(vii) A truss is supported on hinge at one end and on roller on the other end. It is subjected to a horizontal load '*H*' only. The horizontal reaction is carried by
(a) both the supports
(b) the hinge support
(c) the roller support
(d) no horizontal reaction will develop.

(viii) A two dimensional element is subjected to pure shear of magnitude 40 MPa. What is the value of the major principal stress?
(a) 40 MPa (b) 60 MPa (c) 80 MPa (d) 100 MPa.

(ix) What is the effective length of a cantilever column of clear length '*l*'?
(a) 0.8*l* (b) 1.0*l* (c) 2.0*l* (d) 0.65*l*.

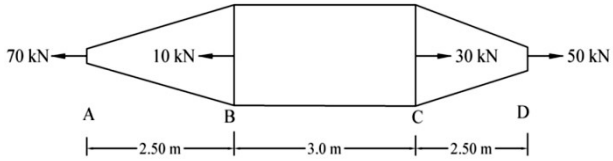
(x) A circular bar is subjected to a torque "*T*". The polar moment of inertia of the bar is "*J*" and modulus of rigidity of the material is "*G*". If the angle of twist is "θ", then the torsional rigidity of the bar is,
(a) T/J (b) T/ θ (c) T/G (d) None of these.

Group – B

2. (a) Draw the stress – strain relationship on a graph paper using the table given below. Identify whether the material is ductile or brittle. Identify proportional limit, yield stress, plastic zone, ultimate stress and breaking stress from the stress – strain curve.

Strain	Stress (N/mm^2)
0	0
0.001	10
0.002	20
0.003	30
0.004	40
0.005	38
0.006	37
0.007	64
0.008	70
0.009	65
0.01	52

(b) A circular bar of varying cross section is subjected to the axial forces as given in the following figure. The diameter of the bar at location 'A' is 15 mm, at 'B' is 40 mm and at 'D' is 25 mm. The bar has uniform cross-section at 'BC'. Find out the total elongation of this bar. Consider modulus of elasticity (E) = 2×10^8 kN/m^2.



8 + 4 = 12

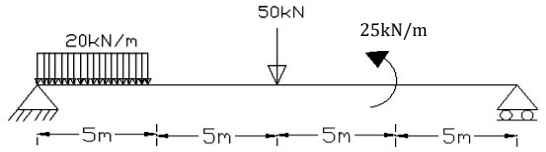
3. (a) A rectangular element is subjected to tensile normal (20 MPa and 40 MPa) stresses and clockwise shear stress (10 MPa). Find out the major and minor principal stresses and the maximum shear stress using Mohr Circle. Find out the normal and shear stresses in the element at an inclination of 10^0 (clockwise) measured from the principal plane.

(b) A thin walled balloon having diameters 70 mm and 55 mm along the horizontal and vertical directions, respectively and wall thickness 5 mm is subjected to internal pressure 10 kg/mm^2. Find out the meridonial and hoop stresses if the hoop stress is 2.0 times the meridonial stress.

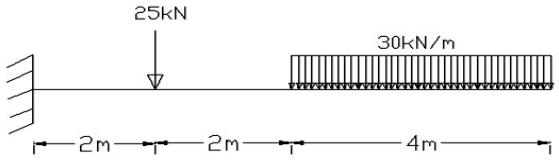
6 + 6 = 12

Group – C

4. Draw the SFD and BMD of the following beams.



(a)



(b)

6 + 6 = 12

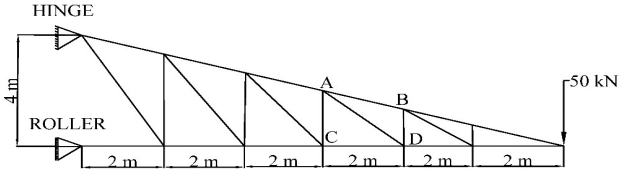
5. (a) A simply supported beam of span 10m has a width of 250mm and depth 300mm. If the permissible bending stress of the beam is 250 N/mm^2, then find out
(i) The maximum intensity of uld the beam can carry and
(ii) Maximum amount of point load the beam can carry at a distance 2.5m from left support.

(b) Write down the assumptions in Theory of simple bending.

(5 + 5) + 2 = 12

Group – D

6. Find out the axial forces in members AB, CD and AD of the truss shown below using Method of Sections.



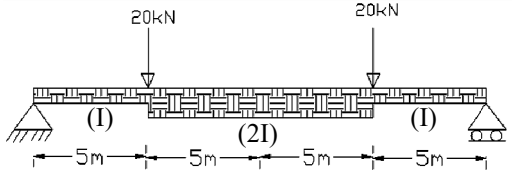
12

7. A solid circular shaft of length 4.0 m and diameter 35 mm is fixed at one end and free at the other end. The first 2.0 m length of the shaft is made of steel and the second 2.0 m length is made of brass. Maximum allowable shear stresses are 35 MPa and 50 MPa for steel and brass, respectively. The modulus of rigidity are 2×10^5 MPa and 1.0×10^5 MPa for steel and brass, respectively. Find out the maximum allowable torque acting at the free end of that shaft if its angle of twist is restricted upto 1.5^0.

12

Group – E

8. (a) A beam of span 20m carries two point loads as shown in the figure. The moment of inertia (I) of the beam for middle 10m length has a value of 2I and the rest of the portion has a value I. Find slope at the two ends and deflection at the midpoint. Use conjugate beam method. Given E = 200kN/mm^2 and I = 1.25×10^9 mm^4. Assume suitable data if not provided.



(b) Derive the expression for strain energy stored in a beam due to bending and shear.

8 + 4 = 12

9. (a) Consider a slender simply supported aluminum column 2.0 m long and circular in cross section. It has a hollow cross-section where the outside diameter is 50 mm. Calculate the necessary internal diameter to prevent failure by buckling if the critical axial load applied on the top of the column is 30 kN. Take *E* for aluminum as 70 GN/m^2.

(b) Find out the 'core' of an eccentrically loaded short column of rectangular cross-section having shorter dimension '*b*' and longer dimension 'd'.

3 + 9 = 12

STRENGTH OF MATERIALS
(CIVL 2102)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) A simply supported beam of length L, cross-section A carrying an udl of W. The value of maximum bending moment will be
(a) WL^2/2 (b) WL^2/8 (c) WL^2/4 (d) WL^2/16.

(ii) The shape of the bending moment diagram for a simply supported beam carrying udl will be
(a) triangular (b) parabolic
(c) circular (d) cubical.

(iii) At the point of contraflexure
(a) Bending moment is zero
(b) Bending moment is maximum
(c) Shear force is zero
(d) Bending moment changes its sign.

(iv) Shear force(V) and bending moment(M) are related as
(a) V = M/Z (b) V = dM/dx
(c) V = $\int Mdx$ (d) V = $\int MZdx$.

(v) A uniform and symmetric I-section is subjected to a shear force F. The maximum shear stress will occur at
(a) top of the section
(b) neutral axis of the section
(c) junction of web and flange
(d) bottom of the section.

(vi) Hook's law holds good upto
(a) Elastic limit (b) yield limit
(c) Breaking point (d) plastic limit.