(vi) A uniform steel rod 20 meters long is hung vertically from a support. The weight density of steel is 78 kN/m^3 and modulus of elasticity is 2×10^8 kN/m^2. The elongation of the rod is,
(a) 0.078 mm (b) 0.89 mm (c) 1.253 mm (d) 2.59 mm.

(vii) If σ_1 and σ_2 are major and minor principal stresses, then the maximum value of shear stress is given by
(a) $(\sigma_1 - \sigma_2)/3$ (b) $(\sigma_1 - \sigma_2)/2$
(c) $(\sigma_1^2 - \sigma_2^2)/2$ (d) $(\sigma_1 - \sigma_2)/4$.

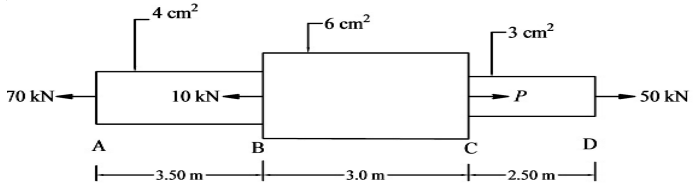
(viii) The circumferential stress in a thin walled pressure vessel is 2N/mm^2. The magnitude of longitudinal stress in that vessel is,
(a) 0.5 N/mm^2 (b) 1.0 N/mm^2
(c) 2.0 N/mm^2 (d) 2.5 N/mm^2.

(ix) 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.

(x) Euler's formula holds good for
(a) short columns (b) slender columns
(c) both short and long columns (d) medium columns only.

Group - B

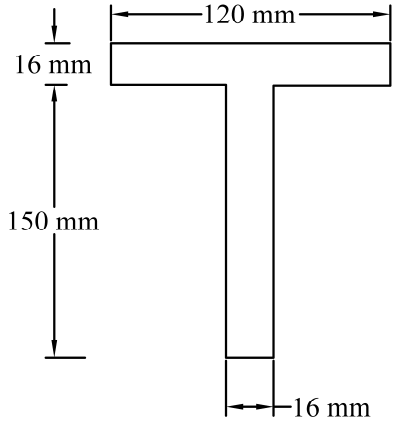
2. (a) Determine the load '*P*' by maintaining the static equilibrium of the axially loaded bar shown in the following figure. Also determine the change in length of the bar. Take *E* = 200 GPa.



(b) A rigid bar as shown in the figure below is suspended by two vertical rods in a horizontal position under its own weight. The rod B is made of brass, length 5 m, cross sectional area 10 mm^2, modulus of elasticity 1×10^5 MPa. The rod A is made of steel, length 3 m, cross sectional area 5 mm^2, modulus of elasticity 2×10^5 MPa. Find out the distance '*x*' from A where a vertical load of 50 kN may be applied by keeping the bar horizontal after application of the load.

9. (a) An ideal slender column of length "*L*" is simply supported at ends. It is rectangular in cross section having dimensions "*b*" an Find out the first buckling of this column.

(b) A column having a T – section is 3.0 m long and simply suppor both ends. Find out the first buckling load using Euler's for *E* = 200 GPa.



6 + 6

B.TECH/CE/3RD SEM/CIVL 2102/2016

STRENGTH OF MATERIALS
(CIVL 2102)

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

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 a practicable.

Group – A
(Multiple Choice Type Questions)

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

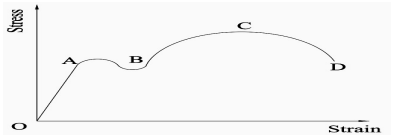
(i) Wherever the bending moment is maximum the shear force is
(a) zero (b) also maximum
(c) minimum (d) does not depend on bending mo

(ii) A beam is said to be loaded in pure bending if
(a) shear force and bending moment are uniform throughout
(b) shear force is zero and bending moment is uniform through
(c) shear force can vary but bending moment is uniform throug
(d) shear force is uniform throughout and bending moment is z

(iii) The relation governing the simple bending of beam is
(a) $\sigma/y = M/E = I/R$ (b) $\sigma/y = M/R = E/I$
(c) $\sigma/E = M/I = y/R$ (d) $\sigma/y = M/I = E/R$.

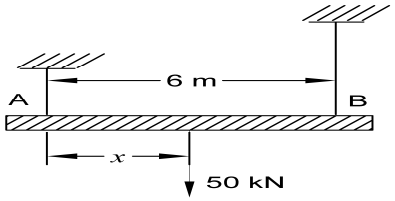
(iv) When a rectangular section of a beam is subjected to a sh force, the ratio of maximum shear stress to the average shear is
(a) 2.0 (b) 1.75 (c) 1.5 (d)

(v) Identify the strain hardening zone in the following stress – curve.



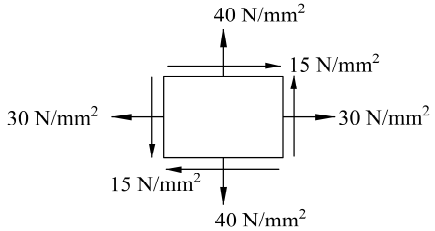
(a) OA (b) AB (c) BC (d

Neglect selfweight of the rigid bar.



6 + 6 = 12

3. (a) A square element is subjected to the two dimensional state of stress as shown in the figure. Find out the major and minor principal stresses and the maximum shear stress using Mohr circle. Find out the normal and shear stresses on a plane incline at an angle 35 degree with the principal plane.

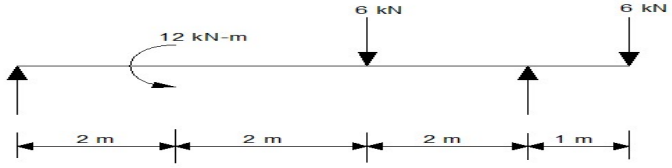


(b) A water pipe 500 mm diameter contains water at a pressure head of 100 m. If the allowable stress in the pipe is 20 N/mm², calculate the minimum thickness of the pipe.

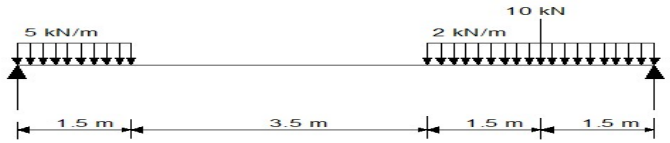
8 + 4 = 12

Group - C

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



(a)

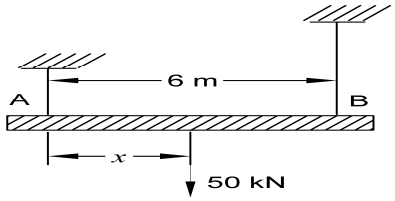


(b)

(6 + 6) = 12

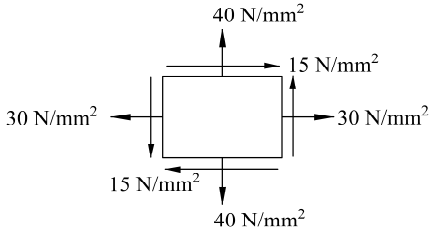
B.TECH/CE/3RD SEM/CIVL 2102/2016

Neglect selfweight of the rigid bar.



6 + (

3. (a) A square element is subjected to the two dimensional state of as shown in the figure. Find out the major and minor pri stresses and the maximum shear stress using Mohr circle. Fir the normal and shear stresses on a plane incline at an ang degree with the principal plane.

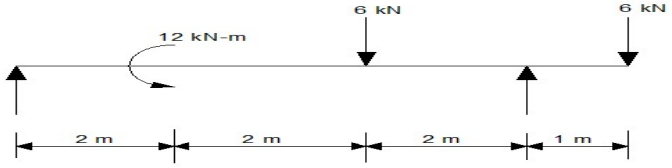


(b) A water pipe 500 mm diameter contains water at a pressure h 100 m. If the allowable stress in the pipe is 20 N/mm², calcula minimum thickness of the pipe.

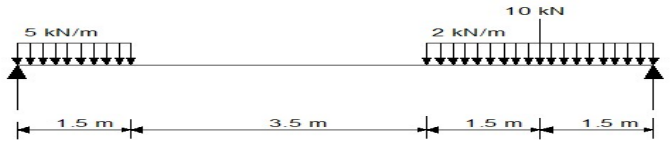
8 + 4

Group - C

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



(a)



(b)

(6 + 6

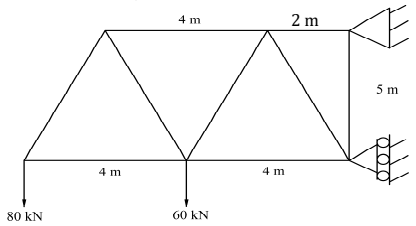
5. (a) What do you understand by Section Modulus? Find out section modulus for rectangular section and circular section.

   (b) An "I" section beam 350mm X 200mm has a web thickness of 12.5 mm and a flange thickness of 25 mm. It carries a shearing force of 200kN at a section. Sketch the shear stress distribution across the section.

3 + 9 = 12

Group - D

6. Find out the member forces for the truss shown the following figure. Use Method of Section or Method of Joints.



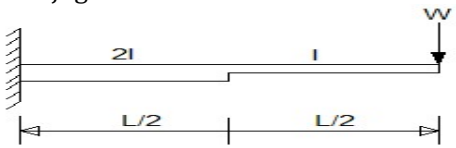
12

7. Two shafts of same material and same length are subjected to same torque. If the first shaft is of solid circular section and the second shaft is of hollow circular section whose internal diameter is 3/4th the external diameter and the maximum shear stress developed in each of them are same, find out the ratio of weights of solid shaft to the hollow shaft.

12

Group - E

8. (a) A cantilever beam of span L is carrying a point load W at B. the moment of inertia for the left half is 2I, whereas that for the right half is I. Find the slope and deflection at free end in terms of EI, W and L. Use conjugate beam method.



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

8 + 4 = 12

B.TECH/CE/3RD SEM/CIVL 2102/2016

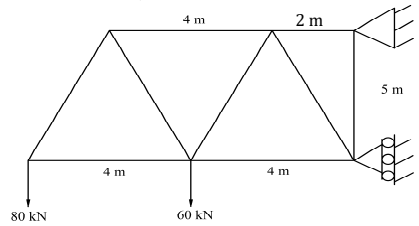
5. (a) What do you understand by Section Modulus? Find out s modulus for rectangular section and circular section.

   (b) An "I" section beam 350mm X 200mm has a web thickness o mm and a flange thickness of 25 mm. It carries a shearing fo 200kN at a section. Sketch the shear stress distribution acro section.

3 + 9

Group - D

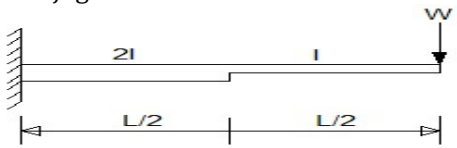
6. Find out the member forces for the truss shown the following figur Method of Section or Method of Joints.



7. Two shafts of same material and same length are subjected to same t If the first shaft is of solid circular section and the second shaft is of h circular section whose internal diameter is 3/4th the external diamet the maximum shear stress developed in each of them are same, find o ratio of weights of solid shaft to the hollow shaft.

Group - E

8. (a) A cantilever beam of span L is carrying a point load W at moment of inertia for the left half is 2I, whereas that for the half is I. Find the slope and deflection at free end in terms of and L. Use conjugate beam method.



   (b) Derive the expression for strain energy stored in a beam d bending moment and shear force.

8 +