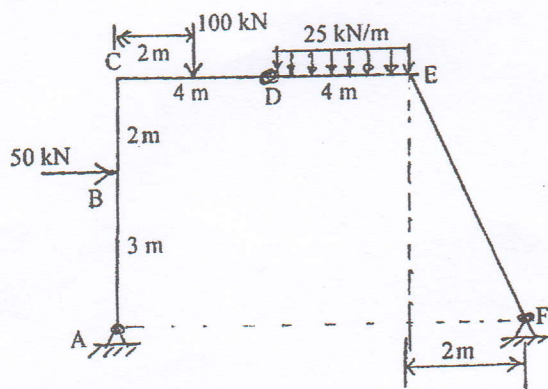


Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

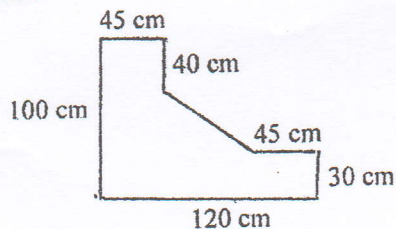
Subject: - Strength of Materials (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

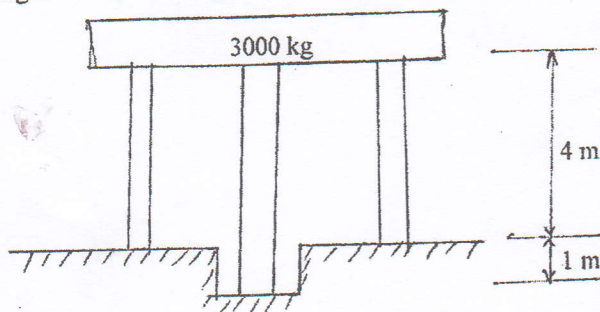
1. Draw axial force, shear force and bending moment diagrams for the frame. Indicate numerical values at salient points. [16]



2. a) What is product of inertia? [2]
 b) Determine principal moment of inertia of the given figure below about the axes passing through the centroid. [10]

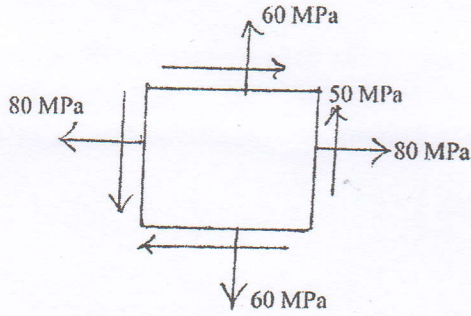


3. a) Derive the expression for the total elongation of a uniform bar of length L and cross section area A under its self weight. [5]
 b) Two copper rods and one steel rod are having diameter 4 cm, together support a load 3000 kg as shown in figure below. Determine the stresses in each rod. Take $E_s = 2 \times 10^6 \text{ kg/cm}^2$ $E_c = 10^6 \text{ kg/cm}^2$ [8]



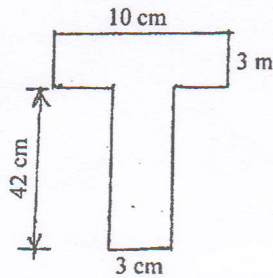
4. a) For the state of plane stress shown in figure below determine. [8]

- i) principal stresses ii) orientation of principal planes
iii) maximum shearing stress iv) normal stress on the plane of maximum shear stress



b) Derive torsional equation. $\frac{T}{J} = \frac{\tau_s}{R} = \frac{G\phi}{L}$ [8]

5. a) A simply supported beam of span 5m loaded with udl 4 kN/m. Determine the maximum value of bending stress 15 cm above the base of the cross section. The cross section is T-section as shown in figure. [8]



b) Derive an expression for the Euler's formula for crippling load on a column with both ends fixed. [8]

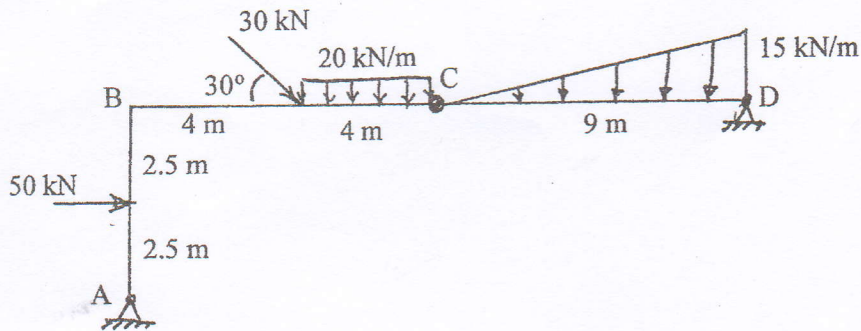
Derive an expression for the volumetric strain of a thin walled cylindrical vessel with its length 'L' internal diameter 'd' and thickness 't'. [7]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

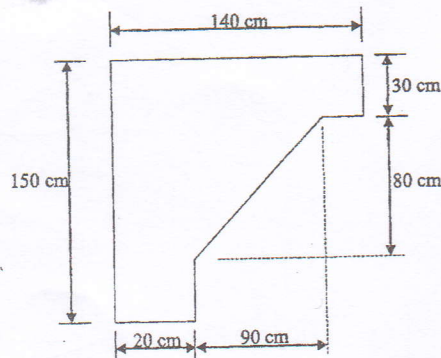
Subject: - Strength of Materials (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

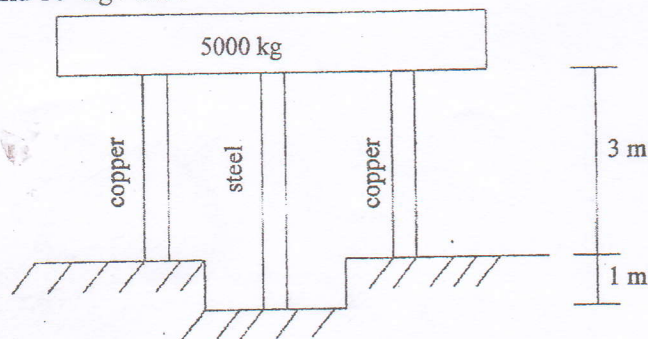
1. Draw axial force, shear force and bending moment diagram for the given frame. Indicate numerical values at salient points. [16]



2. a) What do you understand by principle moment of inertia and principal axis? [4]
 b) Determine the principle moment of inertia of the given figure. [10]

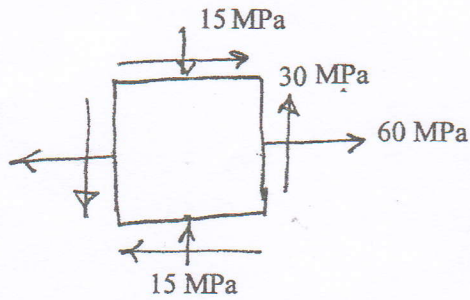


3. Derive the expression for the total elongation due to the circular tapered bar. Two copper rods and one steel rod is of 3 cm diameter, together support a load of 5000 kg as shown in figure below. Find the stresses in each rod. Take 'E' for steel and copper as $2 \times 10^6 \text{ kg/cm}^2$ and 10^6 kg/cm^2 . [6+6]



4. a) For the state of plane stress shown in figure below determine (i) the principal planes (ii) principal stresses (iii) the maximum shearing stress and the corresponding normal stress.

[8]

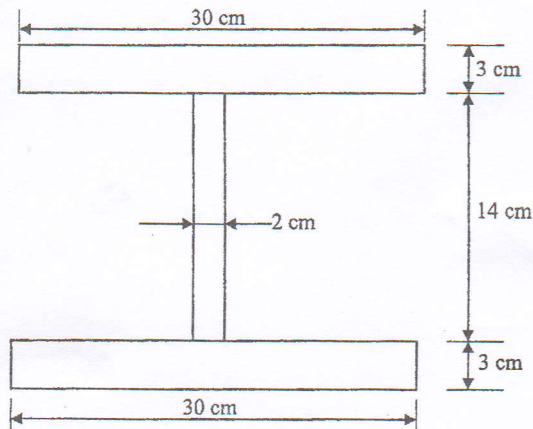


- b) Show that hollow shaft is more strong than solid shaft when material, weight and length are same.
5. a) Derive the expression for the Euler's formula for crippling load on a column with both ends hinged condition. Explain the limitation of Euler's Formula also.
- b) For the simply supported beam of 4m span loaded with UDL of 3 kN/m, determine the value of bending stress 80 mm above the base of the cross section. The cross section of the beam is I section and the dimensions are shown below.

[8]

[8]

[8]



6. Explain the different types of stresses in thin walled cylinders.

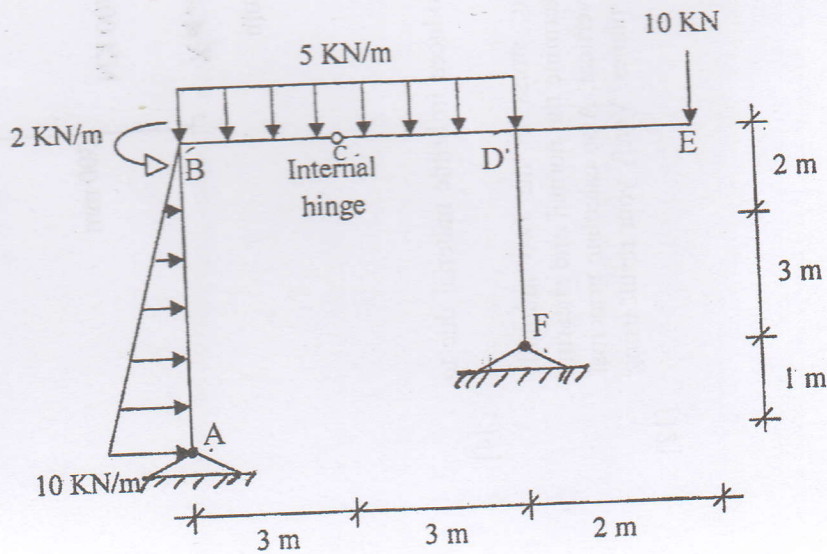
[6]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

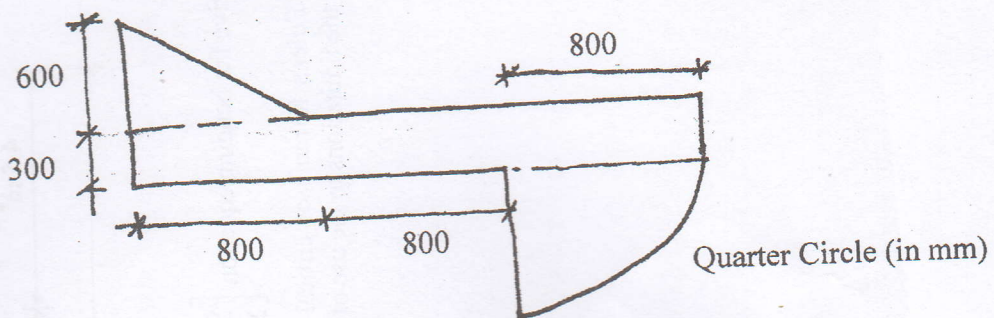
Subject: - Strength of Materials (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

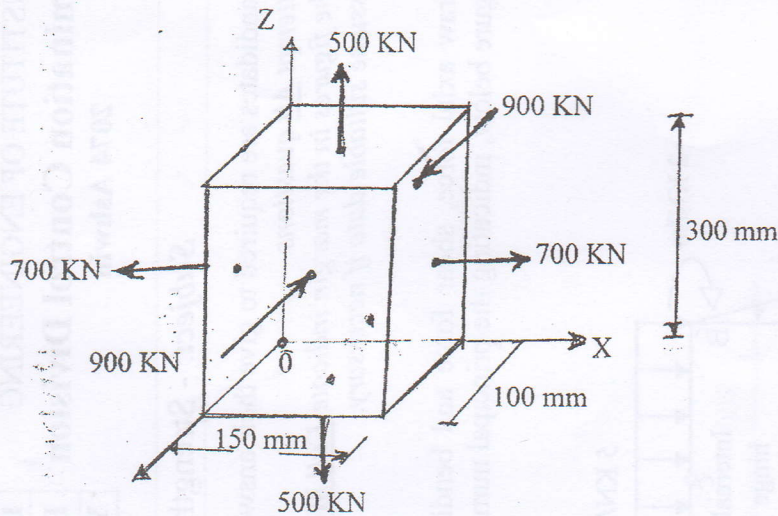
1. Draw axial force, shear force and bending moment diagrams for the frame shown in figure below, indicating the principal numerical values at salient points. [16]



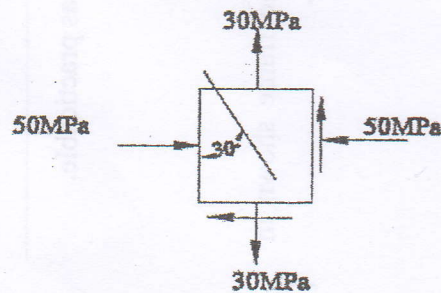
2. Find the principal moments of inertia and directions of principal axes for the section as shown in figure below. [12]



3. a) A block of steel $300\text{ mm} \times 150\text{ mm} \times 100\text{ mm}$ is subjected to axial loads as shown in figure below. Find the change in the dimensions of the bar and change in volume for the material of the block. Take $E_s = 200\text{ GN/m}^2$ and poisson's ratio (σ) = 0.30. [8]

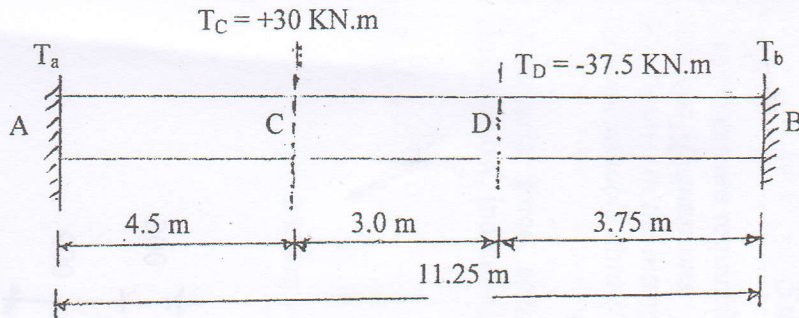


- b) What is the stress concentration? What effect is produced in brittle material due to stress concentration? [4]
4. a) For an infinitesimal element normal and shearing stress in the two mutually perpendicular planes are shown in figure below. Determine the normal and shearing stress on the inclined plane at an angle of 30° with vertical. Also calculate principal stresses their planes, maximum shear stress and their planes. Verify your result using Mohr's circle. [12]



- b) Prove that longitudinal stress is half of the circumferential stress for the thin cylinder with neat sketch. [4]

5. a) A horizontal shaft securely fixed at each ends has a free length of 11.25 m. Viewed from end "A" of the shaft, axial couples of 30 KN.m clockwise and 37.5 KN.m counter clockwise act on the shaft at a distance 4.5 m and 7.5 m from left respectively. Determine the end fixing couples in magnitude and direction and find the diameter of shaft (solid) for a maximum shearing stress of 60 N/mm². [10]



- b) Derive the bending equation $\left[\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R} \right]$ [6]

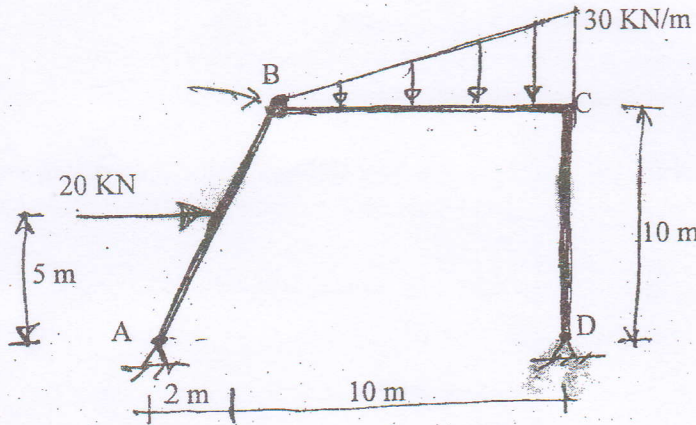
6. Derive Euler's formula of critical load for a steel column with both ends fixed. Also explain the limitations to the use of this formula. [6+2]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

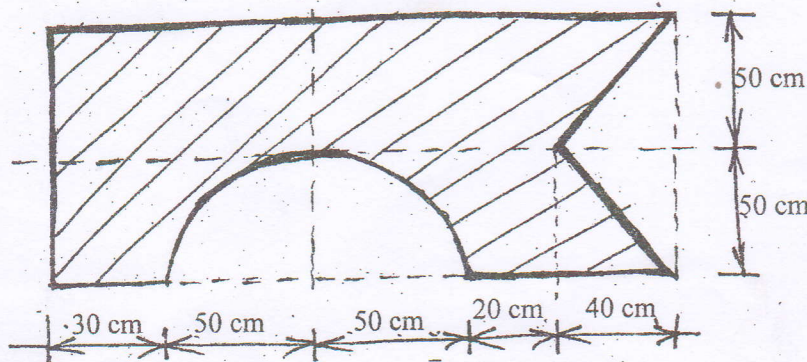
Subject: - Strength of Materials (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define shear force and bending moment at a section of beam. [4]
 b) Draw axial force, shear force and bending moment diagram of the frame shown in figure below. [12]

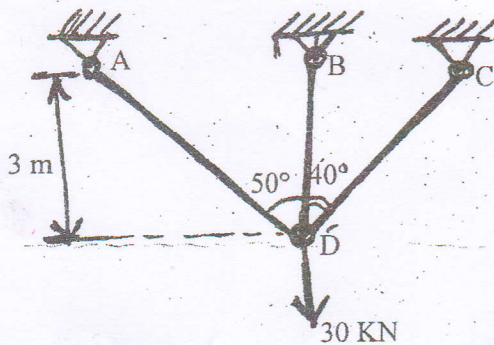


2. a) Obtain the principle moment of inertia and draw principle axes for the plane figure given below. [8]



- b) Derive the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ [8]

3. a) Find the forces in each members of the bar system shown in figure below. Take cross sectional area of each bar as 6 cm^2 and modulus of elasticity E as $2 \times 10^5 \text{ N/mm}^2$. [8]



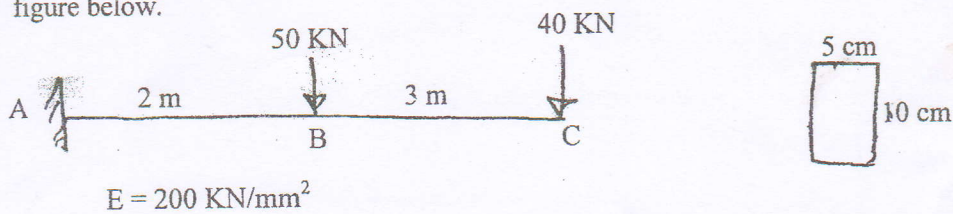
- b) The principle stresses at a point in a bar are 100 MPa tensile and 40 MPa compressive. Find the normal stress shears and resultant stress on a plane inclined at 60° to the axis of major principal stress. [8]

4. a) A water pipe 500 mm internal diameter contains water at a pressure head 100 m. If the unit weight of water is 10 kN/m^3 and allowable stress of pipe material is 20 N/mm^2 . Calculate the thickness of the pipe. [8]

- b) A solid circular shaft is subjected to a torque 120 Nm. Determine the diameter if the allowable shear stress is 100 N/mm^2 and the allowable angle of twist is 30° per 10 diameter length of the shaft. $G = 10^5 \text{ N/mm}^2$. [8]

5. a) Derive euler's column formula for critical load of a column with both ends hinged. [8]

- b) Determine the slope and deflection at the free end of the cantilever beam shown in figure below. [8]

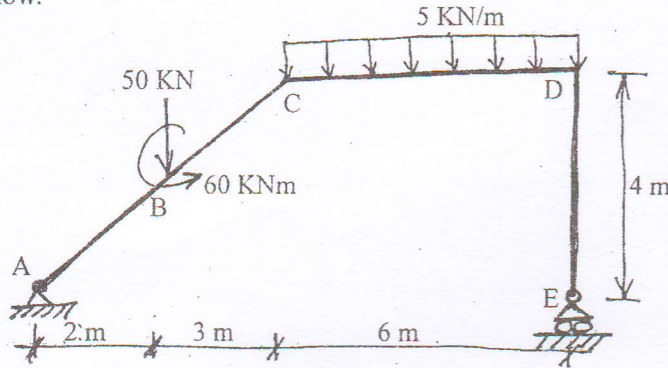


Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

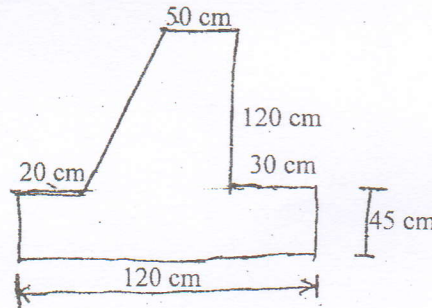
Subject: - Strength of Materials (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

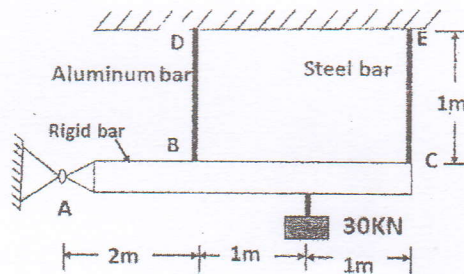
1. a) Explain shear force and bending moments. [4]
 b) Draw axial force, shear force and bending moment diagrams for the frame given in figure below. [12]



2. a) Determine principal moment of inertia and draw orientation of principal axes of the figure shown in figure below. [12]

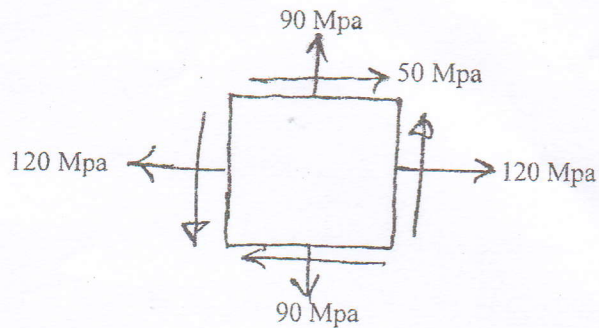


- b) Define principle moment inertia. [4]
 3. a) ABC is a rigid bar, wire BD is made of aluminum and EC is made of steel. Determine the stresses in rods and reactions at A. Take $A_{al} = 4 \text{ mm}^2$, $A_{st} = 2 \text{ mm}^2$, $E_{al} = 72 \text{ KN/m}^2$, $E_{st} = 210 \text{ KN/m}^2$. [8]



- b) Derive a relation between Young's modulus of elasticity, Shear modulus and bulk modulus. [8]

4. a) The state of stress in a two dimensional stress system is as shown in figure below. Determine the principal stresses and orientation of principal planes. [8]



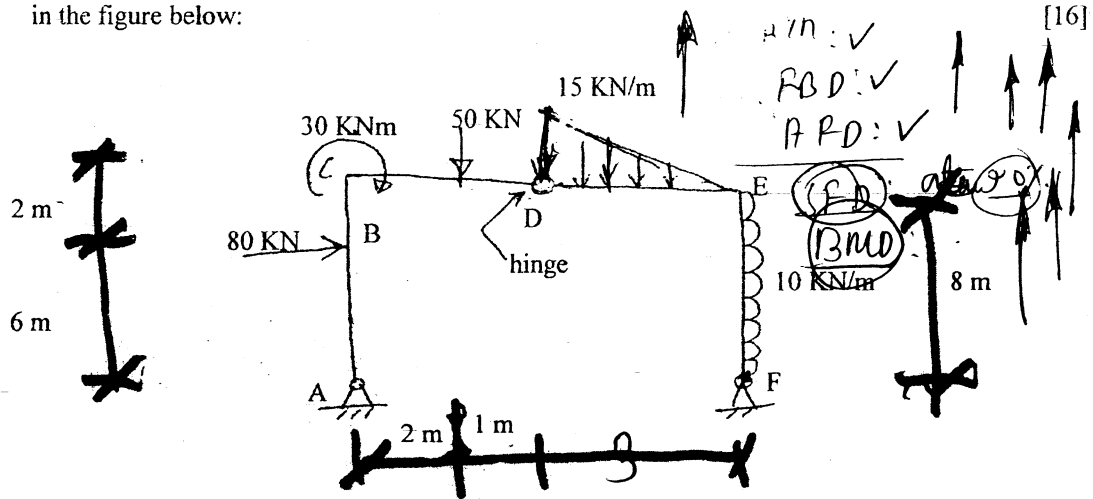
- b) Prove that the longitudinal stress at thin cylinders is equal to the half of circumferential stress at that thin cylinders. [8]
5. a) A solid circular shaft is subjected to a torque 120 Nm. Determine the diameter if the allowable shear stress is 100 N/mm^2 and the allowable angle of twist is 3° per 10 diameter length of the shaft. $G = 10^5 \text{ N/mm}^2$. [8]
- b) Prove that the torque transmitted by the hollow shaft is greater than the solid shaft of same weight, material and length. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

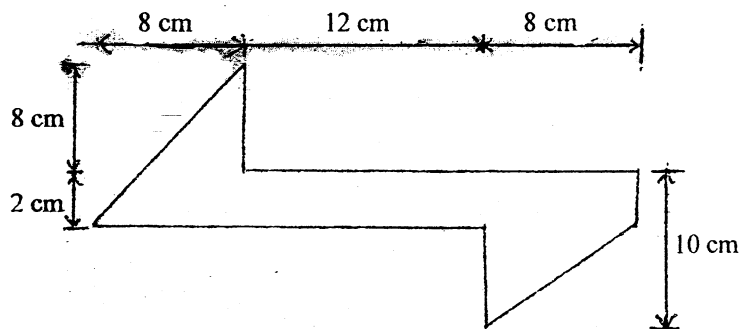
Subject: - Strength of Materials (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

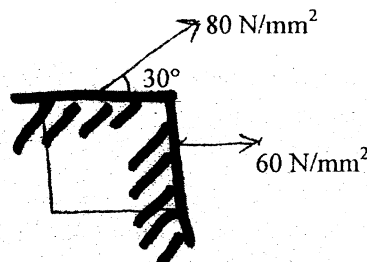
1. Draw axial force, shear force and bending moment diagram of the frame loaded as shown in the figure below: [16]



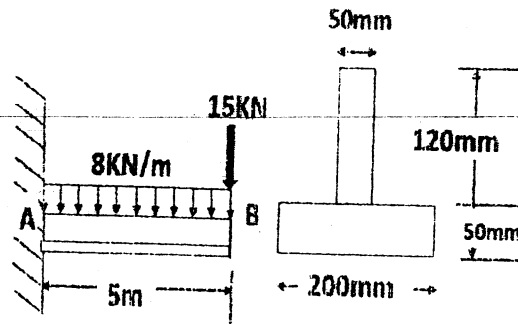
2. Determine the orientation of the principal axes and the moment of inertia about the centroidal axes of composite section as shown. [12]



3. Determine the orientation of principal axes and principal stresses for the element loaded as shown in figure below. Also calculate maximum shear stress and orientation of their plane. [8]



4. A cantilever beam 5m in length is subjected to the loads as shown in figure. Determine the maximum bending stresses in the beam. Also, determine the value of bending stress 25 mm below from the top surface of the beam. [8]



5. Derive a relation between Young's modulus of elasticity and bulk modulus. [8]
6. A hollow steel shaft having 10 cm outer diameter and 7 cm inside diameter is rotating at a speed of 300 rpm. If the permissible shear stress is 80 N/mm^2 and the maximum torque is 1.3 times the mean torque. Determine the power transmitted by the shaft. [8]
7. A thin walled cylindrical shell made up of copper plate has been filled with a liquid at atmospheric pressure. An additional 80cc of liquid is then pumped into 3 m cylindrical shell whose internal diameter is 300 mm and wall thickness 14 mm. Find the values of pressure developed on the wall of cylinder due to this extra liquid. Take Poisson ratio = 0.36 and Modulus of elasticity $E = 10^6 \text{ kg/cm}^2$. [8]
8. Derive an expression for Euler's formula for crippling load of a column of length L with its both ends hinged condition. [12]

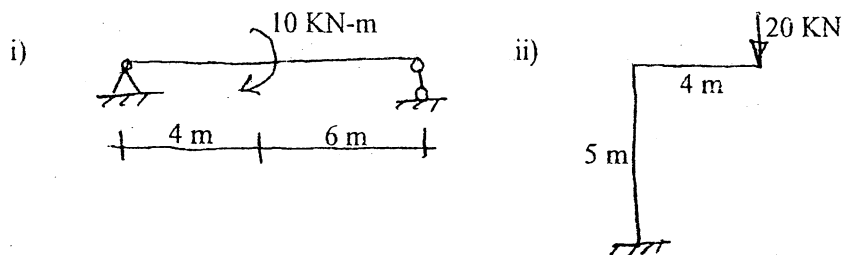
04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

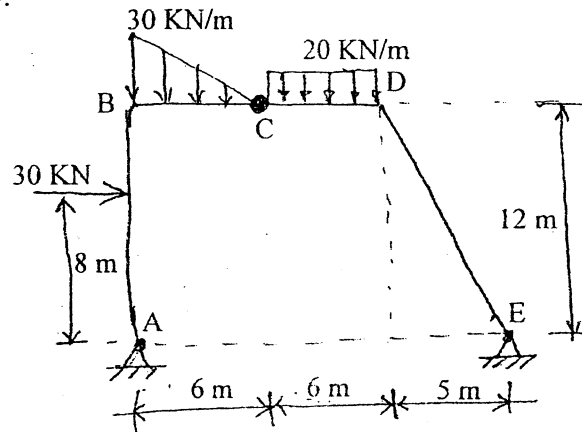
Subject: - Strength of Materials (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

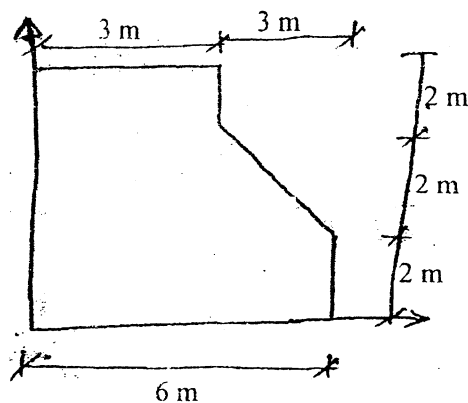
1. a) Draw bending moment diagram in the simple beam and frame shown in figure below: [4]



b) Draw axial force, shear force and bending moment diagram for the frame shown in figure below. [12]



2. Find the principal axes and principal moments of inertia about axes through centroid of the given figure. Verify your results using Mohr's circle. [12]

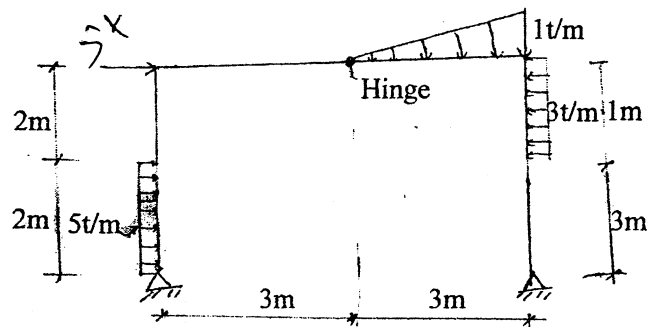


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

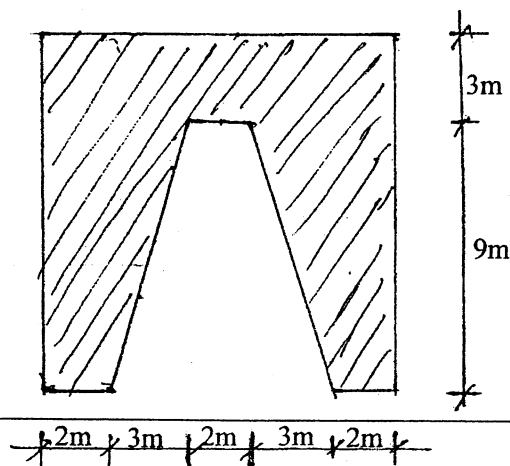
Subject: - Strength of Material (CE 502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw axial force, shearing force and bending moment diagrams for the following frame loaded as shown. Indicate salient points if any. [16]

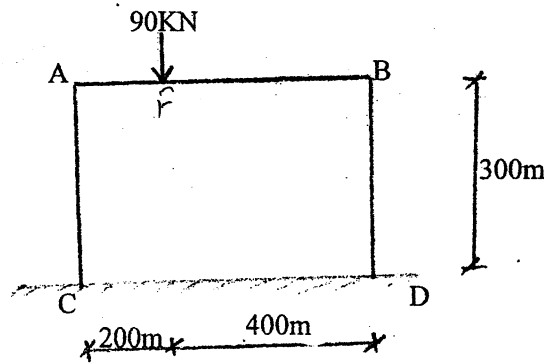


2. a) State and prove parallel axis theorem for product of inertia. [4]
 b) Determine the principle moment of inertia about centroidal axis and locate the principle axes for the section shown in figure below. [8]

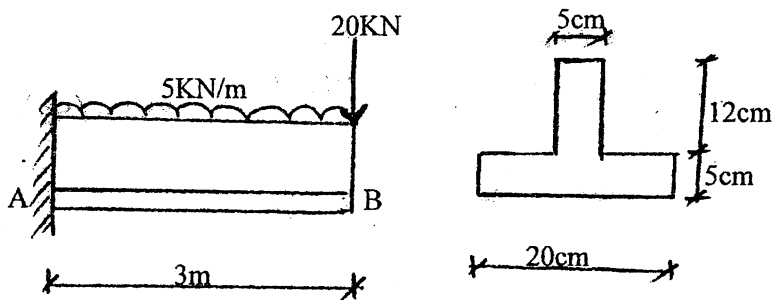


3. a) Derive the relation between Bulk modulus and Young's modulus of Elasticity. [8]
 b) Determine vertical displacement of point F, if AB is a rigid bar and remains horizontal, AC and BD are rods made of steel and aluminium having diameter 20mm

and 40mm respectively. E for steel and aluminium are 200GPa and 70GPa respectively. [8]



4. a) Derive an expression for the normal stress and shear stress on an oblique section of rectangular strained body when it is subjected to direct stresses in two perpendicular directions accompanied with simple shear stress. [8]
- b) Find the external and internal diameters required for a hollow shaft which is to transmit 40 KW of power at 240 rev/minute. The shear stress is to be limited to 100MN/m^2 . Take external diameter to be twice the internal diameter. [6]
5. a) A thin cylindrical shell 4m long and thickness 1.5cm is of 1.5cm internal diameter. Determine the change in length and diameter if the shell is subjected to an internal pressure of 25N/mm^2 . $E=2.05 \times 10^5\text{N/mm}^2$ and poisson's ratio=0.3. [6]
- b) A cantilever beam 3m in length is subjected to load as shown below. Determine maximum bending stress at 25mm below from the top surface of the beam. [8]



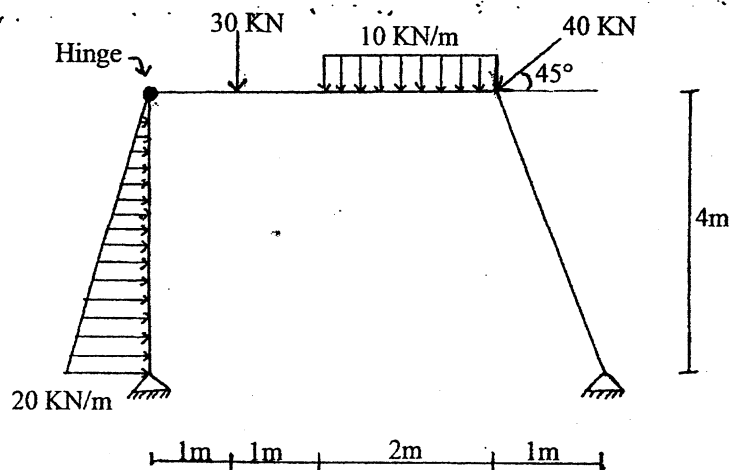
- c) A round bar is clamped at bottom and free at top. Its effective length is 2m. A horizontal force of 300N at top produces a horizontal deflection of 20mm. Determine the buckling load for the bar if the load is applied axially on top. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

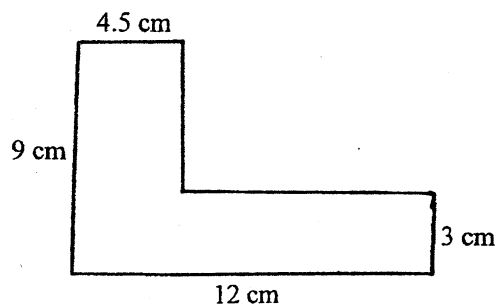
Subject: - Strength of Material (CE502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What do you mean by principle of superposition? Explain with suitable example. What are its limitations? [4]
- b) Draw axial force, shear force and bending moment diagram indicating salient points for the frame loaded as shown. [12]



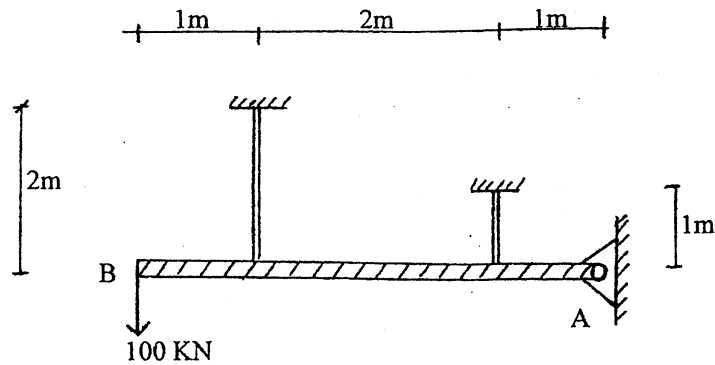
2. Determine the principal moment of inertia and orientation of principal axes for the composite section shown in figure below about its centroid. [12]



3. a) How is offset method defined in drawing stress-strain relationship? Where is it required? [2]
- b) A vertical rod of length 3m tapers uniformly from a diameter of 80mm at the top to 40mm at the bottom. If it is rigidly fixed at the upper end and is subjected to an axial load of 45kN, determine the total extension in the bar. Take density of material = $2 \times 10^5 \text{ kg/m}^3$ and young's modulus = 210 GN/m^2 . [6]

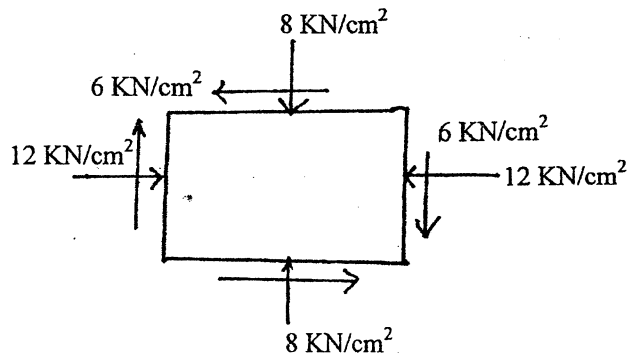
- c) A rigid bar AB is hinged at A and supported by a 2m long copper rod and a 1m long steel rod. It carries a load of 100 kN at the free end B as shown in figure below. If the area of cross-section of the steel and copper rods be 10cm^2 and 8cm^2 respectively and their respective values of E be 200GN/m^2 and 100GN/m^2 , find stresses in each rod and reaction at A (assume no bending in steel and copper rods).

[8]



4. Figure below shows the state of stress of point in a two dimensional stressed body. Determine the values of principal stresses and orientation of principal planes.

[8]



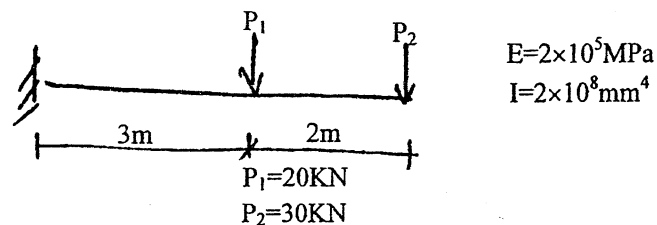
5. A thin walled cylindrical shell made up of copper plate has been filled with a liquid at atmospheric pressure. An additional 50 c.c. of liquid is then pumped in to 2m long cylinder whose internal diameter is 25 cm and wall thickness is 12 mm. Find the values of pressure developed on the wall of cylinder due to this extra liquid. Take poisson ratio = 0.34 and modulus of Elasticity = 10^6 kg/cm^2 .
6. A steel bar of 2.5 cm diameter when subjected to a torque of 300N produces an angle of twist of 1.35 degrees in the length of 25cm. The same bar when subjected to tension elongates 0.01cm in length of 15cm under a load of 70kN. Deduce the value of poisson's ratio for the material.
7. a) Describe the importance of computing deflections in beams. Also give two typical examples of pure bending of beam.
- b) Find the slope and deflection under the load P_1 .

[6]

[6]

[2+1]

[5]



8. Define buckling load and effective length of column and derive a Euler's formula for crippling load of a column of length L with its both ends hinged condition.

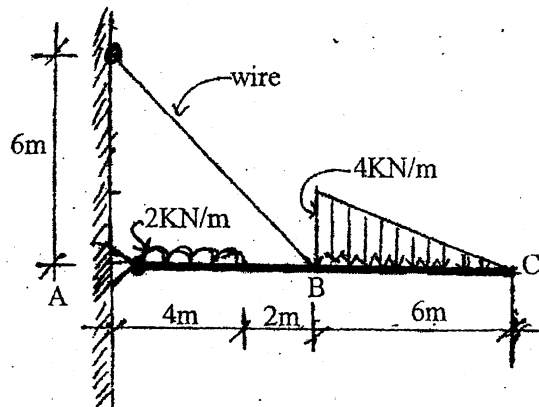
[2+6]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

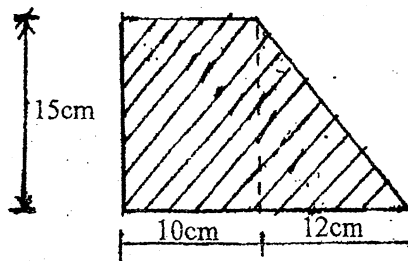
Subject: - Strength Material (CE 502)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Derive the relation between bending moment and shear force at any section of beam. [6]
- b) Draw bending moment and shear force diagrams for the beam ABC, which has hinged support at 'A' and other support at B, supported by wire (Tension member) as shown in figure. [10]



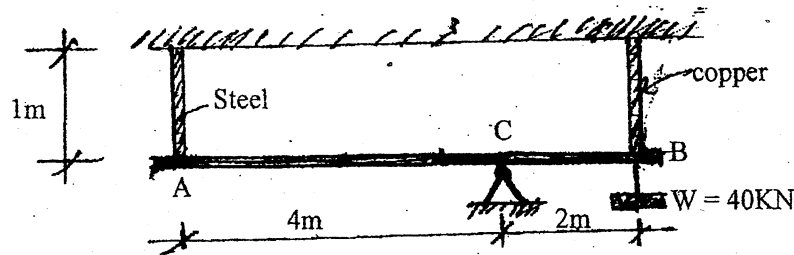
2. a) Find from the first principle product of inertia for a right angled triangle with base 'b' and height 'h' along XX and YY axes. (base and height are collinear with XX and YY axes respectively). [4]
- b) Calculate principal moment of inertia and the orientation of the principle axes for the shaded area shown in figure below. [8]



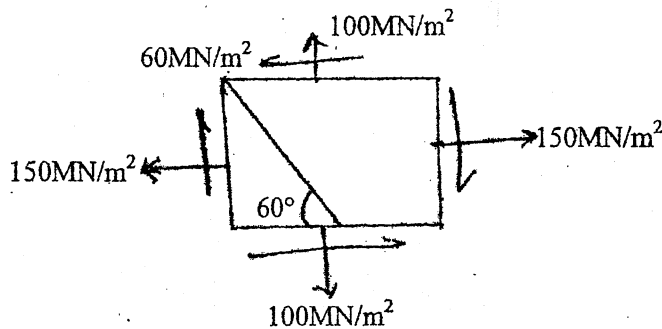
3. Two vertical rods of steel and copper are rigidly fixed with the ceiling at their ends at 100cm apart. Each rod is 3m long and 25mm diameter. A horizontal cross piece connects the lower ends of the rods. Where should a load of 3.5 tonnes be placed on the cross piece

so that it remains horizontal after being loaded. Take $E_s = 2 \times 10^6 \text{ kg/cm}^2$. $E_c = 1.0 \times 10^6 \text{ kg/cm}^2$. [8]

- b) A rigid bar 'AB' is hinged at 'C' and connected with a steel rod and a copper rod at 'A' and 'B' respectively as shown in figure. Both the rods are rigidly fixed with the ceiling at the upper ends. A load of 40KN is applied at 'B'. Find the magnitude of stresses in the steel rod and the copper rod. Cross sectional area of steel is 400mm^2 and copper is 600mm^2 . Take $E_s = 200\text{KN/mm}^2$ and $E_c = 110\text{KN/mm}^2$. [8]



4. a) For stresses shown in figure below, find the normal and resultant stresses on the plane shown. Find the direction of resultant stresses. Show the results diagrammatically. [8]



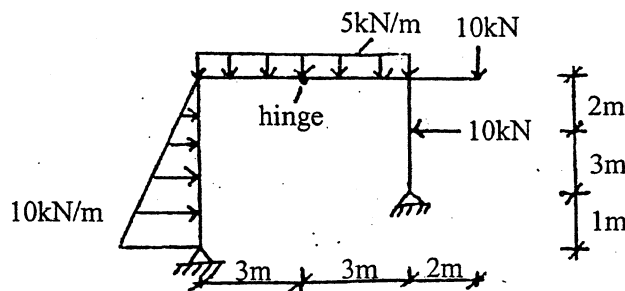
- b) Prove that maximum shear stress in a thin cylinder is half of the longitudinal stress. Also derive an expression for volumetric strain for thin cylinder. [2+6]
5. a) A hollow steel shaft of 10cm outer diameter and 7cm internal diameter is rotating with a speed of 300rpm. If the permissible shearing stress for the material is 80MN/m^2 and maximum torque is 1.3 times the mean torque, determine the power transmitted by the shaft. [6]
- b) A horizontal beam 4m long simply supported at ends carries a uniformly distributed load of 30KN/m over the whole span along with a concentrated load of 40KN at its T-section mid span. The beam is of T-section with web $30\text{cm} \times 3\text{cm}$ and flange $18\text{cm} \times 4\text{cm}$ making overall depth of 34cm. Find the maximum tensile and compressive stresses if the flange is at the top and horizontal. [8]
- c) Prove with Euler's formula that critical load for a steel column with both ends hinged is equal to $\frac{\pi^2 EI}{l^2}$, where all parameters have their usual meanings. [6]

Exam. Level	Regular / Back		
	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

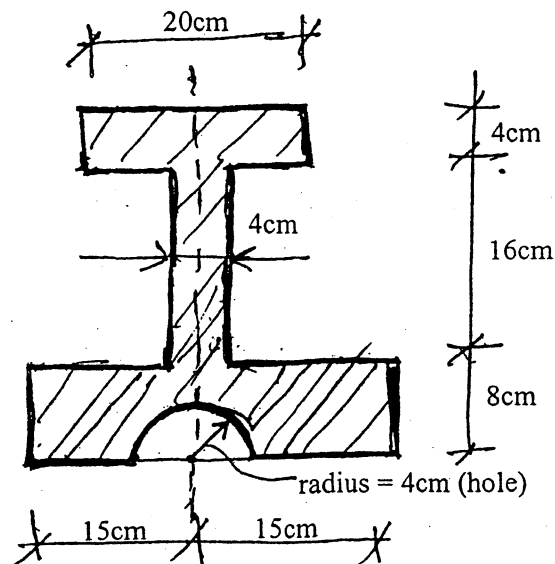
Subject: - Strength of Materials

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw axial force, shear force and bending moment diagrams for the frame shown, indicating the principal numerical values at salient points. [16]

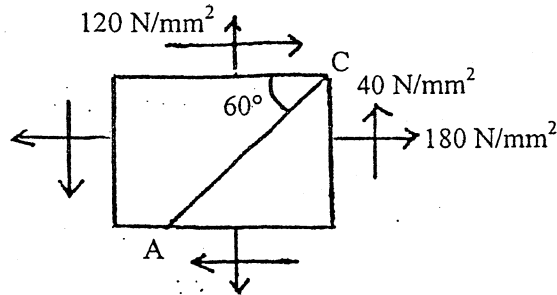


2. a) Calculate the principal moment of inertia about centroid and locate the principle axes for the figure as shown below. [12]

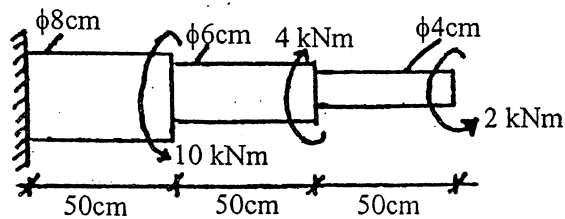


- b) Derive an expression for the elongation of uniform solid circular bar of diameter 'd' and length 'l' due to its self weight. [4]

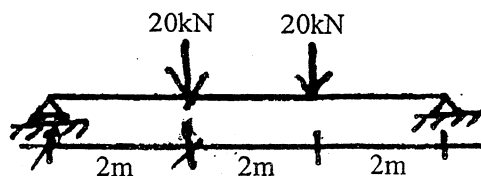
3. a) The state of the stress in a two dimensional stress system is as shown in the figure. Find the principal planes and maximum shear stress. Determine also the normal and tangential stress on plane AC. Verify the results by drawing Mohr's circle. [8]



- b) The modulus of rigidity for a material is $0.5 \times 10^5 \text{ N/mm}^2$. A 10mm diameter rod of the material was subjected to an axial pull of 10kN and the change in diameter was observed to be $3 \times 10^{-3} \text{ mm}$. Calculate the Poisson's ratio and the modulus of elasticity. [8]
4. a) Derive the torsional equation $T/J = \tau/R = G\theta/L$. [6]
- b) A thin cylindrical shell is 4m long and has 1m internal diameter and 12mm metal thickness. Calculate the maximum intensity of shear induced and change in dimensions of the shell if it is subjected to an internal pressure of 2 N/mm^2 . Take $E = 2 \times 10^5 \text{ N/mm}^2$ and $\mu = 0.3$. [10]
5. a) A stepped solid circular shaft of the dimensions shown in the figure is subjected to three torques. If the material has a shear modulus of elasticity $G = 80 \text{ GPa}$, find the angle of twist in degrees at the free end. Also calculate the maximum shearing stress in the shaft. [8]



- b) A simply supported beam of 6m span is subjected to a concentrated load of 20kN at a distance of 4m from the left support. Calculate (i) The position and the value of maximum deflection (ii) Deflection under the point load. [8]



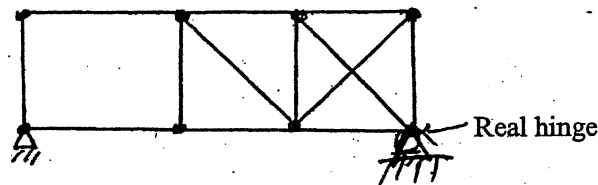
6. a) A solid circular compression member 50mm in diameter is to be replaced by a hollow circular section of the same material. Find the size of the hollow section, if internal diameter is 0.8 times, the external diameter. [8]
- b) Describe the Mohr's circle for stress. [8]

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

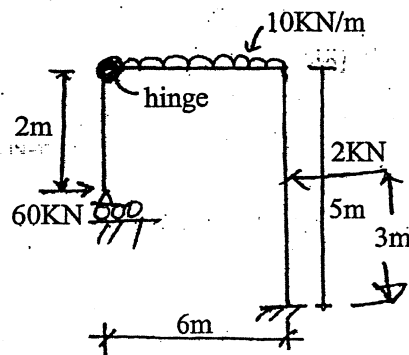
Subject: - Strength of Materials

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

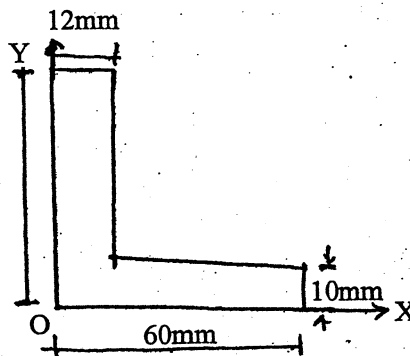
1. a) Explain static determinacy and stability of the following truss. [4]



- b). Draw axial force, shear force and bending moment diagrams for the following frame. [12]

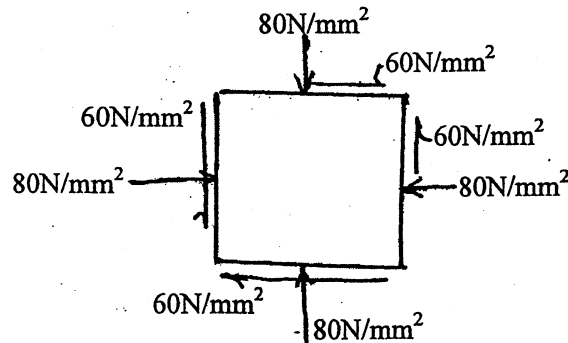


2. a) Calculate the principal MoI and their orientation for the following section about X-Y axes. [12]

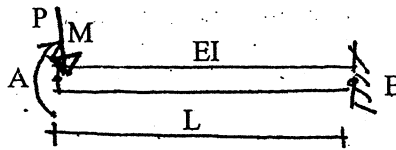


- b) Neatly sketch stress-strain diagram for mild-steel showing salient points. [4]

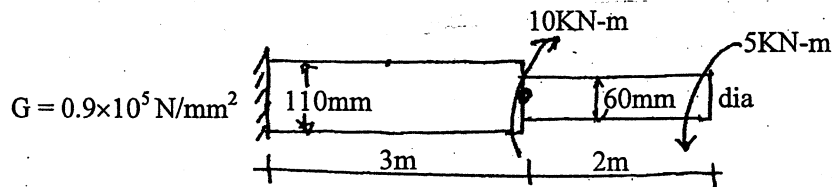
5. a) Derive the relation of modulus of rigidity (G) with modulus of elasticity (E) and Poisson's ratio (γ). [4]
- b) For the following stress condition of an element, obtain principal stresses and their orientation. Show the results in a neat sketch. [12]



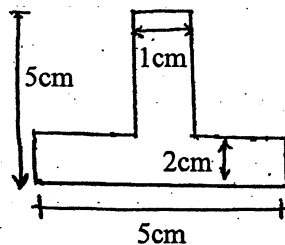
4. a) Obtain deflection at point A of the following beam. [8]



- b) For the following shaft, obtain the angle of twist at free end. [8]



5. a) For thin cylinders loaded with internal pressure p , obtain the relation for Hoop stress, longitudinal stress and maximum shear stress. [6]
- b) Determine the variation of horizontal shear stress for the following section where shear force is 50 kN. [10]



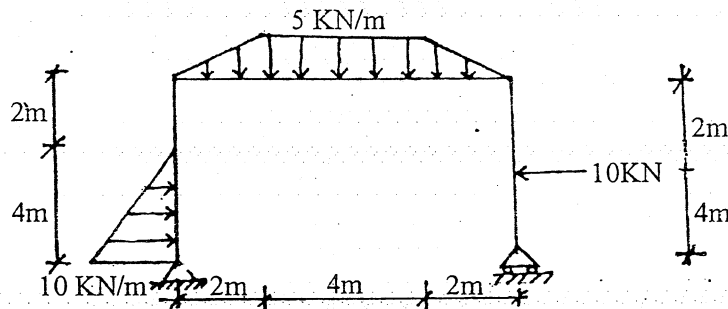
6. a) Prove that the limiting plastic moment of a rectangular beam made of elastoplastic material is 1.5 times the maximum elastic moment. [6]
- b) A 5m long simply supported beam has 30mm maximum deflection due to a 800N transverse load applied at the center of the beam. Determine the buckling load if the same beam of 5m length is used as a column with one end fixed and other end hinged. [10]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agric.	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

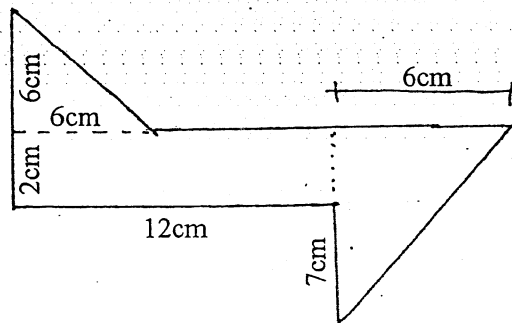
Subject: - Strength of Materials

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

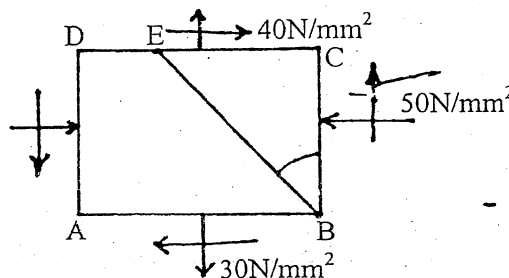
1. a) Describe the types of supports and their reactions with necessary sketches. [4]
 b) Draw axial force, shear force and bending moment diagrams for the frame shown indicating salient points with their values. [12]



2. a) Define principal axes and principal moment of inertia. [4]
 b) Determine the orientation of principal axes and the principal moment of inertia about centroidal axes of the composite section shown in figure. [12]

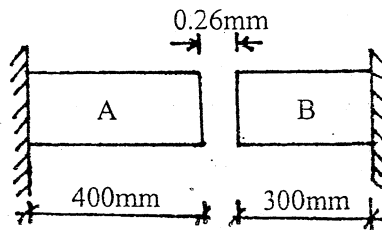


3. The state of stress in a two dimensionally stressed body is as shown in figure below. Determine principal stresses, principal planes and maximum shear. Determine also the normal and tangential stresses on plane BE and verify the results by drawing Mohr's circle. [16]



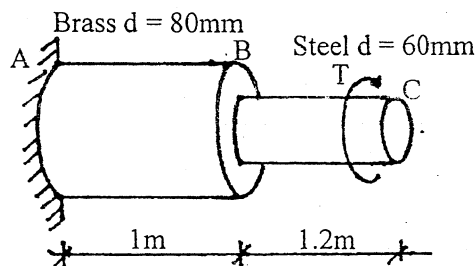
4. a) The gap between bar A of cross-sectional area 1600mm^2 and bar B of cross-sectional area 800mm^2 is 0.26mm at room temperature. What are the stresses induced in the bars if the temperature is raised to 40°C ? Given: $E_A = 2 \times 10^5 \text{ N/mm}^2$, $\alpha_A = 12 \times 10^{-6}/^\circ\text{C}$ and $E_B = 1 \times 10^5 \text{ N/mm}^2$, $\alpha_B = 23 \times 10^{-6}/^\circ\text{C}$.

[8]



- b) The allowable shear stress in brass is 88 N/mm^2 and steel is 110 N/mm^2 . Find the maximum torque 'T' that can be applied at the free end C in the stepped shaft of solid circular section as shown. Find also the total rotation of free end of the shaft with respect to the fixed end, if $G_{\text{brass}} = 400 \text{ kN/mm}^2$ and $G_{\text{steel}} = 80 \text{ kN/mm}^2$.

[8]



5. a) Derive the expression for Euler's critical load for strut with one end fixed and the other hinged. Explain the limitation to the use of this formula.
- b) A cylindrical shell 4m long and 1m diameter is subjected to an internal pressure of 2 N/mm^2 . If the thickness of the shell is 8mm, find the circumferential stress and longitudinal stress. Find also the maximum shear stress and change in volume.
6. a) Derive a relation between Young's modulus, bulk modulus and Poisson's ratio.
- b) An I section beam (symmetrical) has 200mm wide flanges and overall depth 500mm. Each flange is 25mm thick and the web is 20mm thick. Determine (i) the maximum bending moment that should be imposed in the section if the tensile or the compressive stress is not to exceed 40 N/mm^2 (ii) What percentage of the moment is resisted by flanges and web?

[8]

[8]

[6]

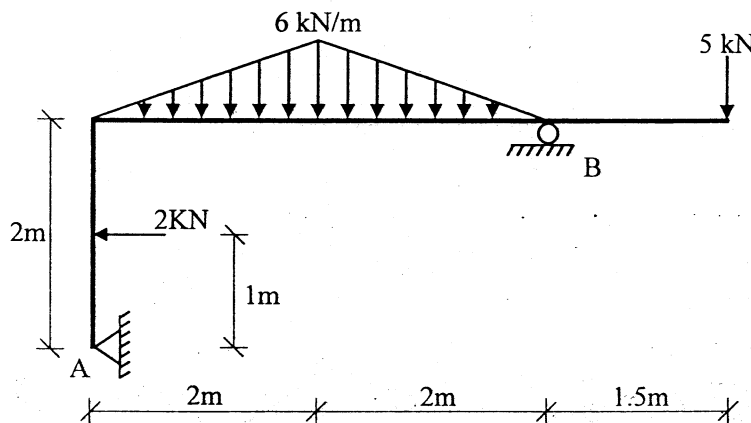
[10]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

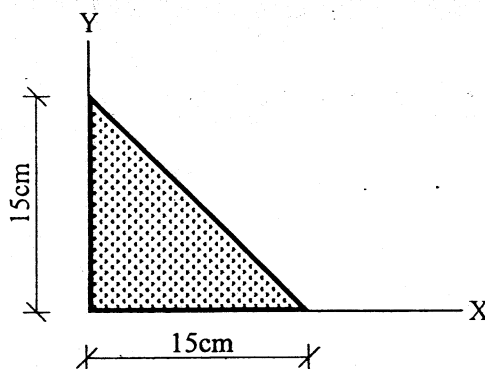
Subject: - Strength of Materials

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Define the plastic moment capacity of beam. [4]
- b) Draw bending moment diagram and locate the maximum and minimum values of BM for the frame which has hinged support at A and other support at B as shown in figure. [12]

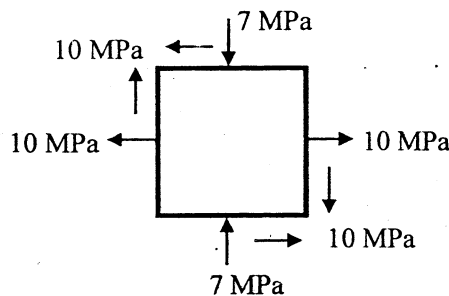


2. a) Calculate principal moment of inertia about the X-Y axes and locate the principal axes of the right angled triangle section with 15cm x 15cm sides. [8]



- b) Prove that the volumetric strain is three times the longitudinal strain for a cube subjected to equal stresses in the three mutually perpendicular directions. [8]
3. a) Define the modulus of elasticity, modulus of rigidity, bulk modulus and Poisson's ratio. [4]

- b) A compound tube consists of steel tube 130mm internal diameter and 10mm thickness and outer brass tube 160mm internal diameter and 10mm thickness. The two tubes are of same length. The combined tube carries a compressive load of 750 kN. Find the stresses and load carried by each of the steel tube and the brass tube and the amount it shortens. Length of each tube is 250mm. $E_{\text{steel}} = 2 \times 10^5 \text{ MPa}$ $E_{\text{brass}} = 1 \times 10^5 \text{ MPa}$. [12]
4. a) Transform the state of stress into the principal stresses and the maximum shearing stresses and the associated normal stresses. Show the results for both cases on properly oriented elements. Tensile stress is 10 MPa, Compressive stress is 7 MPa and shearing stress is 10 MPa. [12]



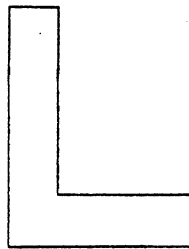
- b) Prove that plastic torque of a solid circular shaft made of elasto-plastic material is 4/3 times the maximum elastic torque of the shaft. [4]
5. a) A thin walled cylindrical pressure vessel of 1m diameter and 8mm thick is filled with water at atmosphere pressure. Additional water is pumped and the internal pressure is raised to 10 N/mm^2 . Find principal stresses, maximum shear stress in the wall of the vessel material, $E = 200,000 \text{ N/mm}^2$, $\nu = 0.3$. For water, $K = 2100 \text{ N/mm}^2$. [8]
- b) Determine the internal and external diameters of a hollow shaft to transmit a power of 30 kW at 240 rpm if the shear stress must not exceed 100 MPa. The outside diameter is to be twice the inside diameter. [8]
6. a) A beam of I section 20cm deep and 10cm wide has flanges 3cm thick and web 2cm thick. It carries a bending moment of 10 kNm at a section. Draw bending stress diagram showing values of maximum stresses in the section of the beam. Calculate the moment carried by the flanges. [8]
- b) A hollow 5m long mild steel tube has the internal diameter of 4cm and thickness of 6mm. It is used as a strut with one end fixed and the other hinged. Find crippling load, crippling stress and the safe compressive load for the member if $E = 2 \times 10^5 \text{ N/mm}^2$ and factor of safety is 3. [8]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

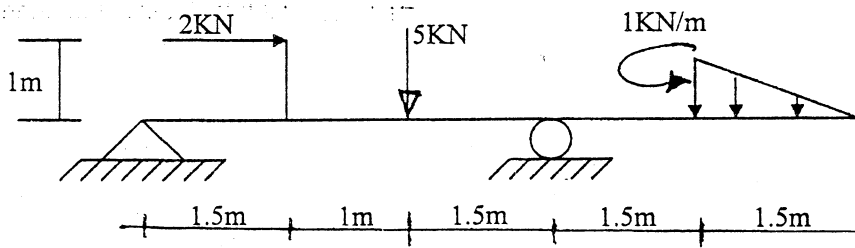
Subject: - Strength of Materials

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Calculate principal moment of inertia and locate the principal axes through the centroid of the area of the L section shown in figure. Total depth of the web is 20cm. Total breadth of the flange is 15cm and thickness of the web and flange is 5cm. [16]



2. Calculate maximum positive and maximum negative bending moment and draw thrust diagram and bending moment diagram for the beam as shown in the figure. [16]



3. a) Derive the relationship among Poisson's ratio, Young's modulus and modulus of rigidity. [6]

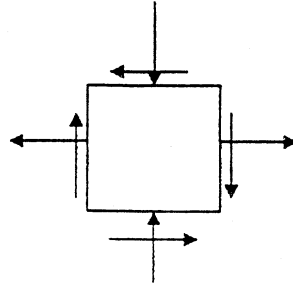
- b) A compound tube consists of a steel tube 15cm internal diameter and 1cm thickness and an outer brass tube of 17cm internal diameter and 1cm thickness. Two tubes are of the same length. The compound tube carries an axial load of 1000 kN. Find the stresses and the load carried by each tube. [10]

Take $E_{\text{steel}} = 2 \times 10^7 \text{ N/cm}^2$ and $E_{\text{brass}} = 1 \times 10^7 \text{ N/cm}^2$

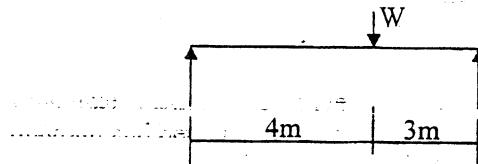
4. a) Prove $\sigma_x + \sigma_y = \sigma_1 + \sigma_2$ [6]

[Sum of normal stresses is equal to sum of principal stresses]

- b) A plane element is subjected to the stresses as shown in figure. Determine analytically or graphically, the principal stresses and their directions. Tensile stress is 50 MPa, Compressive stress is 20 MPa, Shear stress is 30 MPa. [10]



5. A timber beam 160mm wide and 300mm deep is simply supported on a span of 5m. It carries a uniformly distributed load of 1 kN/m run over the whole span and three equal concentrated loads W each placed at mid span and quarter span points. If the stress in timber is not to exceed 10 N/mm^2 , find value of W . [16]
6. a) Find deflection of the beam shown below at middle of the span. Given that: [8]
 Modulus of Elasticity of the material is 20000 MPa
 Section of the beam is 150mm \times 250mm
 Point Load $W = 10 \text{ kN}$



- b) A steel spherical pressure vessel of radius 1000mm having wall thickness of 10mm is filled with a fluid and the internal pressure is raised to 1 MPa. Calculate circumferential stresses and change in diameter. Take $E = 200 \text{ GPa}$ and $\nu = 0.25$. [8]
