
Take elastic limit in simple tension is equal to 270 MPa and Poisson's ratio = 0.3. Adopt F.O.S. = 3.

(B) The intensity of resultant stress on a plane AB as shown in figure at a point in a material under stress in 800 N/cm^2 and it is inclined at 30^0 on the normal to that plane. The normal component of stress on another plane BC at right angles to plane AB is 600 N/cm^2. Determine : [7]

(*i*) the resultant stress on the plane BC,

(*ii*) the principal stresses and their directions and

(*iii*) the maximum shear stress.



Or

8. (A) A solid circular shaft is subjected to a bending moment of 8 kNm and a torque of 12 kNm. In a uniaxial test the shaft material gave the following results : Modulus of elasticity = 200 GN/m^2, Stress at yield point = 300 N/mm^2, Poisson's ratio = 0.3, Factor of safety = 3. Estimate the least diameter of the shaft using : [6]

(*i*) Maximum shear stress theory

(*ii*) Shear strain energy theory.

(B) At a point in a strained material, two-dimensional state of stress is as shown in figure. Determine graphically : [7]

(*i*) Principal stresses

(*ii*) Principal planes

(*iii*) Maximum shear stress

(*iv*) Normal and shear stress component on planes whose normals are at 35° and 125° with *x*-axis.