TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

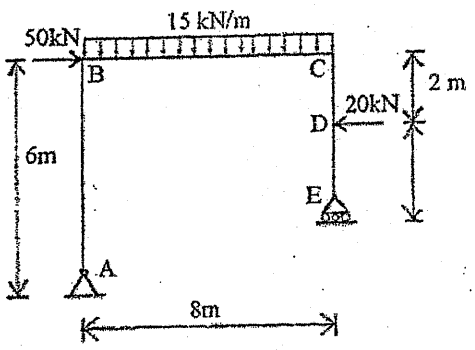
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(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.*

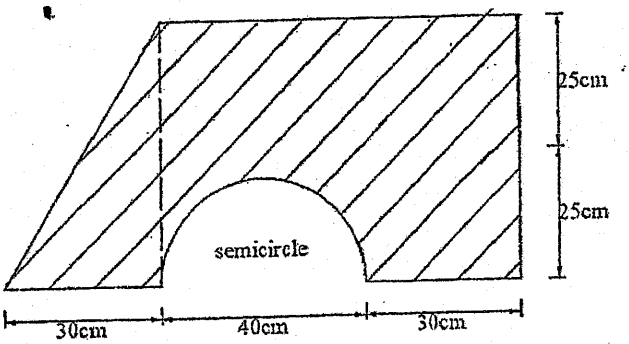
1. a) Define point of contraflexure. Derive the relationship between rate of loading, Shear force and Bending moment. [2+4]

   b) Draw axial force shear force and bending moment diagram for a given loaded frame. Also write the salient features. [10]

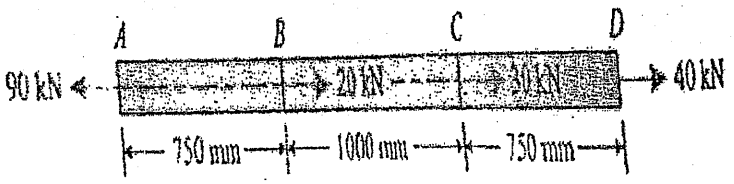


2. a) Define principal moment of inertias and principal axes. [2]

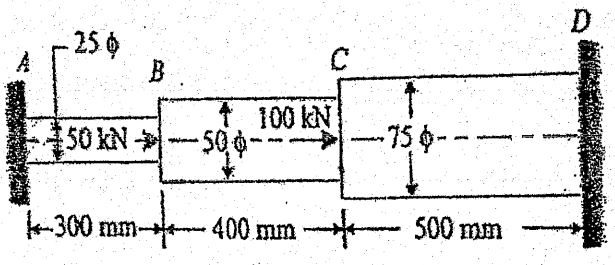
   b) Determine principal moment of inertias and principal axes passing through the centroid for the following shaded area. [10]



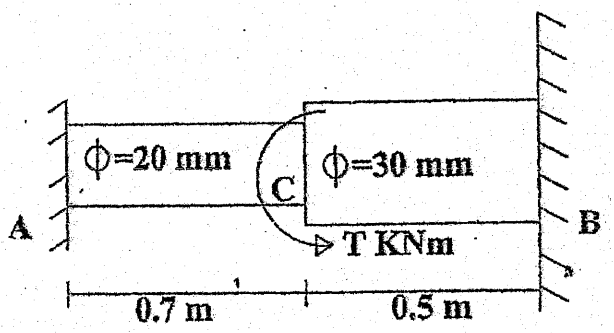
3. a) Find the total elongation in the bar. Take E for the material as the 200Gpa. A Steel bar of 600 mm^2 cross-sectional area is carrying loads as shown in the figure given below. [6]



b) A Circular bar ABCD, rigidly fixed at A and D is subjected to axial loads of 50 KN and 100 KN at B and C as shown in the figure. Find the loads shared by each part of the bar and displacements of the points B and C. Take E for the steel as 200Gpa. [10]



4. Direct stresses of 100 MPa in tension and 60 MPa in compression are applied to an elastic material at a certain point on planes right angles to each other. If the maximum stress in not to exceed 150 MPa, to what shearing stress can the material be subjected at the point? What is then the maximum shearing stress in the material? Also find the magnitude of the principal stresses and its planes. [8]
5. A thin cylindrical shell is 5m long and has 1m internal diameter and 20mm metal thickness. Calculate the maximum intensity of shear stress, longitudinal stress and circumferential stress induced, if subjected to an internal pressure of 5 N/mm2. Also calculate change in diameter, length and volume of the shell. Take E = 200 GPa and poisons ratio = 0.3. [6]
6. A steel shaft is connected to fixed supports as shown in figure. Limiting shear stress in the material is 50 MPa. Determine the maximum torque that can be applied at joint C. What is the shear stress at A? [8]



7. A simply supported beam of span 10m is to carry uniformly distributed load 20 KN/m over the entire span and a point load 50 KN at its center. Determine the dimension of beam, if the beam is rectangular in cross section and the maximum permissible stress in bending tension and compression are 120 N/mm^2 and 100 N/mm^2 respectively. Take depth of beam two times its breadth. [8]
8. Derive the Eulers formula for critical load for a strut with both end hinged. [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

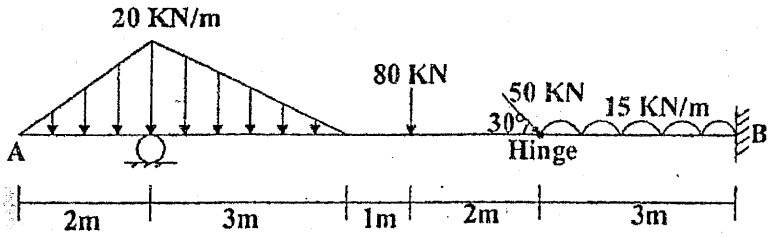
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(CE 502)*

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

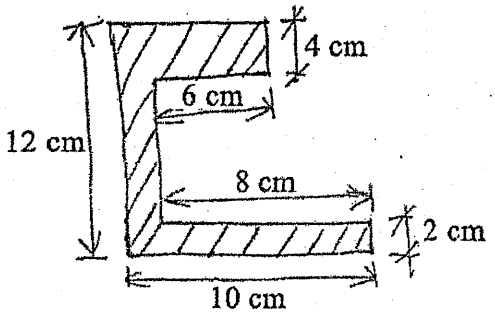
1. a) Briefly explain the properties of internal hinge. What do you understand by point of contraflexure? [2+2]

   b) Draw AFD, SFD and BMD for following beam. Also indicate the silent features. [12]



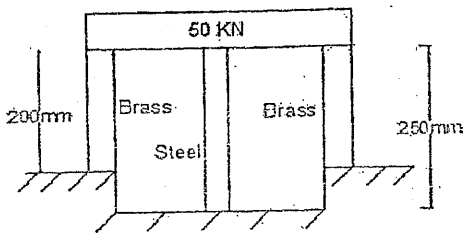
2. a) Define product moment of inertia. [2]

   b) Calculate the principal moments of inertia of the section given in figure and their orientation. Assume horizontal and vertical axes to be the given x and y axes and the bottom left corner of the section to be the origin for the purpose of your calculation. [10]

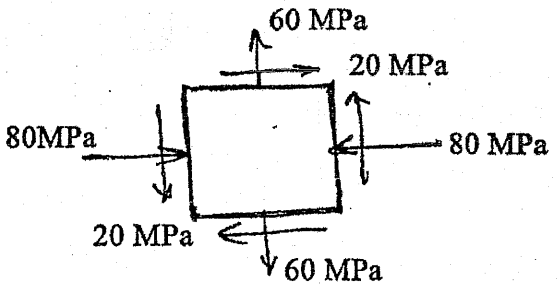


3. a) Determine the expression for elongation in bar having uniformly tapering circular section subjected to tensile load P. [6]

   b) A steel rod of cross sectional area 1000mm^2 and two brass rod each of cross sectional area 800mm^2 together support the load of 50KN. Calculate the stresses in the rod. Take E for steel as 200GPa and E for brass as 100 GPa. [10]



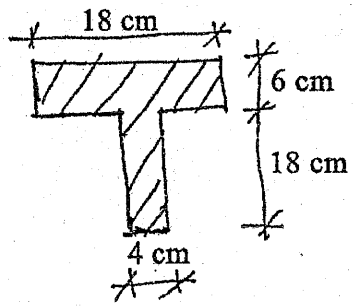
4. a) The state of stress in a two dimensional stress system is shown in figure. Determine the principal stresses and their direction, maximum shear and associated normal stress. [8]



b) Prove that the hollow shaft of same material, same weight and same length is more stronger than the solid shaft in case of torque transmission. [8]

5. a) Derive Euler critical buckling load formula for a column having one end fixed and the other end free. Discuss the limitations of Euler buckling formula. [6]

b) A 3.0m long cantilever beam having self-weight 1.5 kN/m is subjected to a downwards point load of 'P' kN at the free end. Determine the value of 'P' and the moment of resistance of the beam. Take permissible bending stress in tension and compression as 150MPa. The cross section is shown in figure. [8]



6. A cylindrical shell of 260mm external diameter 2.5 m length and 5mm wall thickness is subjected to internal pressure of 1.60 MPa. Calculate the change in diameter, length and volume of the cylinder if the cylinder has a longitudinal joint (85% efficiency) and circumferential joint (65% efficiency). Take Young's modulus = 200GPa and Poisson's ratio = 0.3 [6]

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TRIBHUVAN UNIVERSITY
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Examination Control Division
2076 Ashwin

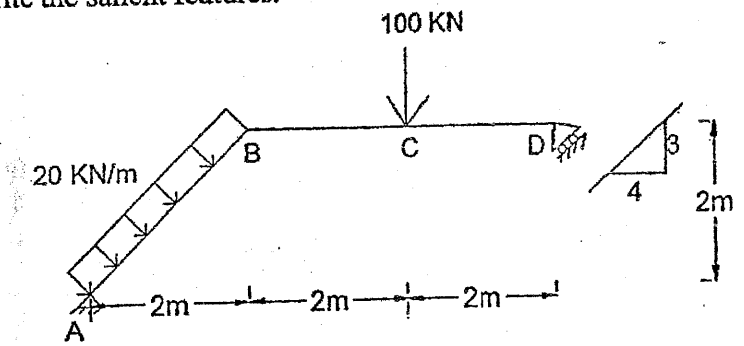
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Material *(CE 502)*

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

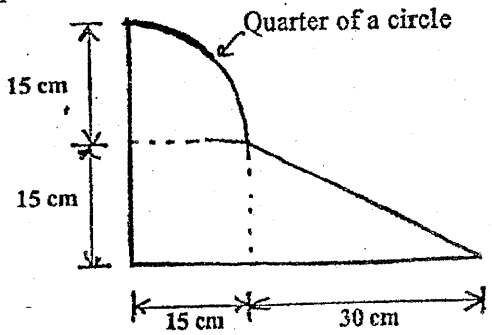
1. a) State the principle of Superposition. Explain the stepwise procedure for the determination of bending moment of the beam using the principle of superposition. [2+2]

   b) Draw axial force, shear force and bending moment diagram for a given loaded frame. Also write the salient features. [12]



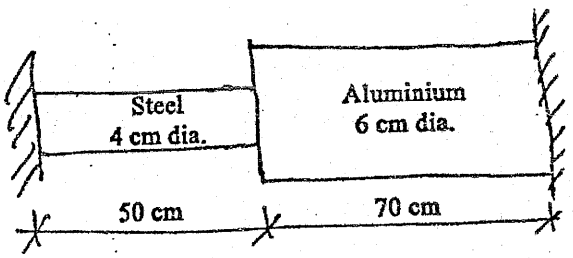
2. a) What is radius of gyration? [2]

   b) Determine principal moment of inertia about the centroidal axis of following figure. [10]

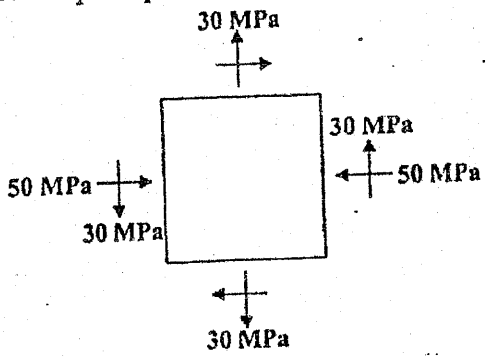


3. a) In an experiment, a bar of 30mm diameter is subjected to a pull of 60 KN. The measured extension on guage length of 200 mm is 0.09 mm and the change in the diameter is 0.0039mm. Calculate the values of Poisson's ratio and three elastic moduli. [6]

   b) A composite bar made up of steel and aluminum is rigidly fixed between two supports as shown in figure. The two bars are free of stress at initial temperature of 25°C. Find the stresses in the two bars when the temperature increases to 50°C *if*,
   i) The support are unyielding
   ii) The supports move away from each other by 0.1 mm.
   [Given: E_s=200 GPa, E_A=70 GPa, α_S=13×10^{-6}/°C, α_A=23.1×10^{-6}/°C] [10]



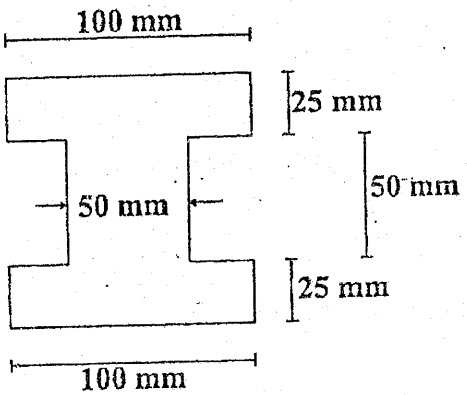
4. a) Determine the normal and shearing stress on the inclined plane at the angle of 40° to the vertical. Also calculate principal stresses and their planes. [8]



b) A 1 m long hollow cylindrical shaft is to be designed to transmit a power of 1670 KW at a rotational speed of 4500 rpm. The outer diameter is to be 1.75 times the inner diameter. The maximum shear stress of the material is to be limited to 210 MPa and the angle of twist is not to exceed 0.5 degrees. Determine the size of the shaft. Assume maximum torque is 30% greater than the average torque. shear modulus of material is 25.5 GPa. [8]

5. a) Derive the Euler's formula for critical load for a strut with one end fixed another hinged. Also mention the limitation for using this formula. [6]

b) A simply supported beam of span 10 m, subjected to UDL w throughout the length. If permissible bending stress in tension and compression are 150 MPa and 180 MPa respectively. Calculate Moment of resistance and value of UDL by assuming the I-section as shown in figure. [8]



6. A cylindrical shell of length 4m internal diameter 300mm and wall thickness of 12mm is initially filled with water at atmospheric pressure. Find the increase in volume if the water is pumped to increase the internal pressure to $6N/mm^2$. Take $E=2.10\times10^5 N/mm^2$, v=0.3 and $K=2100\ N/mm^2$. [6]

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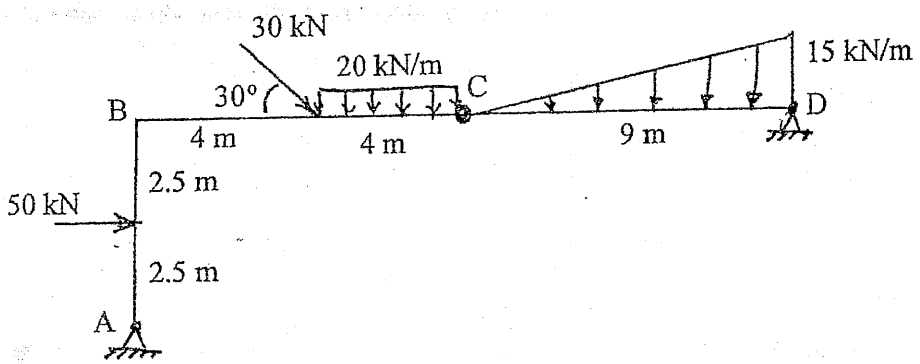
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

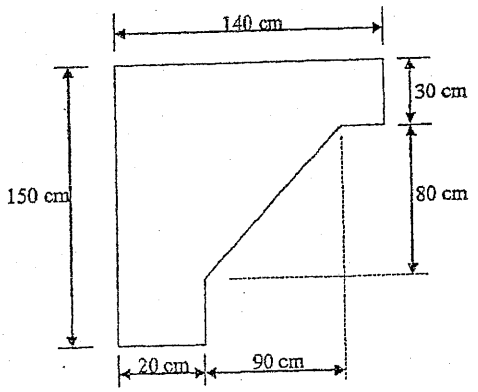
Subject: - Strength of Materials *(CE502)*

- ✓ 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.*

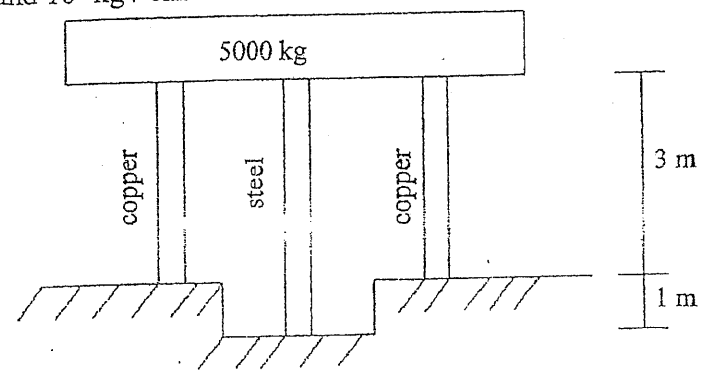
1. Draw axial force, shear force and bending moment diagram for the given frame. Indicate numerical values at salient points. [16]



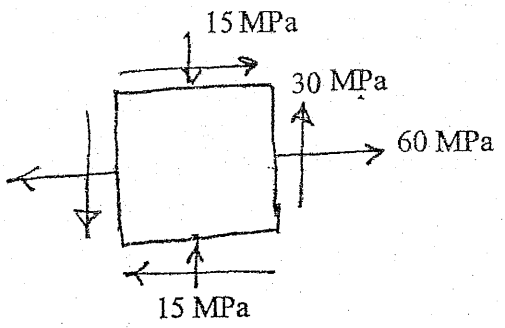
2. a) What do you understand by principle moment of inertia and principal axis? [4]
   b) Determine the principle moment of inertia of the given figure. [10]



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 2×10^6 kg/cm^2 and 10^6 kg / cm^2. [6+6]



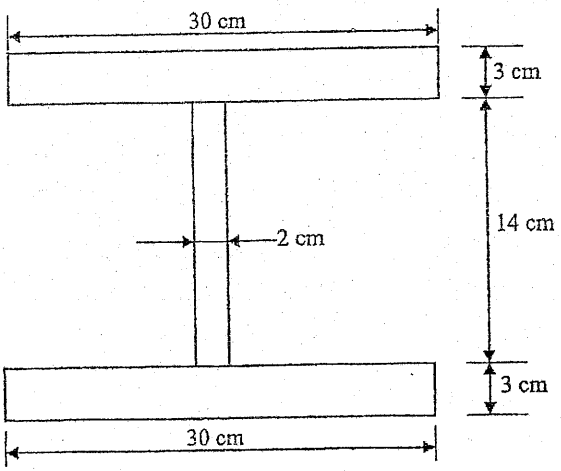
4. a) For the state of plane stress shown in figure below determine (i) the principal planes (ii) principal stresses (iii) the maximum shearing stress and the corresponding normal stress. [8]



b) Show that hollow shaft is more strong than solid shaft when material, weight and length are same. [8]

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. [8]

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]



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

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Exam.	Back		
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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 <u>All</u> questions.*
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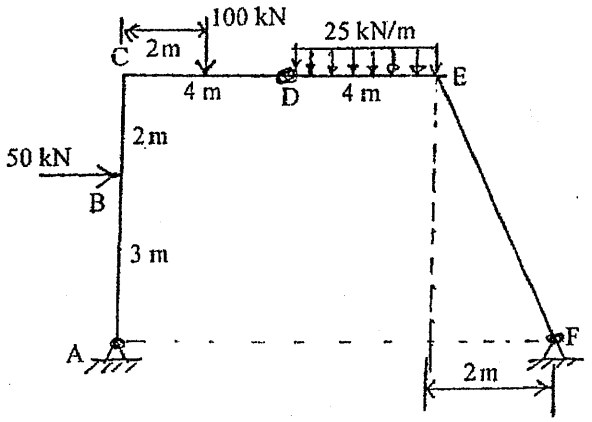
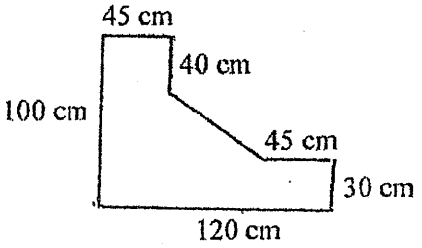
1. Draw axial force, shear force and bending moment diagrams for the frame. Indicate numerical values at salient points. [16]



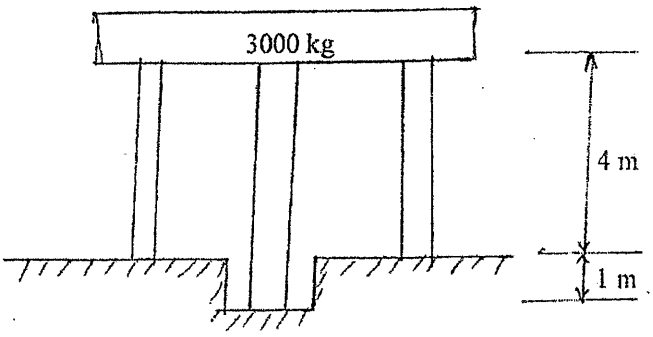
2. a) What is product of inertia? [2]

   b) Determine principal moment of inertia of the given figure below about the axes passing through the centroid. [10]



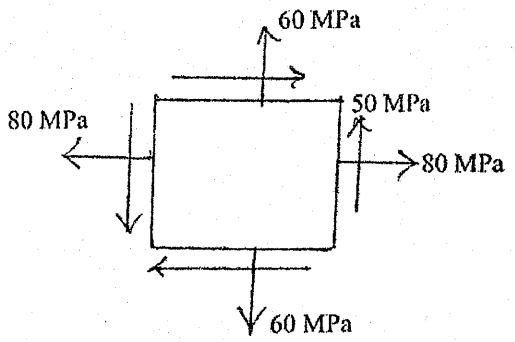
3. a) Derive the expression for the total elongation of a uniform bar of length L and cross section area A under its self weight. [5]

   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 $E_s = 2 \times 10^6$ kg/cm^2 $E_c = 10^6$ kg/cm^2 [8]



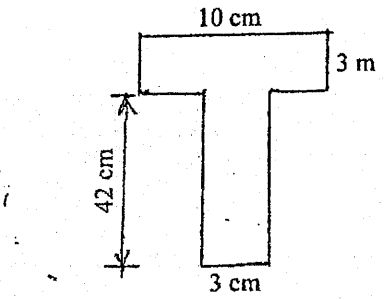
4. a) For the state of plane stress shown in figure below determine. [8]

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. $\frac{T}{J} = \frac{\tau_s}{R} = \frac{G\varphi}{L}$ [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]

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

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07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
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2073 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 <u>All</u> questions.*
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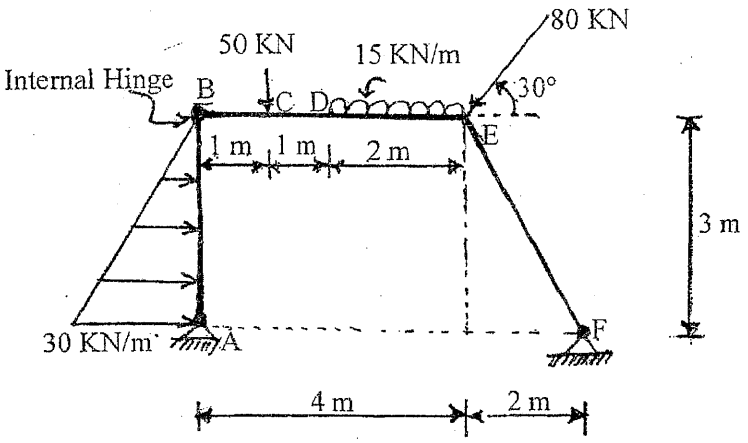
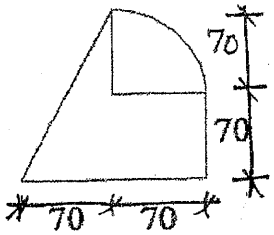
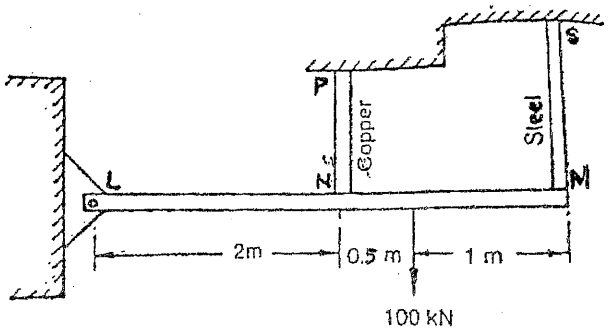
1. Draw axial force, shear force and bending moment diagrams for the given frame. Indicate numerical values at salient points. [16]



2. Define principal moment of inertia and principal axes. Determine the principal axes and principal moment of inertia of the given section. [2+10]

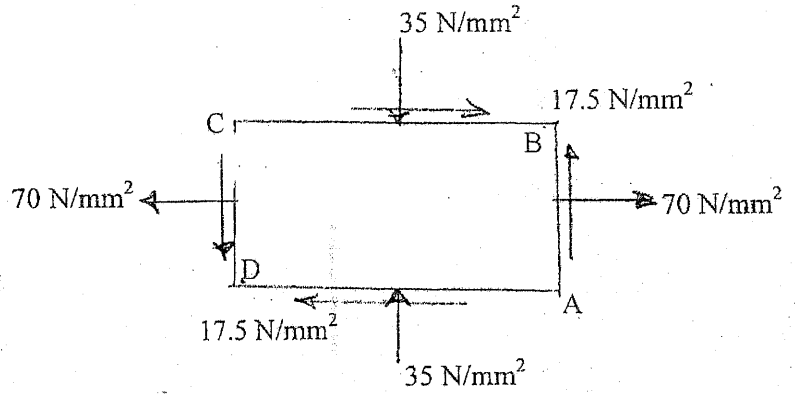


3. a) A rigid bar 3.5 m in length is hinged at L and is supported by steel rod SM and copper rod PN as shown in figure below. If the length of SM and PN are 1 m and 0.75 m and cross-sectional area 2 cm^2 and 4 cm^2 respectively, determine stress in each of the rods and elongation of the steel rod if a load of 100 KN is applied on the bar at a distance of 2.5 meters from the hinge. [8]
Take $E_C = 1.2\times10^8$ KN/m^2 and $E_S = 2\times10^8$ KN/m^2
The bar is horizontal prior to the application of the load.



b) Sketch the stress and strain diagram for mild steel as per tensile test and describe the characteristics points. [4]

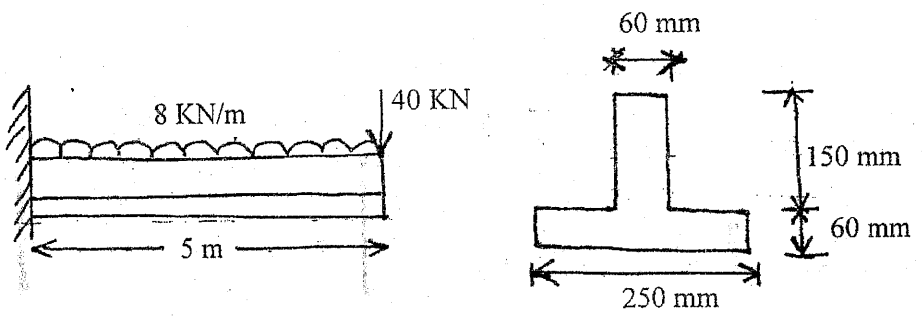
4. a) Two planes AB and BC which are at right angles, carry shear stresses of intensity 17.5 N/mm^2 while these planes also carry a tensile stress 70 N/mm^2 and compressive stress of 35 N/mm^2 respectively. Determine the principles planes and principal stresses and also determine maximum shear stress and the plane at which it acts. [8]



b) A copper plate vessel in the shape of thin spherical shell 50 cm radius and 1 cm shell thickness is completely filled with a fluid at atmospheric pressure. Additional fluid is then pumped till the pressure increase by 10 MN/m^2. Find the volume of this additional fluid, given that the poisson's ratio is 0.26 and modulus of elasticity 100 GN/m^2 for the shell material. [8]

5. a) A hollow cylinder shaft is required to transfer 500 KW at 120 rpm. The maximum torque is likely to exceed the mean torque by 25%. If the shear is not to exceed 60 MN/m^2 and the twist not to exceed 2° for a length of 4 m, find the minimum external diameter of the shaft to satisfy above conditions. Take diameter ratio to be 2/5 and G = 80 GN/m^2. [8]

b) A Cantilever beam 5 m in length is subjected to load as shown in figure below. Determine the value of bending stress 30 mm below from the top surface of the beam. [8]



6. Classify the column based on their nature of failure pattern. Derive the expression for the Euler's formula for crippling load on a column of length I with both ends hinged condition. [3+5]

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Subject: - Strength of Materials *(CE502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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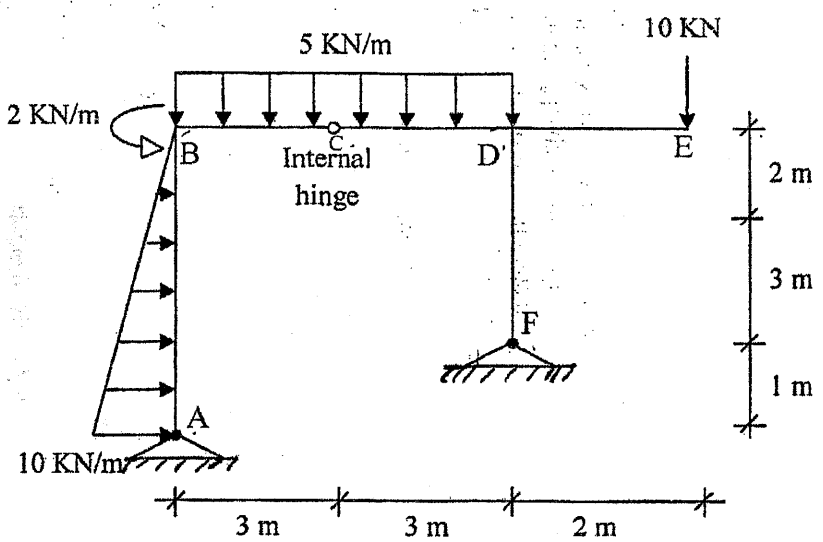
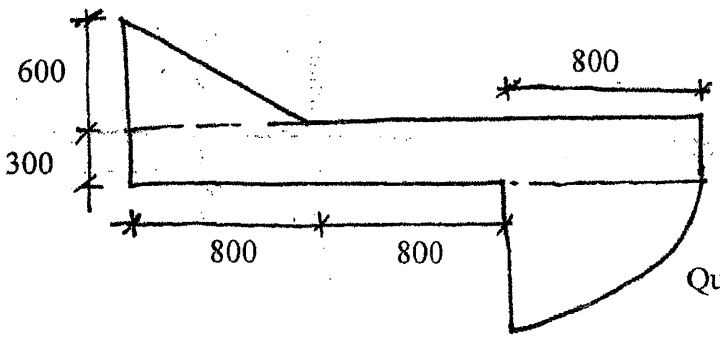
- ✓ *Assume suitable data if necessary.*

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]

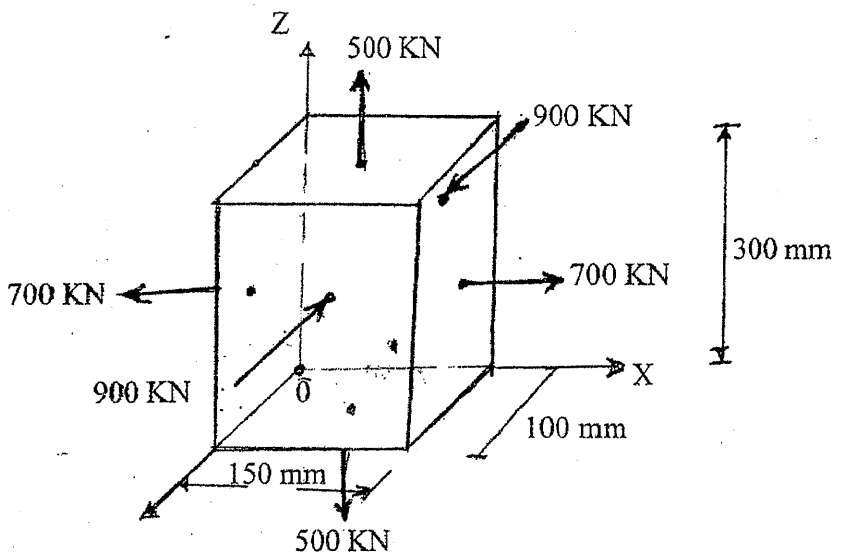


2. Find the principal moments of inertia and directions of principal axes for the section as shown in figure below. [12]



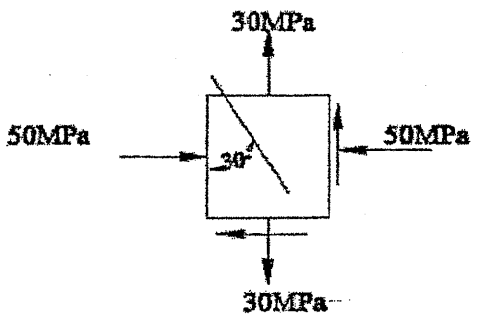
Quarter Circle (in mm)

3. a) A block of steel 300 mm×150 mm× 100 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 GN/m^2 and poisson's ratio (σ) = 0.30. [8]



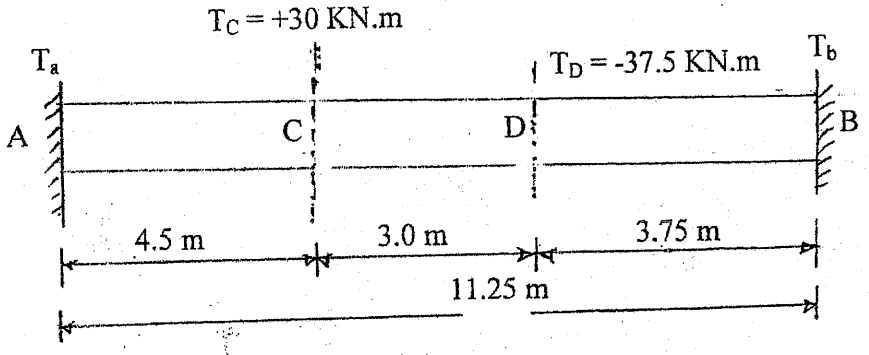
b) What is the stress concentration? What effect is produced in brittle material due to stress concentration? [4]

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/mm^2. [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]

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

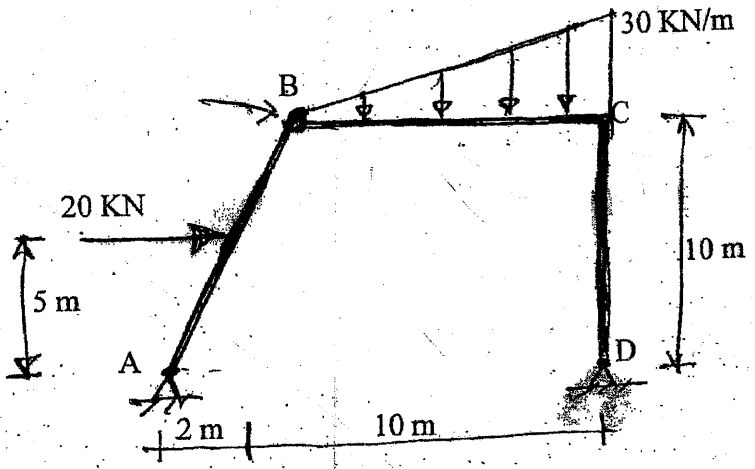
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(CE502)*

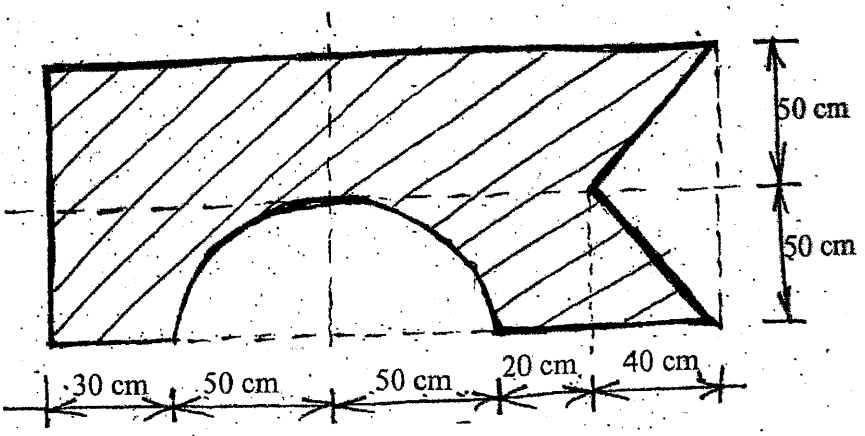
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]

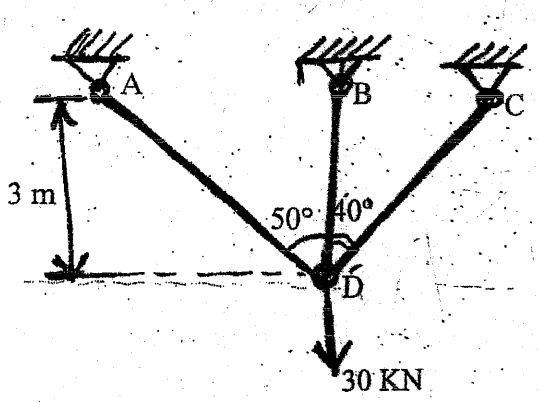


2. a) Obtain the principle moment of inertia and draw principle axes for the plane figure given below. [8]



   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 $2\times10^5 N/mm^2$. [8]



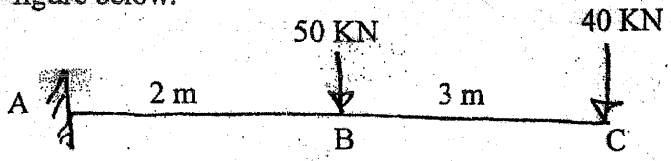
b) The principle stresses at a point in a bar are 100 MPa tensile and 40 MPa compressive. Find the normal stress shears and resultant stress on a plane inclined at 60° to the axis of major principal stress. [8]

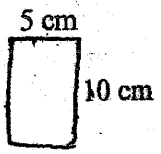
4. a) A water pipe 500 mm internal diameter contains water at a pressure head 100 m. If the unit weight of water is 10 KN/m^3 and allowable stress of pipe material is 20 N/mm^2. Calculate the thickness of the pipe. [8]

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. $G = 10^5 N/mm^2$. [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]





$E = 200\ KN/mm^2$

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07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

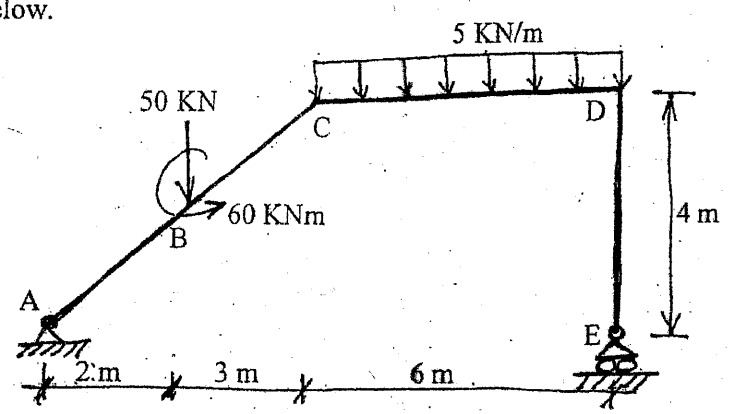
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(CE502)*

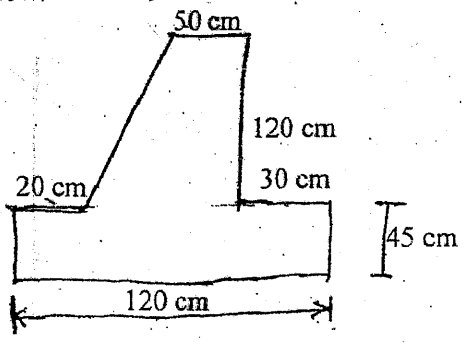
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) 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]

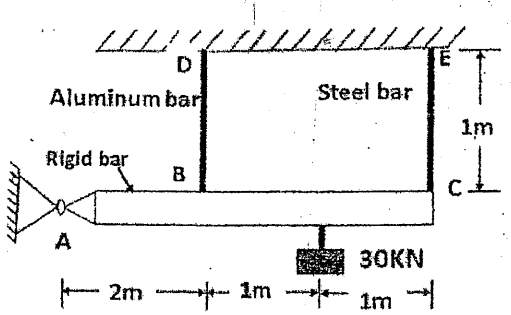


2. a) Determine principal moment of inertia and draw orientation of principal axes of the figure shown in figure below. [12]



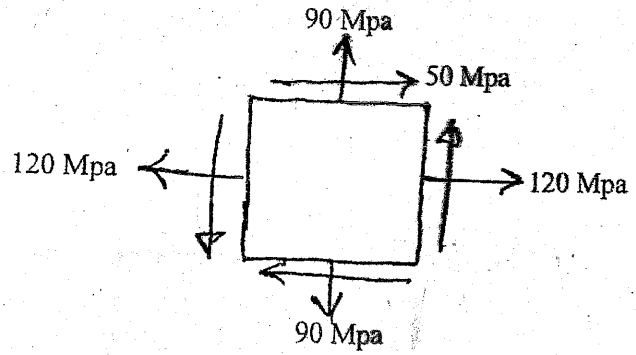
   b) Define principle moment inertia. [4]

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 mm^2, A_{st} = 2 mm^2, E_{al}= 72 KN/m^2, E_{st} = 210 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. $G = 10^5$ 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]

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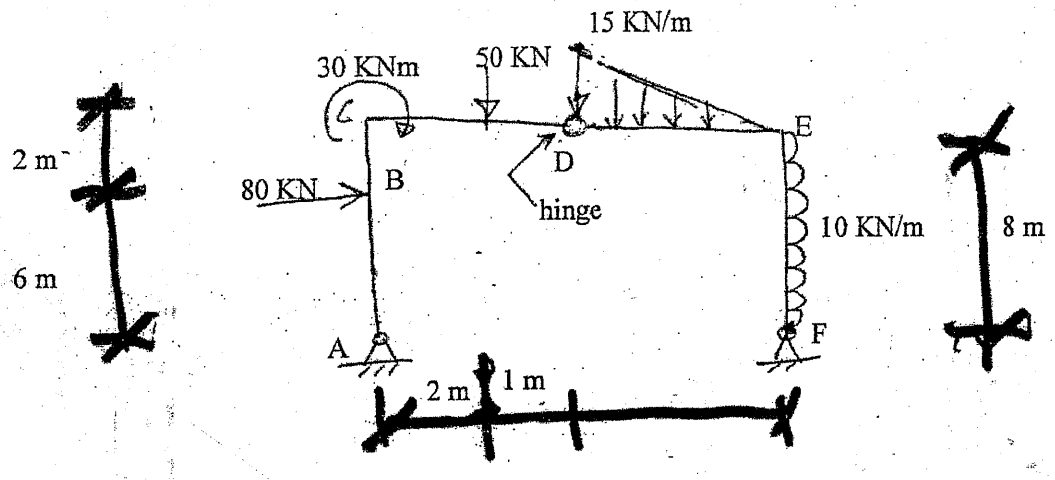
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

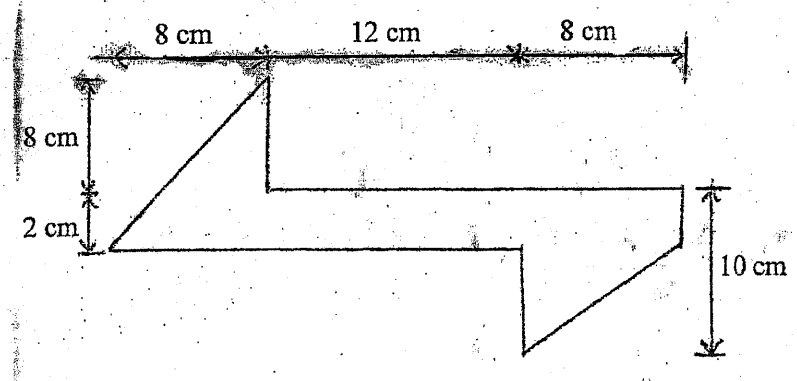
Subject: - Strength of Materials *(CE502)*

- ✓ 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.*

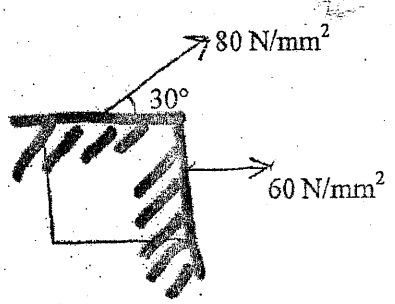
1. Draw axial force, shear force and bending moment diagram of the frame loaded as shown in the figure below: [16]



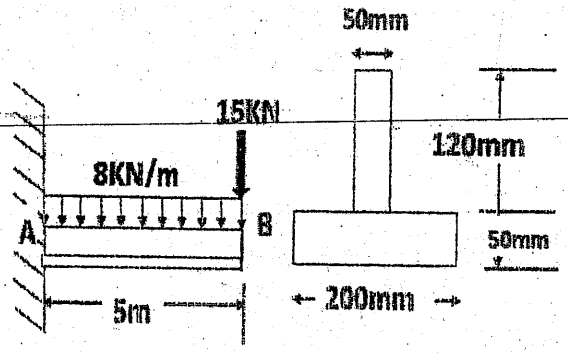
2. Determine the orientation of the principal axes and the moment of inertia about the centroidal axes of composite section as shown. [12]



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 $E = 10^6$ 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]

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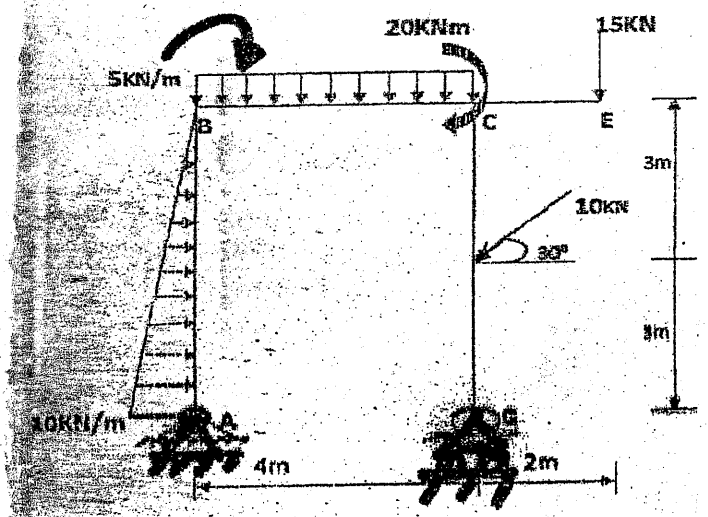
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

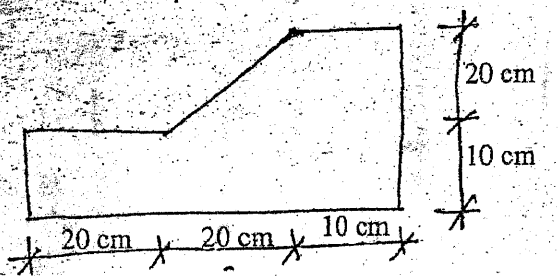
Subject: - Strength of Materials *(CE502)*

- ✓ 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.*

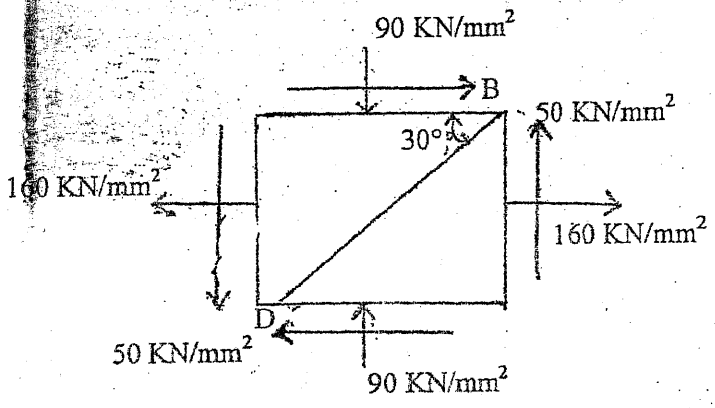
1. Draw axial force, shear force and bending moment diagram of given loaded frame. Also show the salient feature. [16]



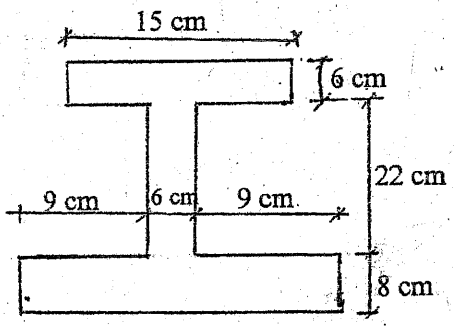
2. Obtain the principle moment of inertia and draw the orientation of principal axes in a sketch. [12]



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



4. A horizontal beam 4 m long is simply supported at ends carries a UDL 0 KN/m over the whole span along with a concentrated load of 40 KN at its mid spar ie Beam is of I-section of overall depth 36cm. Find the maximum Tensile and Compre e stress. [8]

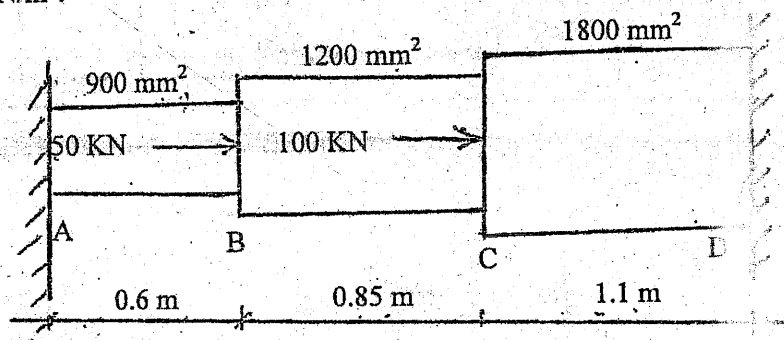


5. Derive the expression for Euler's Critical load for Strut with one en d and other hinged. Also explain the limitations to the use of this formula. [8]

6. A hollow steel shaft, of 6 cm and 4 cm outer and inner diameters re ively, rotates with a speed of 250 RPM. Permissible shearing stress for the material 0 MN/m^2 and maximum torque is 1.2 times the mean torque. For the shaft obtain; (a) P er transmitted by the shaft (b) Strength of hollow shaft. [8]

7. Prove that the longitudinal stress at thin cylinders is equal to the half c ircumferential stress at that thin cylinders. [8]

8. A bar ABCD fixed at A and D is subjected to axial forces as shown figure below. Determine the forces in each portion of the bar and displacement of poi B and C. Take E = 210 GN/m^2. [12]



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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

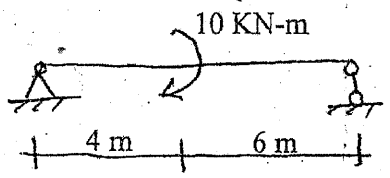
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(CE502)*

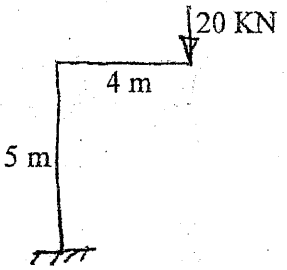
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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

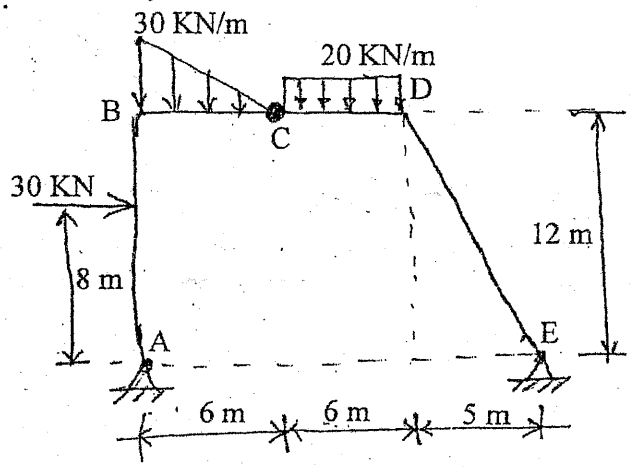
i)



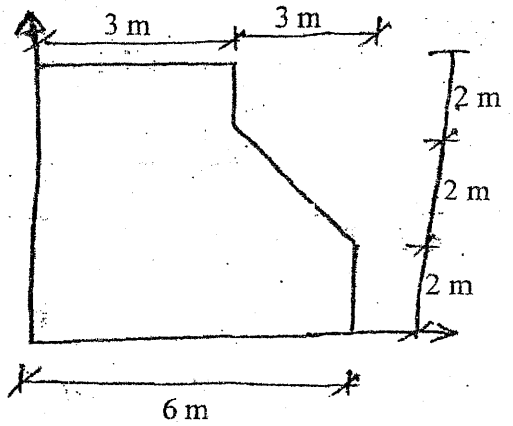
ii)



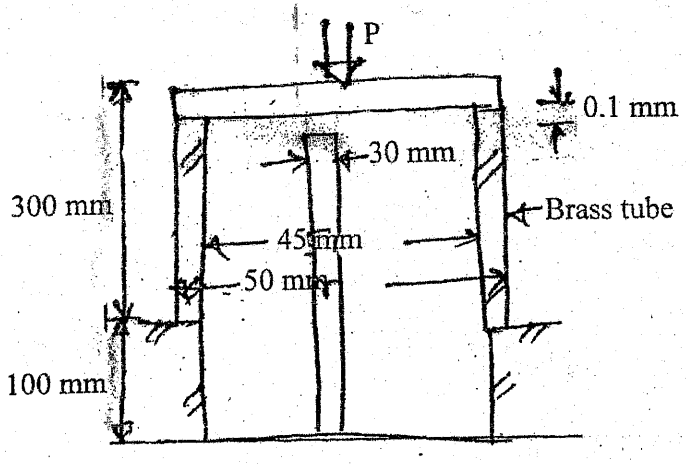
b) Draw axial force, shear force and bending moment diagram for the frame shown in figure below. [12]



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]



3. Determine the maximum permissible load if the compressive stress in the rod is not to exceed 110 MPa and that in the tube is not to exceed 80 MPa. Take E_s = 200 Gpa and E_b = 100 GPa.



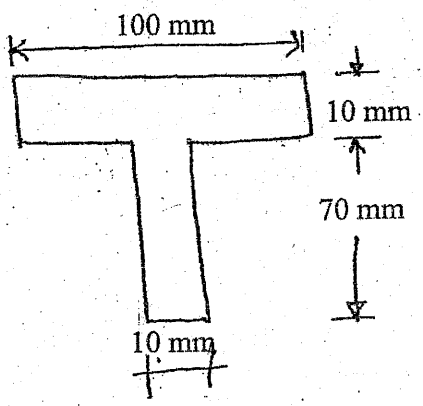
4. The intensity of the resultant stress on a certain plane is 60 N/mm^2 (tensile) and is inclined at an 30° to the normal of the plane. The stress on a plane right angle to this plane has a normal tensile component intensity of 40N/mm^2. [12]
   Find: (a) The resultant stress in the second plane
   (b) The principal plane and principal stresses
   (c) The plane of maximum shear and its intensity

5. Derive a ratio for thickness of cylindrical portion to spherical portion for a cylindrical vessel with hemispherical ends. [6]

6. A solid bar of metal 50 mm diameter and 200 mm length is tested under tension. A 10 KN load produces an elongation of 0.0051 mm. The same bar undergoes θ twist of 1° when subjected to a torque of 4 KNm. Determine Young's modulus and Poisson's ratio of the shaft material. [6]

7. What is pure bending? Prove that $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$, where the symbols have their usual meanings. [1+7]

8. Calculate the bucking load for a strut of T section shown in figure below. The strut is 3m long and hinged at both ends. Take E = 200 GN/m^2 [8]



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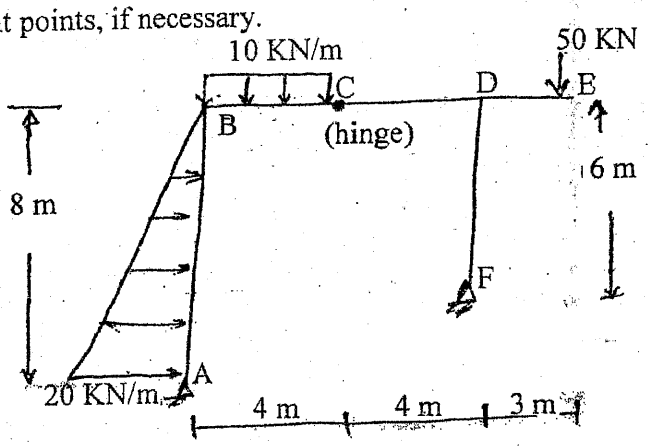
04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

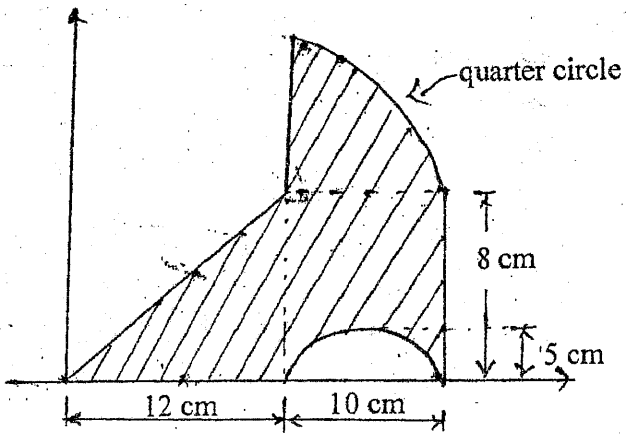
Subject: - Strength of Materials *(CE502)*

- ✓ 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.*

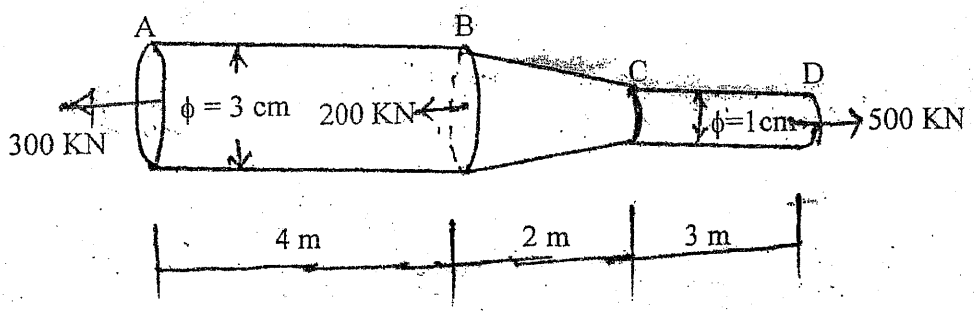
1. Draw bending moment; shear force and axial force and diagrams for the given frame. Also indicate salient points, if necessary. [16]



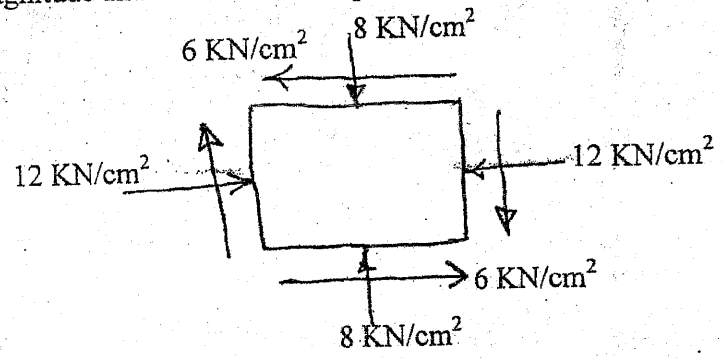
2. Calculate the principal moment of inertia, direction and position for the given shaded figure. [12]



3. a) Derive a relation between Young's modulus and Bulk modulus. [8]
   b) Determine the elongation of the bar as shown in figure. Take $E = 2 \times 10^5 N/mm^2$ [8]



4. Figure below shows the state of stress of a point in a two dimensional stressed body. Determine the magnitude and direction of the principle stresses. [8]



5. A simply supported timber joist of 5 m span has to carry uniformly distributed load 6 KN/m over its whole span and a point load of 15 KN at its center. Determine the dimensions of the joist if the maximum permissible stress in bending is 10 N/mm^2. Take the depth of the joist is twice of its breadth. [8]

6. Prove that the longitudinal stress at thin cylinders is equal to the half of circumferential stress at that thin cylinder. [6]

7. A hollow steel shaft 3 m long must transmit 150 KW of power at 150 rpm. The total angle of twist in this length should not exceed 2.5 degrees and allowable shearing stress is 60 MPa. Determine the inside and outside diameters of the shafts if G = 85 Gpa. [6]

8. Derive an expression for Euler critical load for a strut with one end fixed and another hinged. Explain the limitations to the use of this formula. [8]

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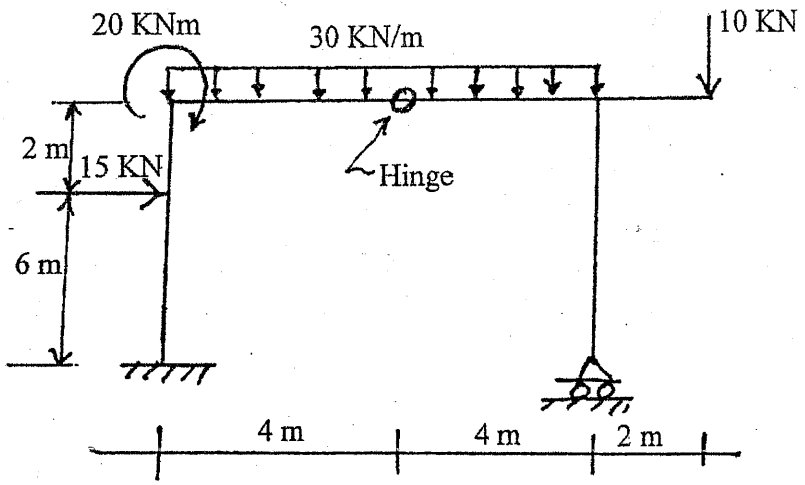
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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)*

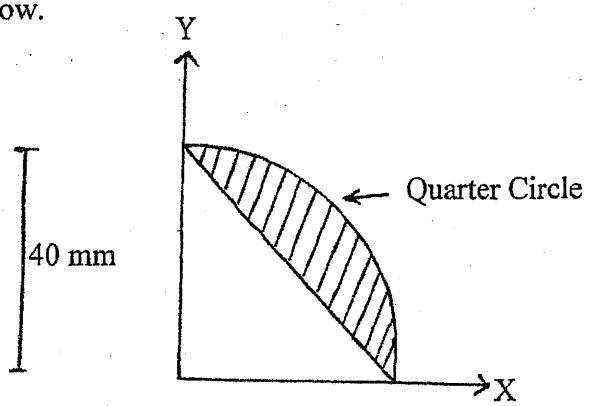
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Determine the reactions at supports, draw free body diagrams of each members and plot axial force, shearing force and bending moment diagram for the frame loaded as shown in figure below. [16]



2. a) "The moment of inertia forms the basis of dynamics of rigid bodies and strength of material". Explain the statement. [4]

   b) Determine principal moment of inertia and their orientation of the shaded area as shown in figure below. [8]



3. a) Explain with neat sketch a typical stress-strain diagram for characteristics of mild steel. Also describe stress concentrations in the strained body. [5+3]

   b) A steel bar 2.5 cm diameter and 25 cm long was subjected to a tension test. On applying a tensile load of 25 KN the elongation was found to be 0.005 cm and decrease in diameter was 0.00025 cm. Calculate the value of: [8]
      i) Modulus of elasticity
      ii) Poisson's ratio
      iii) Change in volume
      iv) Shear modulus

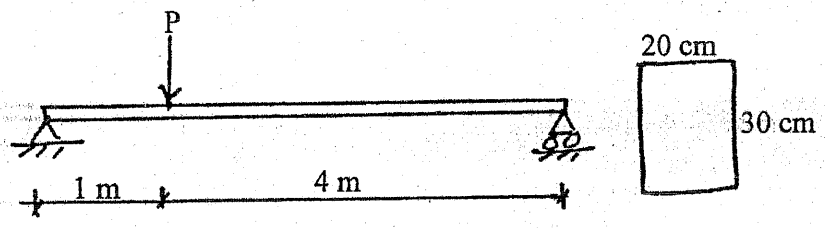
4. An element in a stressed material has a tensile stress of 500 MN/m^2 and a compressive stress of 350 MN/m^2 acting on two mutually perpendicular planes and equal shear stresses of 100 MN/m^2 on these planes. Find principal stresses and plot Mohr's circle to verify your results. [8]

5. Determine change in diameter and volumetric strain for the cylindrical shell of 2 m external diameter and 5 m length, subjected to an internal pressure of 350 N/cm^2. The Principle stress is not to exceed 16 KN/cm^2. Assume E = 200 GPa and poisson's ratio 0.25. [6]

6. A hollow shaft of external diameter 150 mm an internal diameter 100 mm is 3.5 m long. If the permissible shear stress is limited to 50 MN/m^2, how much torque can be transmitted and what will be the maximum angle of twist? G = 100 GN/m^2 [6]

7. a) What are the assumptions in pure bending? Explain. [2]

   b) Determine the maximum value of P in the simply supported beam shown in figure below if the bending stress is limited 12000 KN/m^2. [6]



8. a) Derive an expression for the equivalent length of a strut when its one end is fixed and other hinged. [4]

   b) What do you understand by term buckling in the column theory? Also explain the limitations of Euler's formula for the analysis of long column. [4]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

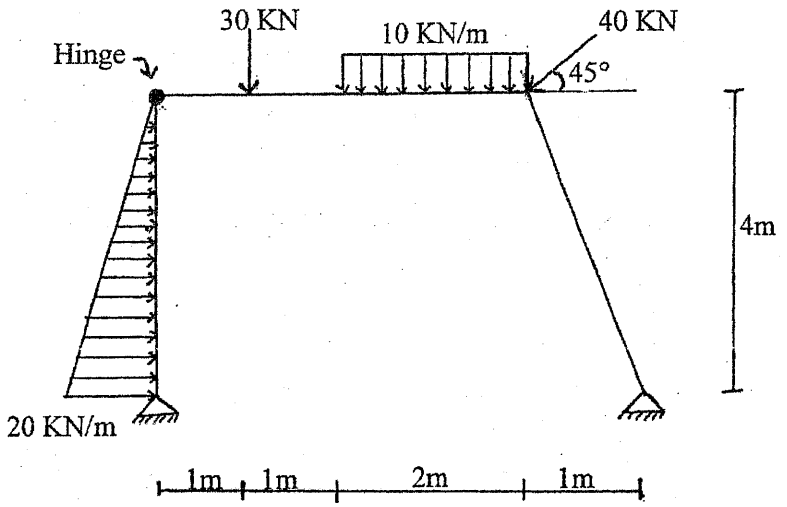
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Material *(CE502)*

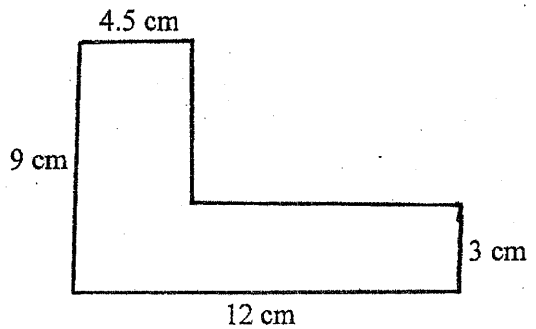
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]



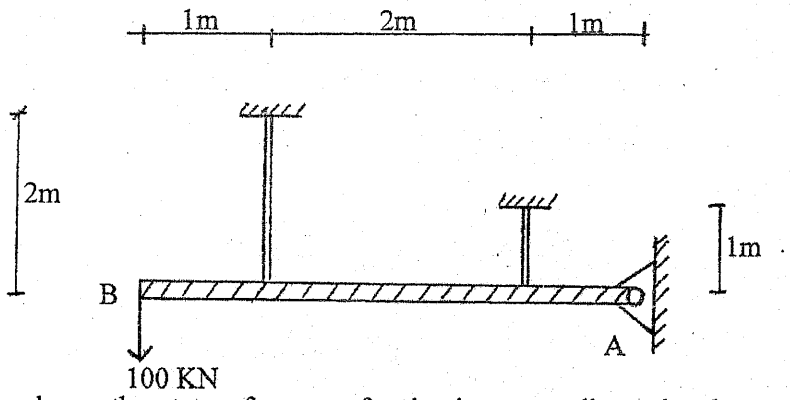
2. Determine the principal moment of inertia and orientation of principal axes for the composite section shown in figure below about its centroid. [12]



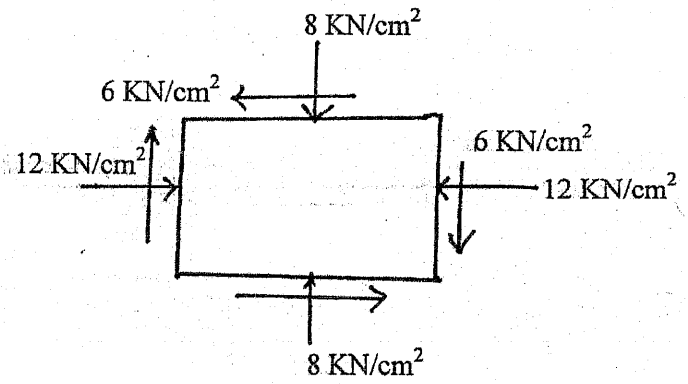
3. a) How is offset method defined in drawing stress-strain relationship? Where is it required? [2]

   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 = $2\times10^5 kg/m^3$ and young's modulus = $210GN/m^2$. [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]

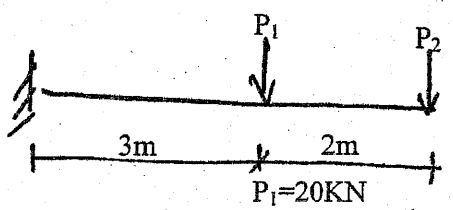


5. A thin walled cylindrical shell made up of copper plate has been filled with a liquid at atmospheric pressure. An additional 50 c.c. of liquid is then pumped in to 2m long cylinder whose internal diameter is 25 cm and wall thickness is 12 mm. Find the values of pressure developed on the wall of cylinder due to this extra liquid. Take poission ratio = 0.34 and modules of Elasticity = 10^6 kg/cm^2. [6]

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. [6]

7. a) Describe the importance of computing deflections in beams. Also give two typical examples of pure bending of beam. [2+1]

   b) Find the slope and deflection under the load P_1. [5]



$E=2\times10^5 MPa$
$I=2\times10^8 mm^4$

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]

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

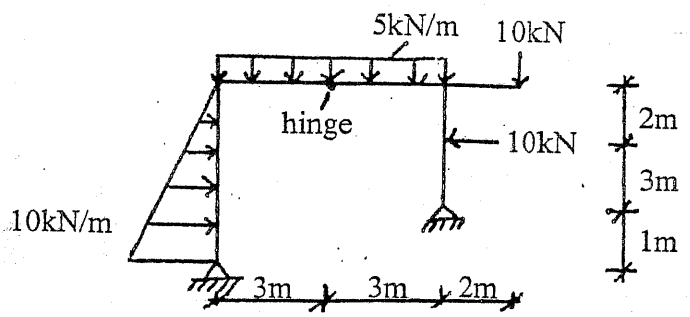
Exam.	
Level	
Programme	
Year / Part	1

80	
32	
3 hrs.	

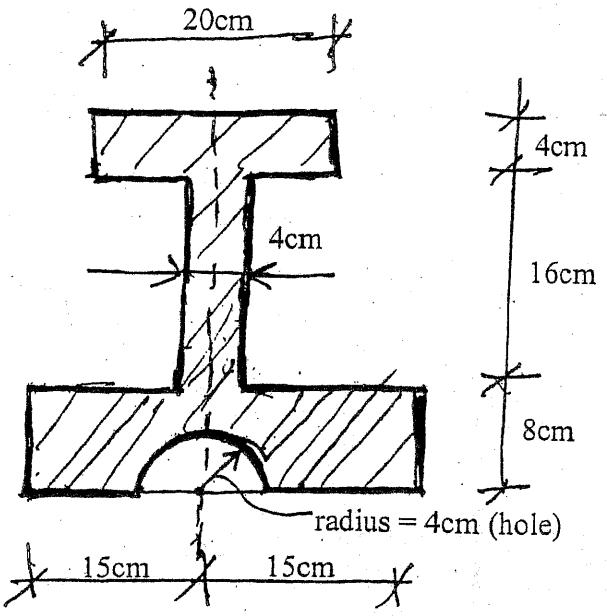
Subject: - Strength of Materials

- ✓ 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]

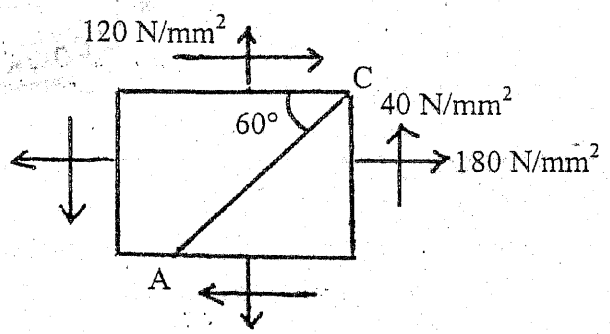


2. a) Calculate the principal moment of inertia about centroid and locate the principle axes for the figure as shown below. [12]



b) Derive an expression for the elongation of uniform solid circular bar of diameter 'd' and length 'l' due to it's 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]

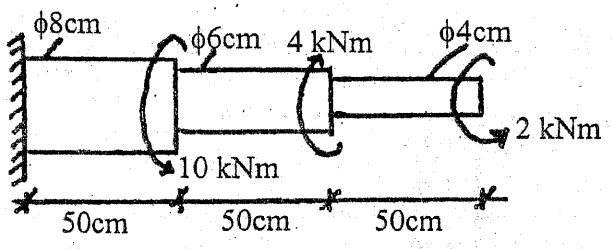


b) The modulus of rigidity for a material is 0.5×10^5 N/mm². A 10mm diameter rod of the material was subjected to an axial pull of 10kN and the change in diameter was observed to be 3×10^{-3}mm. Calculate the Poisson's ratio and the modulus of elasticity. [8]

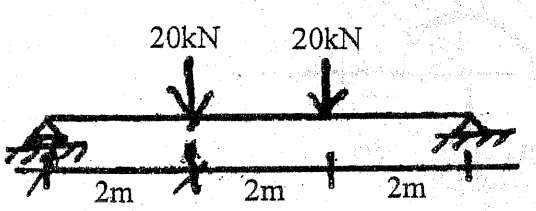
4. a) Derive the torsional equation $T/J = \tau/R = G\theta/L$. [6]

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 2N/mm². Take $E = 2 \times 10^5$N/mm² and $\mu = 0.3$. [10]

5. a) A stepped solid circular shape of the dimensions shown in the figure is subjected to three torques. If the material has a shear modulus of elasticity G = 80 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]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

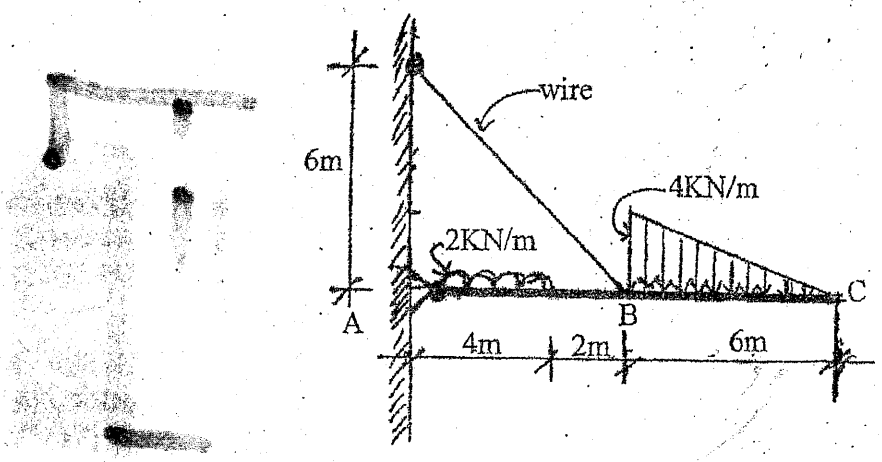
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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.*

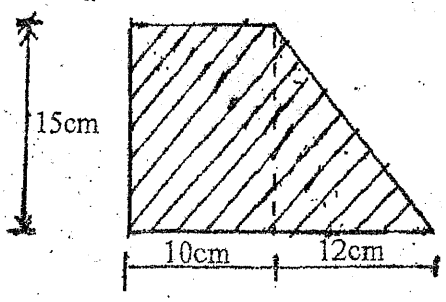
1. a) Derive the relation between bending moment and shear force at any section of beam. [6]

   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]

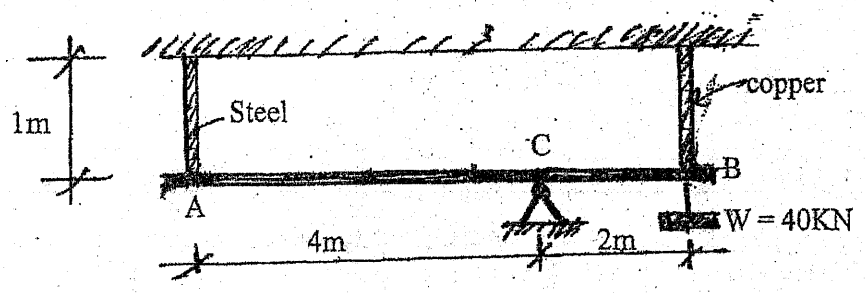
   b) Calculate principal moment of inertia and the orientation of the principle axes for the shaded area shown in figure below. [8]



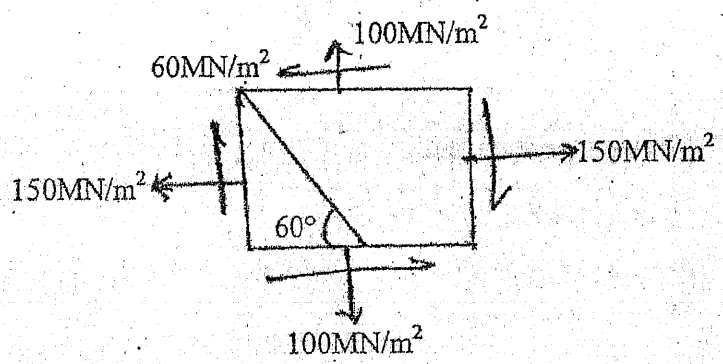
3. Two vertical rods of steel and copper are rigidly fixed with the ceiling at their ends at 100cm apart. Each rod is 3m long and 25mm diameter. A horizontal cross piece connects the lower ends of the rods. Where should a load of 3.5 tonnes be placed on the cross piece

so that it remains horizontal after being loaded. Take $E_s = 2\times10^6$ kg/cm^2. $E_c = 1.0\times10^6$ 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 $E_s = 200$KN/mm^2 and $E_c = 110$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 30cm×3cm and flange 18cm ×4cm 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 $\frac{\pi^2 EI}{\ell^2}$, where all parameters have their usual meanings. [6]

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