TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

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

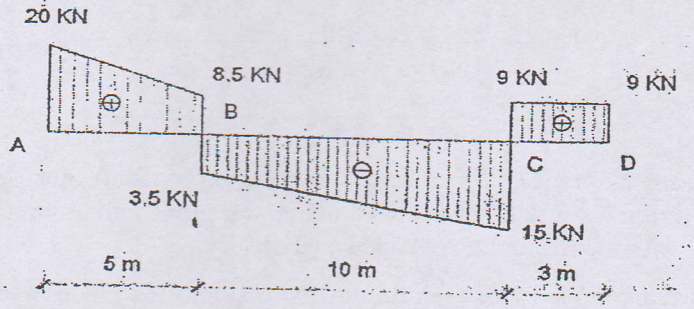
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Define geometrical stability of the structure. "A structure which is statically determinate or indeterminate may be geometrically unstable". Give example to support the statement. [4]

   b) The shear force diagram (SFD) of an overhanging beam AD with support at A and C is shown in figure. Using it, determine

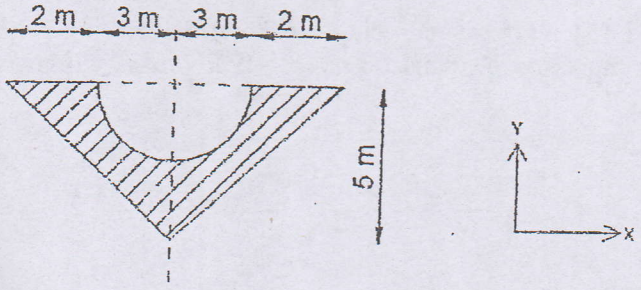
   i) Bending moment at critical location and bending moment diagram.

   ii) Loading on the beam. [12]



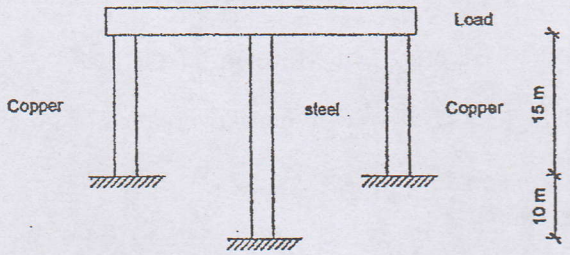
2. a) Find from first principle the product of inertia about centroidal axis of a quarter circle lying in first quadrant. [4]

   b) Determine moments and product of inertia about centroidal axes for a shaded area shown. What will be the change in these values about an axis inclined at 30° counterclockwise to the centroidal X and Y-axis? From the data obtained, show that the polar moment of inertia is invariant under rotation transformation. [8]

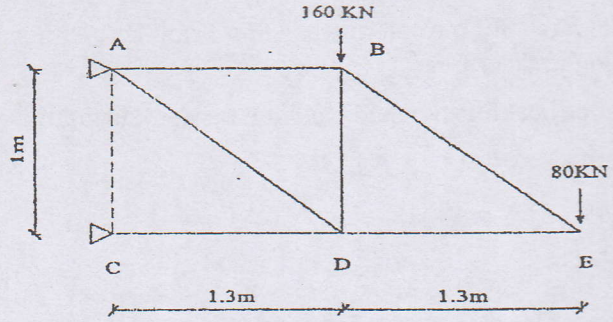


3. a) What is the significance of upper yield point as seen in ductile material like mild steel? Also explain how to specify the strength of materials which do not have distinct yield point. [4]

b) Two cooper rods and one steel rod together support a load as shown in figure. If the stress in copper and steel are not to exceed 550 kg/cm^2 and 1000 kg/cm^2 respectively. Determine the safe load that can be applied. The cross section of copper is 3×3 cm^2 and that of steel is 4×4 cm^2. Take Es=2Ec. [7]



c) A steel truss is acted upon by the force as shown. It is found that a 20 mm diameter steel rod is capable of taking an ultimate load of 150 kN. If factor of safety is to taken as 3; determine the required diameter of rod BE. [5]

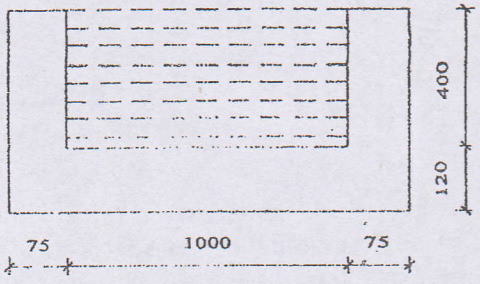


4. What is Mohr's stress circle? Write step wise step procedure for Mohr's circle construction to determine stress on an inclined plane, the plane acting with "like normal stresses". Verify it with the expression obtained analytically. [8]

5. Compare thin and thick walled vessel. A thin cylindrical shell is made of steel plates. It has hemispherical ends having diameter 300 mm and wall thickness 2 mm. Determine the thickness of cylindrical portion if there is no distortion of the junction under pressure. Take Es = 200 GPa and poisson's ratio = 0.3. [2+4]

6. Discuss shaft in series and parallel on the basis of total angle of twist and torsion. A hollow steel shaft 20 cm in internal diameter and 30 cm external diameter is to be replaced by a solid alloy shaft. If the tensional rigidity is same for both the shafts, determine the ratio of polar moduli. G for steel is equal to 2.5 times G for alloy. [8]

7. An 8 m long reinforced concrete channel section as shown is carrying water. Calculate maximum tensile and compressive bending stresses. $r^c = 25kN/m^3, r^w = 10kN/m^3$. [8]



8. Write an empirical formula for calculating critical load for intermediate column. Calculate the maximum value of slenderness ratio of steel column for which Euler's formulas is valid. Take σc = 330 MN/m^2 and E = 210 GN/m^2. [6]

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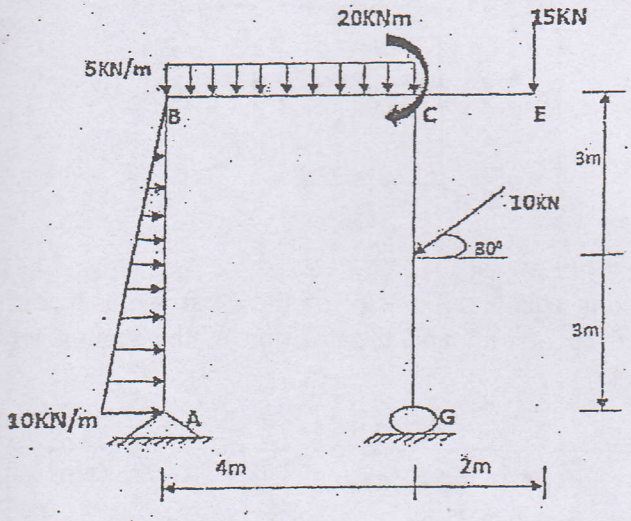
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

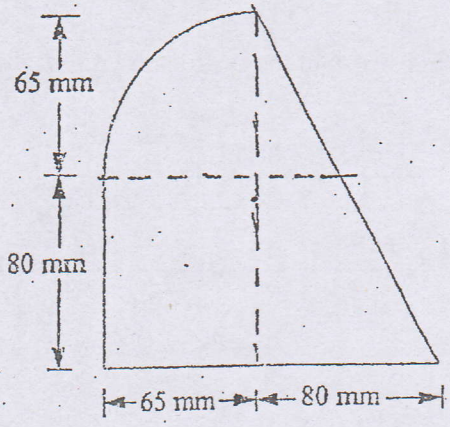
Subject: - Strength of Materials *(CE 502)*

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



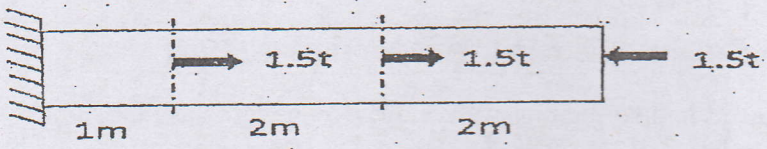
2. a) Calculate the principal moment of inertia about the centroid and locate the principal axes for the figure as shown below. [12]



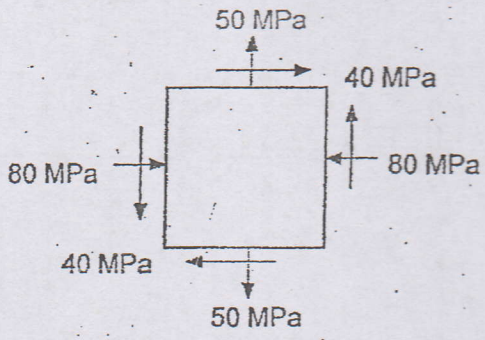
b) A seamless spherical vessel of 1.9 m internal diameter and 6 mm thick is filled with a fluid under pressure until its volume increases by 400 cm^2. Calculate the pressure exerted by the fluid in the vessel. Take 2×10^5 N/mm^2 and Poisson's ratio = 0.25. [6]

3. a) Derive relationship between young's modulus and bulk modulus. [6]

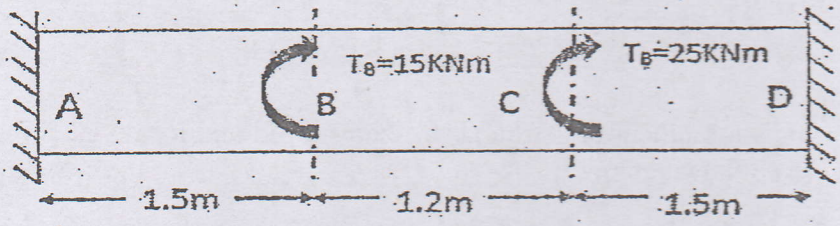
b) At what distance 'x' from the fixed end of the uniform bar should the '2t' force be applied in order that the net overall change in length of the bar will be zero? [8]



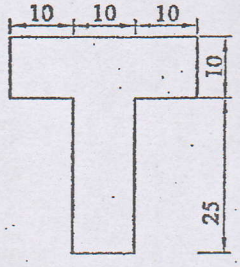
4. a) For an infinitesimal element normal and shearing stresses in the two mutually perpendicular planes are given below. Determine the normal and shearing stresses on the inclined plane at an angle of 20° with vertical. Also calculate principal stresses, their planes, maximum shear stresses and their planes. [8]



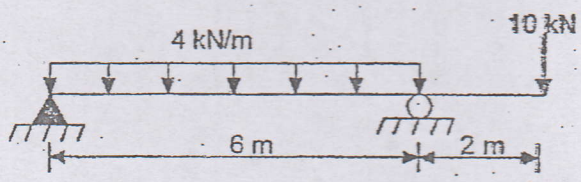
b) Determine the end fixing couples, diameter of the shaft if the maximum shearing stress is not to exceed 50 MN/m^2 and the position of the section where the shaft suffers no angular twist. [8]



5. a) Determine the maximum bending stress in the beam shown in figure below. [10]



All dimensions are in cm



b) A hollow mild steel tube is 5 m long and 4 cm internal diameter. Thickness of tube is 8 mm and it is used as a strut with both ends hinged. Determine critical load and safe load on the strut. Take $E = 2.1 \times 10^5$ N/mm^2 F.O.S = 3 [6]

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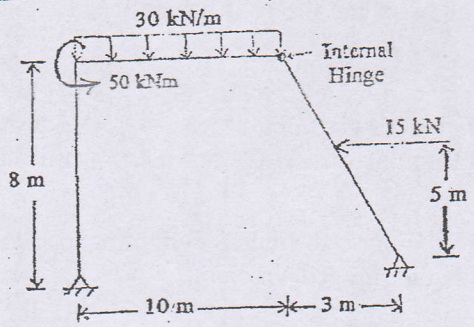
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

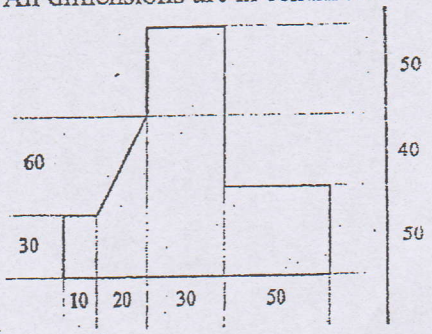
Subject: - Strength of Materials *(CE 502)*

- ✓ 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. Draw axial force diagram, shear force diagram and bending moment diagram for the frame shown, indicating the salient features. [16]



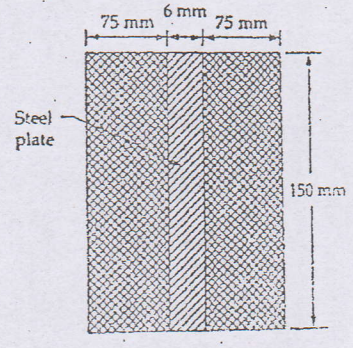
2. a) Determine principal moment of inertia and orientation of principal axes passing through the centroid. All dimensions are in centimeter. [12]



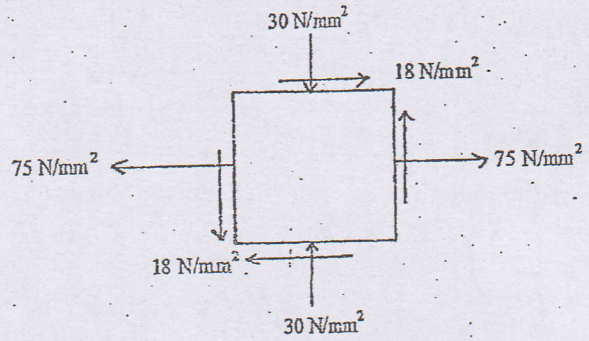
b) In a thin walled cylindrical vessel show that the volumetric strain is equal to two times circumferential strain plus longitudinal strain. [6]

3. a) Derive a relation between Young's modulus of elasticity, Shear modulus and bulk modulus. [6]

b) Two 150 mm × 75 mm × 4 m long timber members are reinforced with a steel plate 150 mm × 6 mm × 4 m long as shown in figure. The three members are adequately bolted together. The permissible stresses for the timber and the steel members are 6 N/mm^2 and 130 N/mm^2 respectively. E for timber is 8.4 GN/m^2 and for steel is 210 GN/m^2. Calculate the permissible tensile load for the composite member and the amount of elongation due to this load. [8]



4. a) Determine the principal stresses, orientation of principal planes, maximum shearing and normal stress on the plane of maximum shear stress. Verify the results by drawing Mohr's Circle. [8]



b) A steel shaft transmits 200 horse power at 150 rpm. If the shaft is 110 mm in diameter, find the torque in the shaft and the maximum shear stress developed. Also, determine the angle of twist for the shaft in the length 5 m. Take G = 90 GN/m². (1 hp = 746 watt) [8]

5. a) A simply supported timber joist of 6 m span has to carry uniformly distributed load 5 kN/m over its entire length and a point load of 15 kN at its center. Determine the dimensions of the rectangular joist if the maximum permissible stress in bending is 12 N/mm². [8]

b) Derive an expression for Euler's formula for crippling load of a column of length 'L' with one end fixed and other hinged condition. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

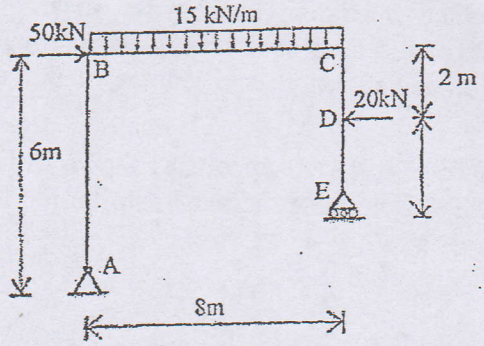
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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.*

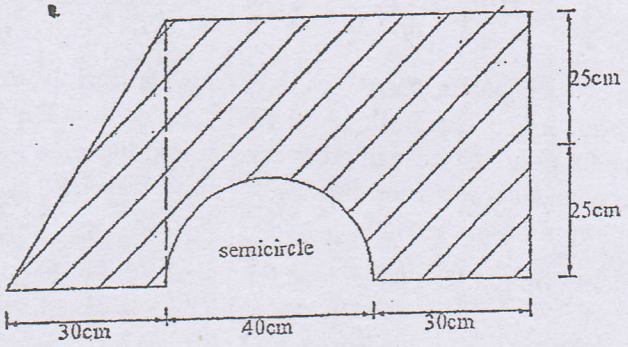
1. a) Define point of contraflexure. Derive the relationship between rate of loading, Shear force and Bending moment. [2+4]

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

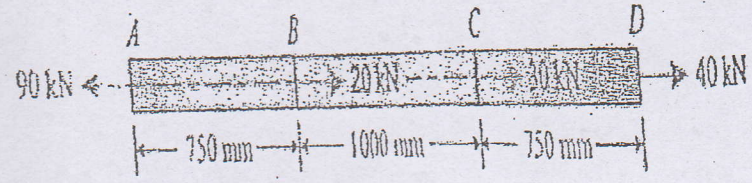


2. a) Define principal moment of inertias and principal axes. [2]

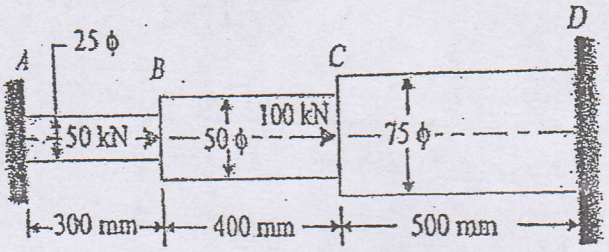
   b) Determine principal moment of inertias and principal axes passing through the centroid for the following shaded area. [10]



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]



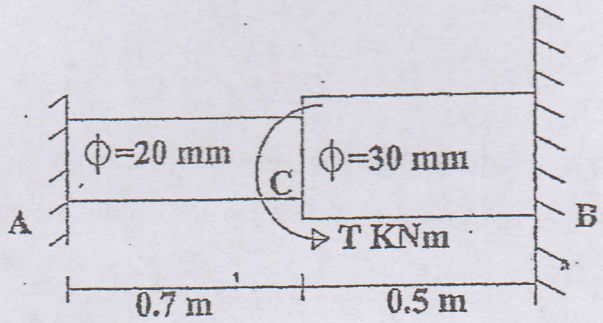
b) A Circular bar ABCD, rigidly fixed at A and D is subjected to axial loads of 50 KN and 100 KN at B and C as shown in the figure. Find the loads shared by each part of the bar and displacements of the points B and C. Take E for the steel as 200Gpa. [10]



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
2076 Ashwin

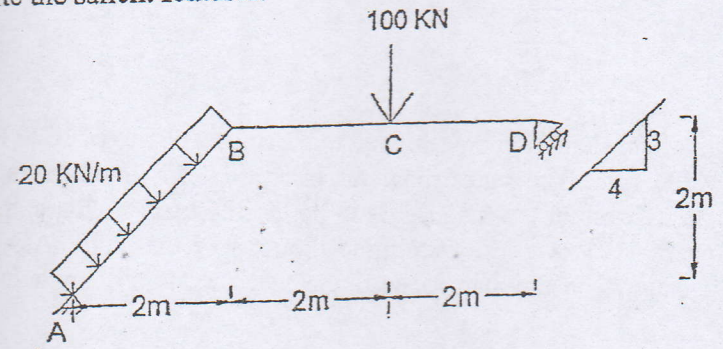
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

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

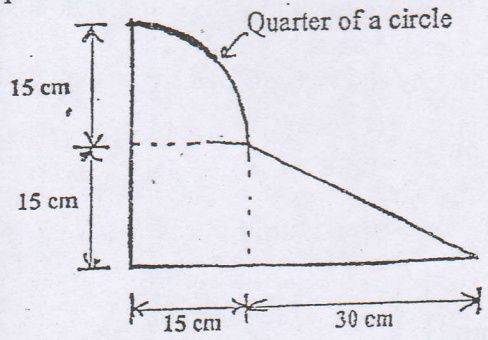
1. a) State the principle of Superposition. Explain the stepwise procedure for the determination of bending moment of the beam using the principle of superposition. [2+2]

   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]



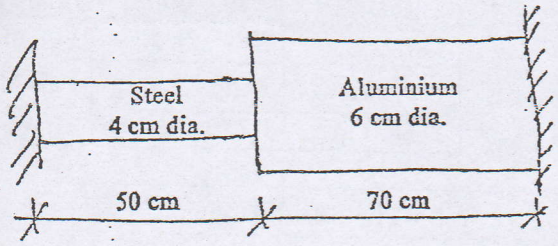
3. a) In an experiment, a bar of 30mm diameter is subjected to a pull of 60 KN. The measured extension on guage length of 200 mm is 0.09 mm and the change in the diameter is 0.0039mm. Calculate the values of Poisson's ratio and three elastic moduli. [6]

   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*,

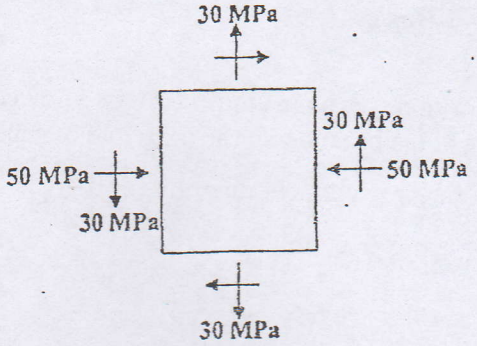
   i) The support are unyielding

   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]



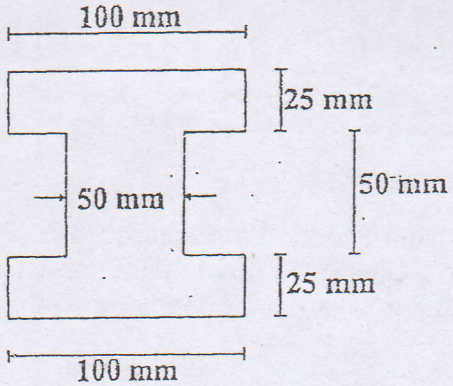
4. a) Determine the normal and shearing stress on the inclined plane at the angle of 40° to the vertical. Also calculate principal stresses and their planes. [8]



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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TRIBHUVAN UNIVERSITY
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Examination Control Division
2075 Chaitra

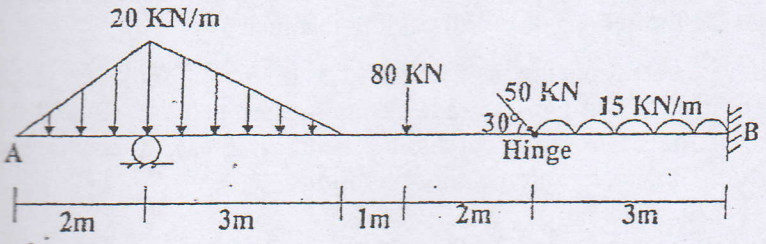
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

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

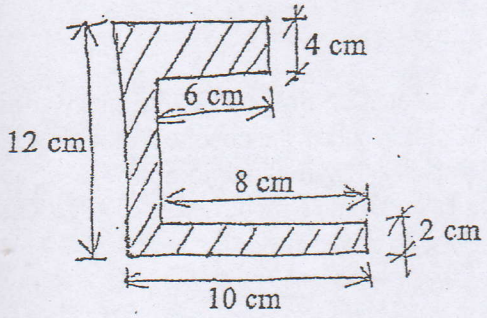
1. a) Briefly explain the properties of internal hinge. What do you understand by point of contraflexure? [2+2]

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



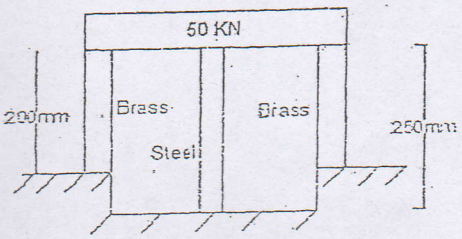
2. a) Define product moment of inertia. [2]

   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]

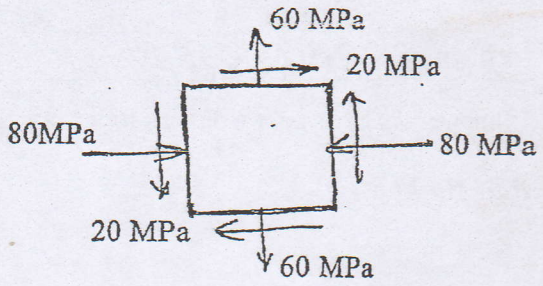


3. a) Determine the expression for elongation in bar having uniformly tapering circular section subjected to tensile load P. [6]

   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]



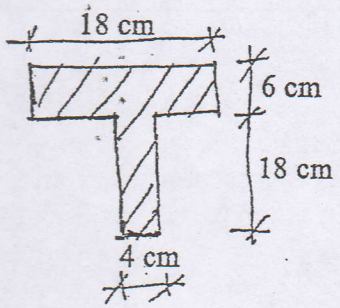
4. a) The state of stress in a two dimensional stress system is shown in figure. Determine the principal stresses and their direction, maximum shear and associated normal stress. [8]



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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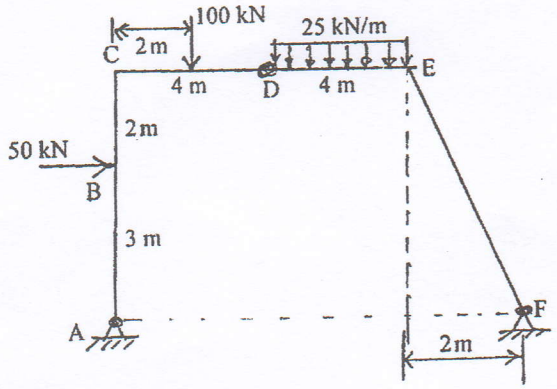
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

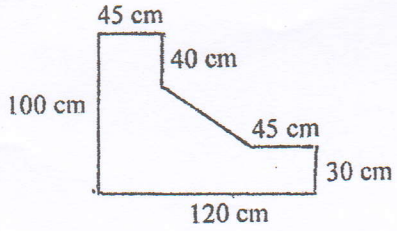
Subject: - Strength of Materials *(CE502)*

- ✓ 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.*

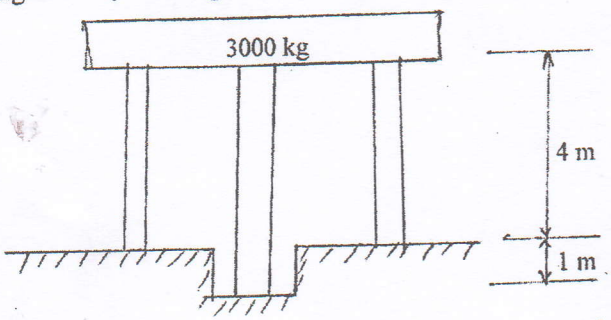
1. Draw axial force, shear force and bending moment diagrams for the frame. Indicate numerical values at salient points. [16]



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]

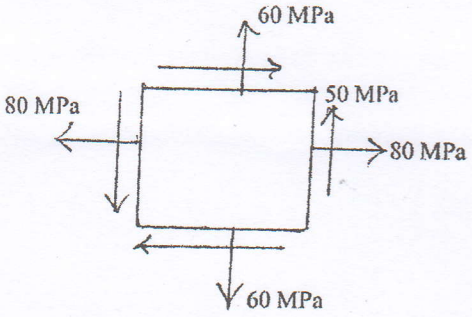


3. a) Derive the expression for the total elongation of a uniform bar of length L and cross section area A under its self weight. [5]
   b) Two copper rods and one steel rod are having diameter 4 cm, together support a load 3000 kg as shown in figure below. Determine the stresses in each rod. Take $E_s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



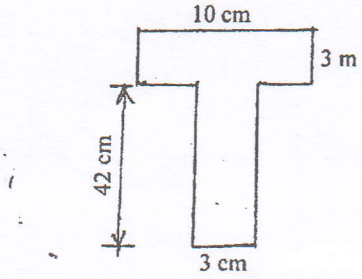
4. a) For the state of plane stress shown in figure below determine. [8]

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]

. 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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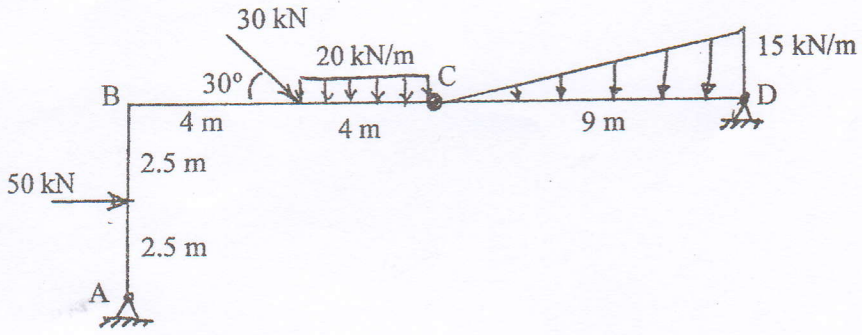
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

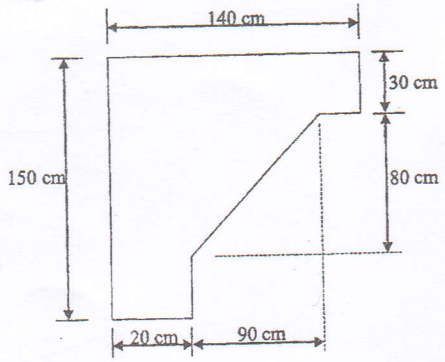
Subject: - Strength of Materials *(CE502)*

- ✓ 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.*

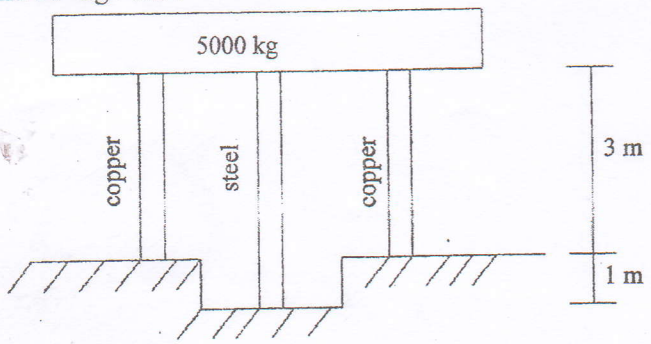
1. Draw axial force, shear force and bending moment diagram for the given frame. Indicate numerical values at salient points. [16]



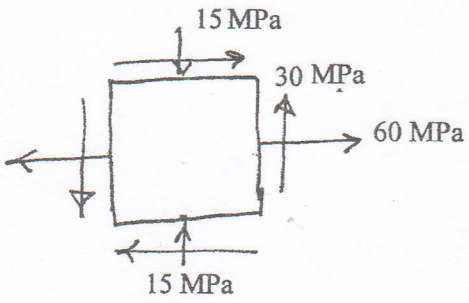
2. a) What do you understand by principle moment of inertia and principal axis? [4]
   b) Determine the principle moment of inertia of the given figure. [10]



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]



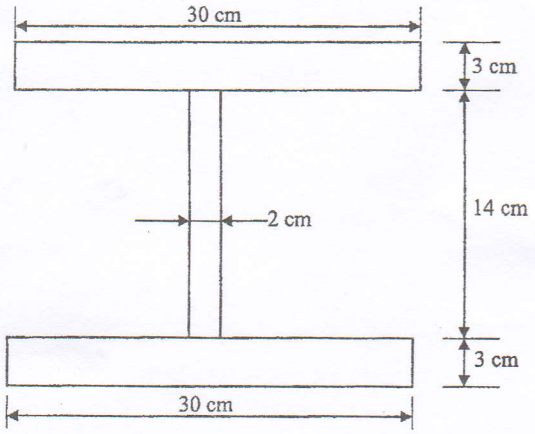
4. a) For the state of plane stress shown in figure below determine (i) the principal planes (ii) principal stresses (iii) the maximum shearing stress and the corresponding normal stress. [8]



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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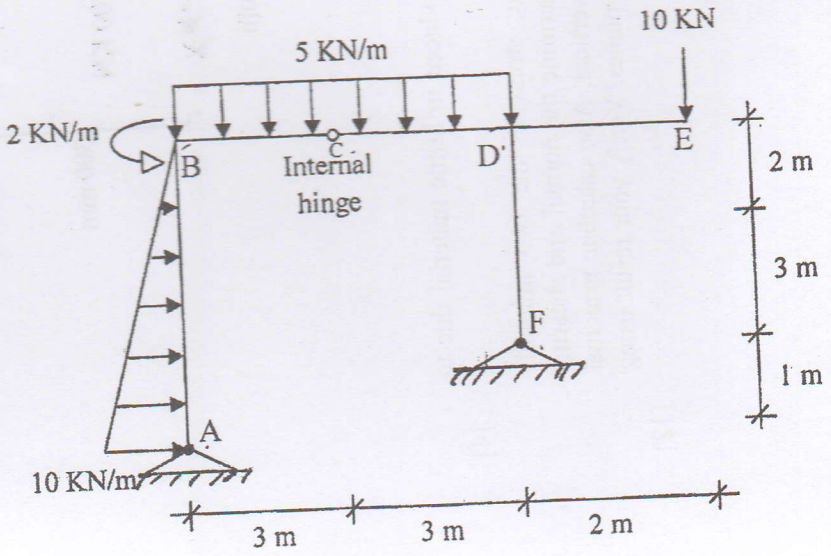
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

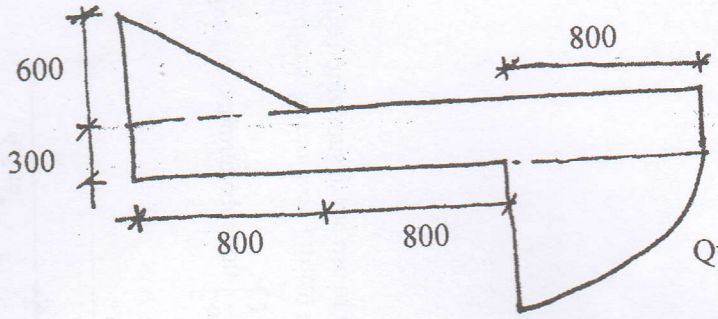
Subject: - Strength of Materials *(CE502)*

- ✓ 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]

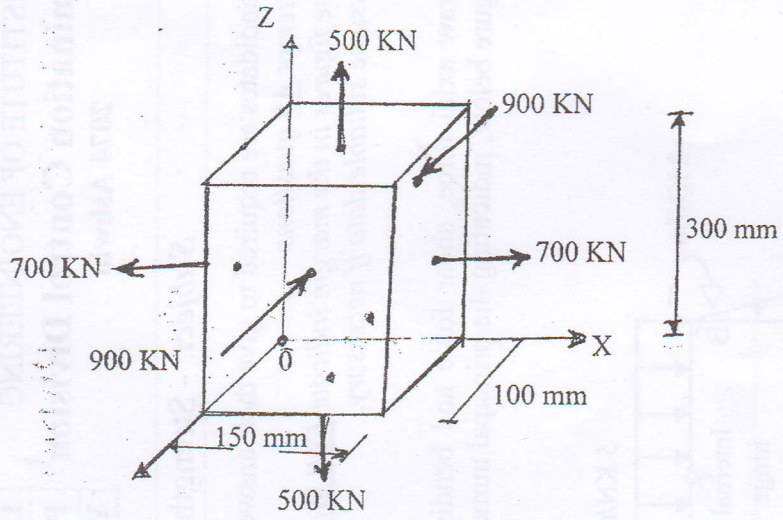


2. Find the principal moments of inertia and directions of principal axes for the section as shown in figure below. [12]



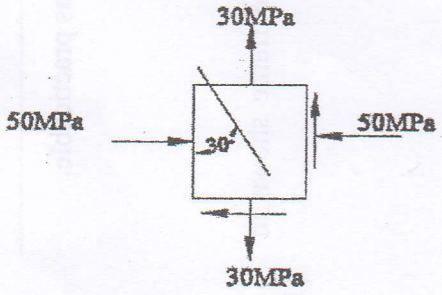
Quarter Circle (in mm)

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]



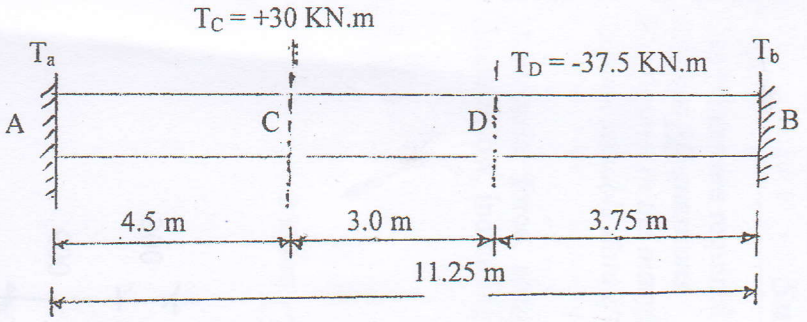
b) What is the stress concentration? What effect is produced in brittle material due to stress concentration? [4]

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

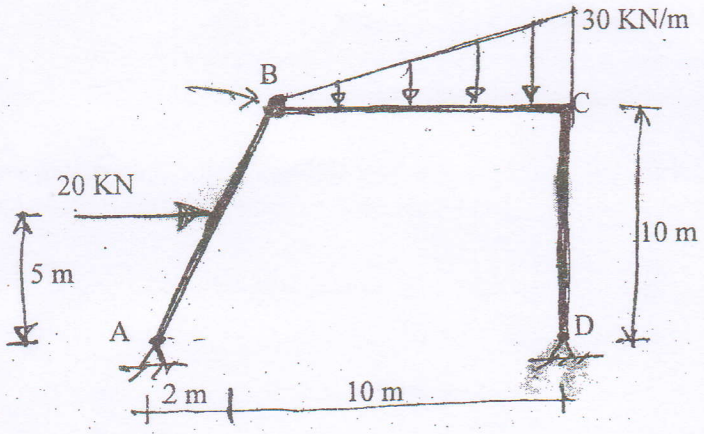
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(CE502)*

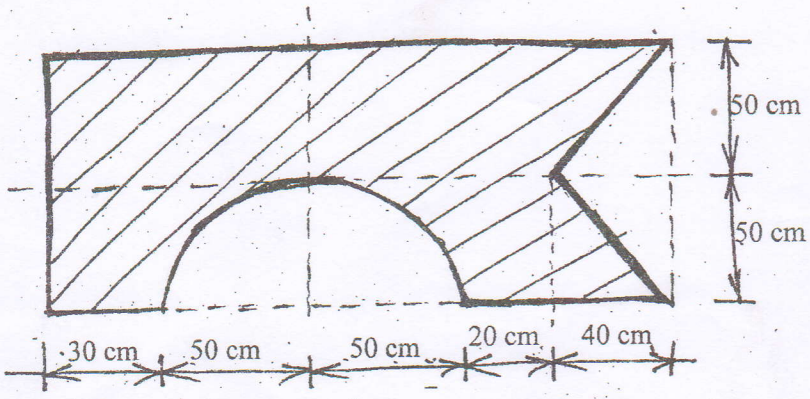
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]

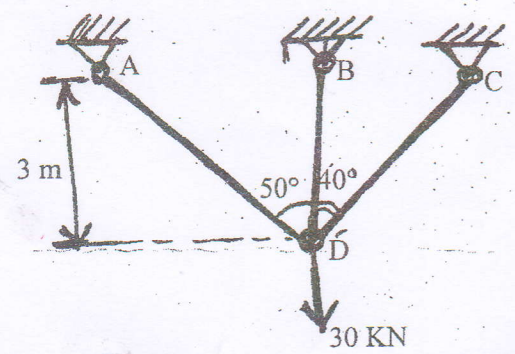


2. a) Obtain the principle moment of inertia and draw principle axes for the plane figure given below. [8]



   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]



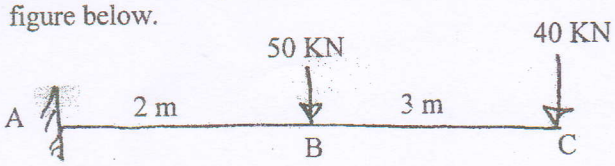
b) The principle stresses at a point in a bar are 100 MPa tensile and 40 MPa compressive. Find the normal stress shears and resultant stress on a plane inclined at 60° to the axis of major principal stress. [8]

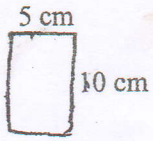
4. a) A water pipe 500 mm internal diameter contains water at a pressure head 100 m. If the unit weight of water is 10 KN/m^3 and allowable stress of pipe material is 20 N/mm^2. Calculate the thickness of the pipe. [8]

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

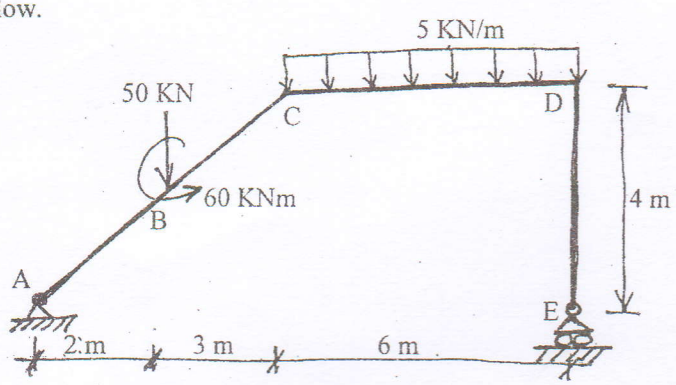
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(CE502)*

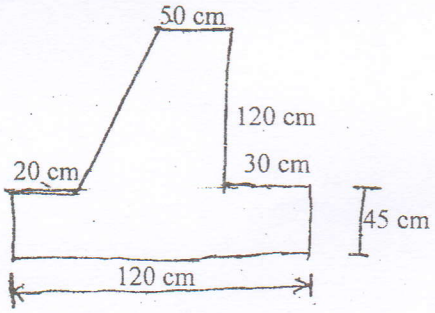
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]

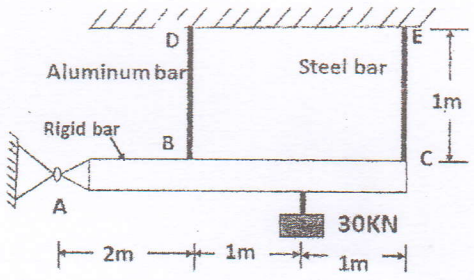


2. a) Determine principal moment of inertia and draw orientation of principal axes of the figure shown in figure below. [12]



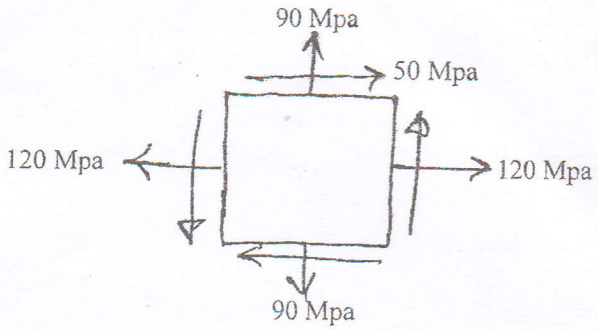
   b) Define principle moment inertia. [4]

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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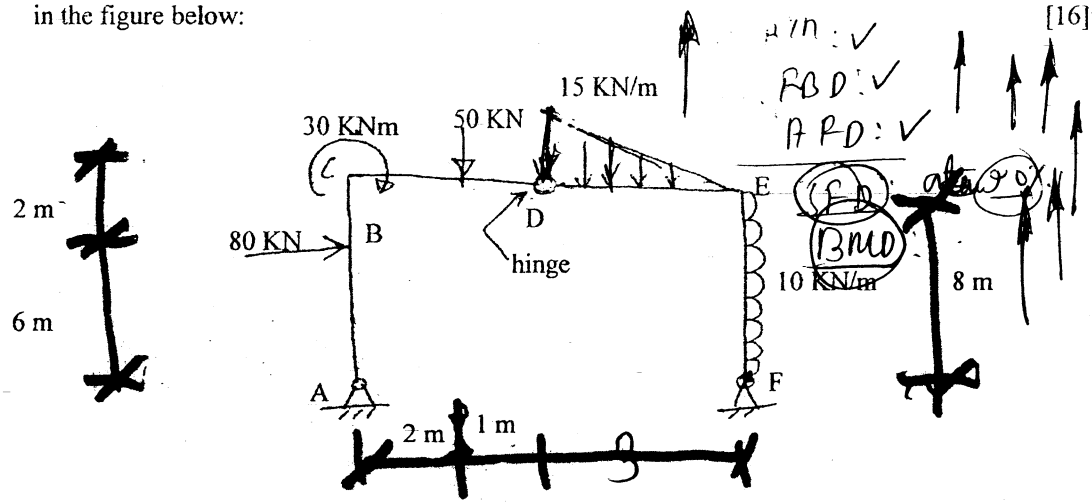
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

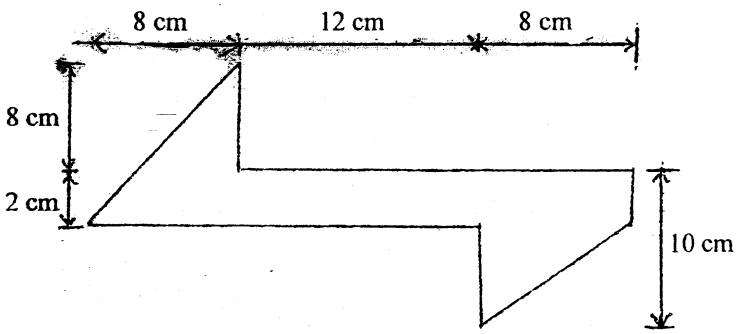
Subject: - Strength of Materials *(CE502)*

- ✓ 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.*

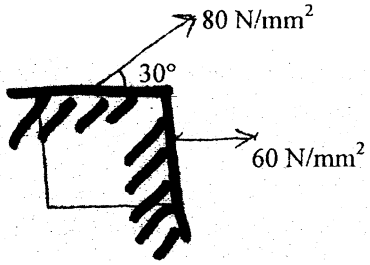
1. Draw axial force, shear force and bending moment diagram of the frame loaded as shown in the figure below: [16]



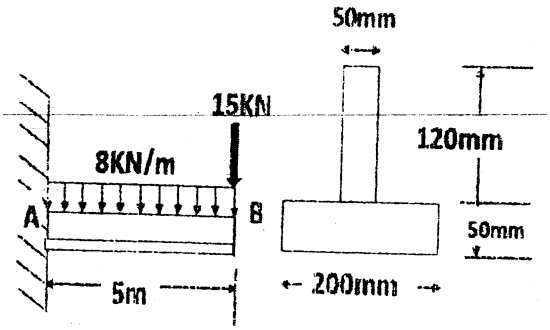
2. Determine the orientation of the principal axes and the moment of inertia about the centroidal axes of composite section as shown. [12]



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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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

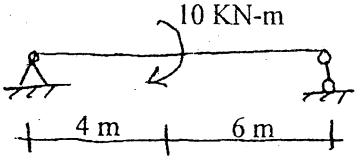
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials *(CE502)*

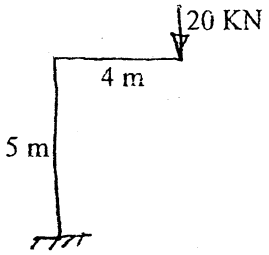
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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

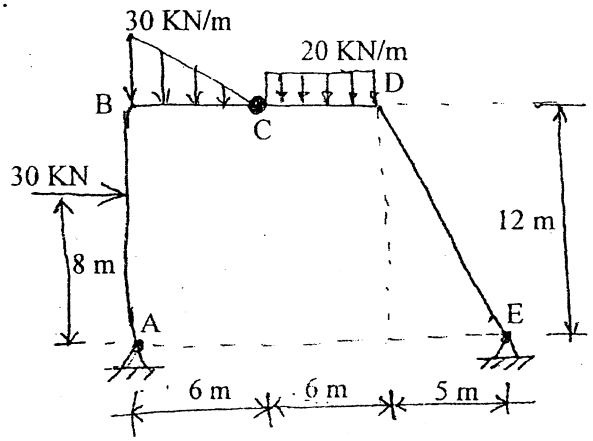
i)



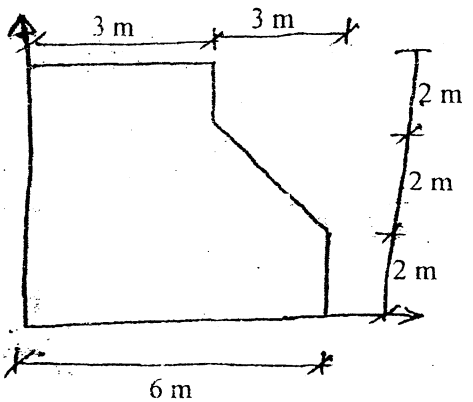
ii)



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]



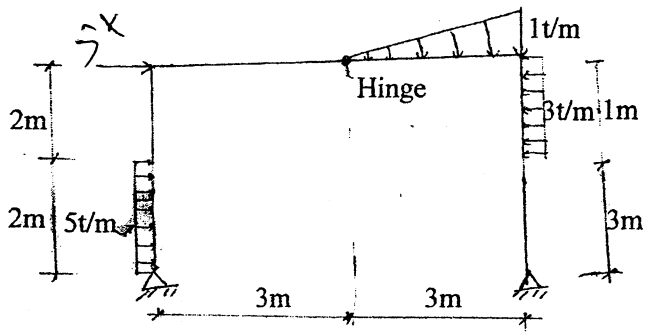
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Ashad

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

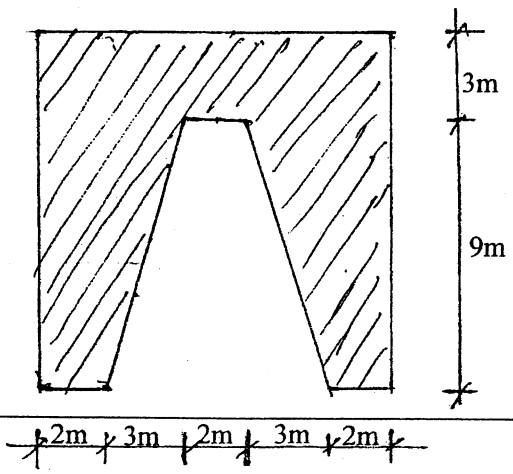
Subject: - Strength of Material *(CE 502)*

- ✓ 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]

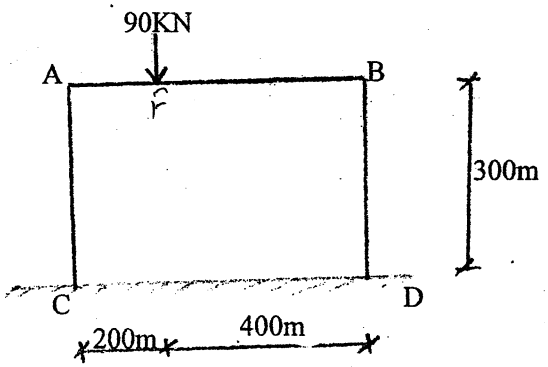


2. a) State and prove parallel axis theorem for product of inertia. [4]
   b) Determine the principle moment of inertia about centrodial axis and locate the principle axes for the section shown in figure below. [8]



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]

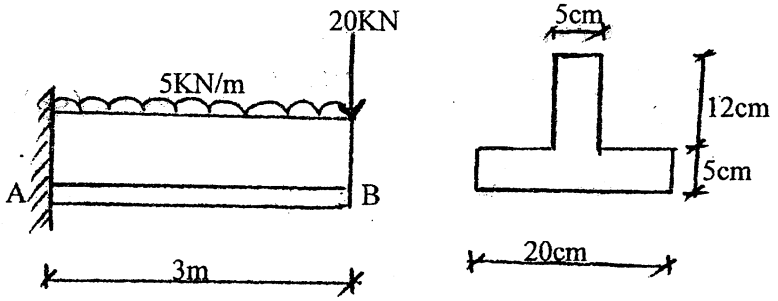


4. a) Derive an expression for the normal stress and shear stress on an oblique section of rectangular strained body when it is subjected to direct stresses in two perpendicular directions accompanied with simple shear stress. [8]

   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=2.05×10^5N/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]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

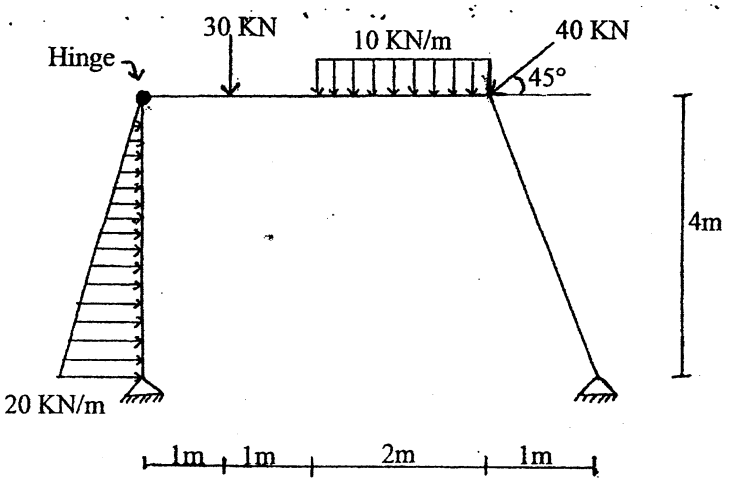
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Material *(CE502)*

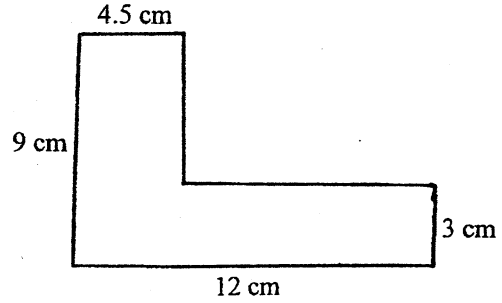
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]



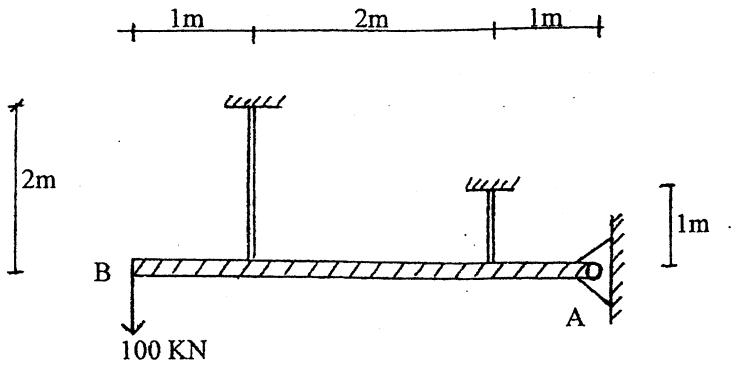
2. Determine the principal moment of inertia and orientation of principal axes for the composite section shown in figure below about its centroid. [12]



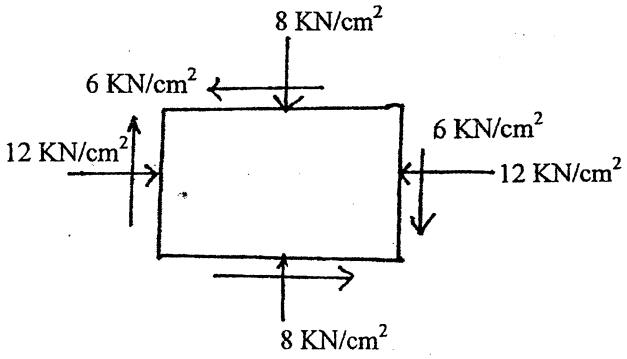
3. a) How is offset method defined in drawing stress-strain relationship? Where is it required? [2]

   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]

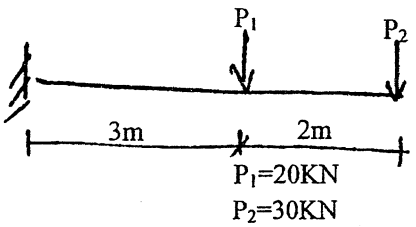


5. A thin walled cylindrical shell made up of copper plate has been filled with a liquid at atmospheric pressure. An additional 50 c.c. of liquid is then pumped in to 2m long cylinder whose internal diameter is 25 cm and wall thickness is 12 mm. Find the values of pressure developed on the wall of cylinder 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=2×10^{5}MPa
I=2×10^{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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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

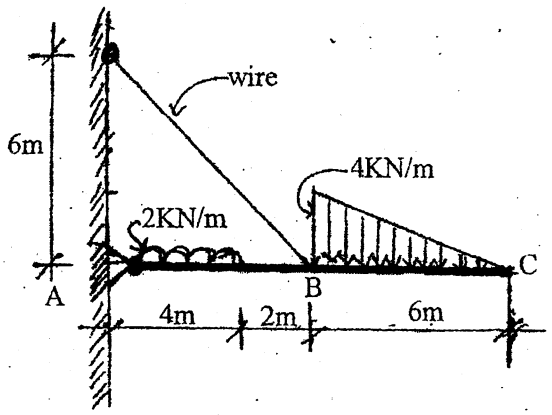
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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.*

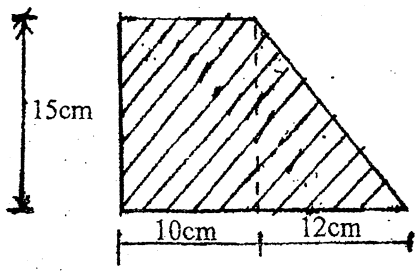
1. a) Derive the relation between bending moment and shear force at any section of beam. [6]

   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]

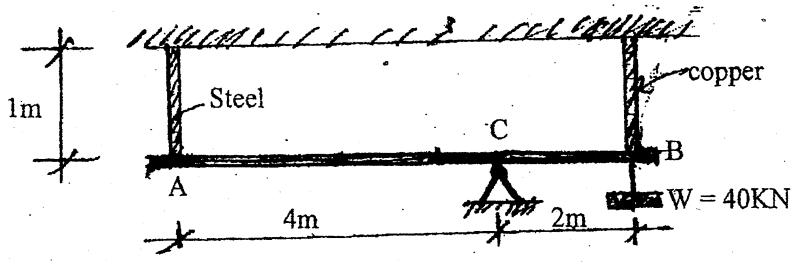
   b) Calculate principal moment of inertia and the orientation of the principle axes for the shaded area shown in figure below. 8]



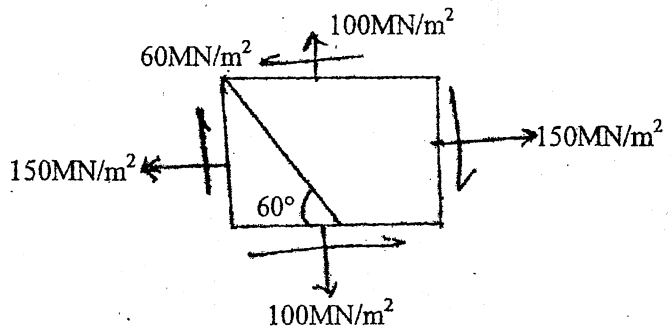
3. Two vertical rods of steel and copper are rigidly fixed with the ceiling at their ends at 100cm apart. Each rod is 3m long and 25mm diameter. A horizontal cross piece connects the lower ends of the rods. Where should a load of 3.5 tonnes be placed on the cross piece

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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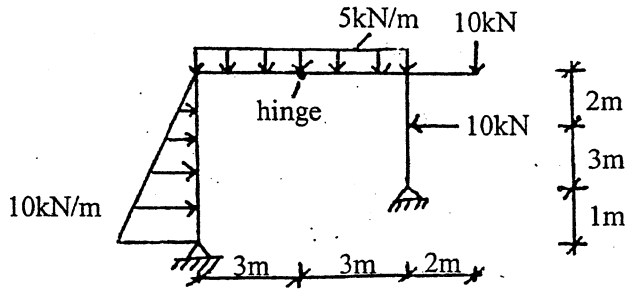
04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

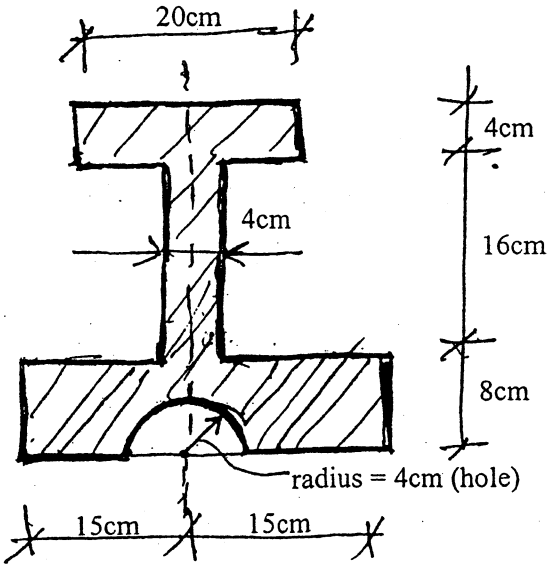
Subject: - Strength of Materials

- ✓ 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]

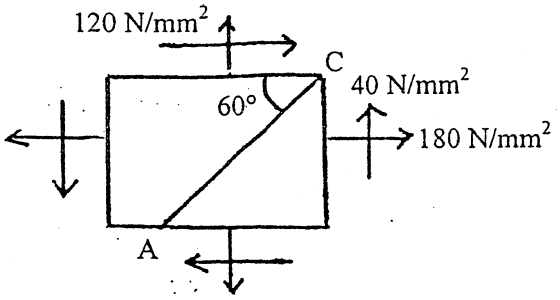


2. a) Calculate the principal moment of inertia about centroid and locate the principle axes for the figure as shown below. [12]



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

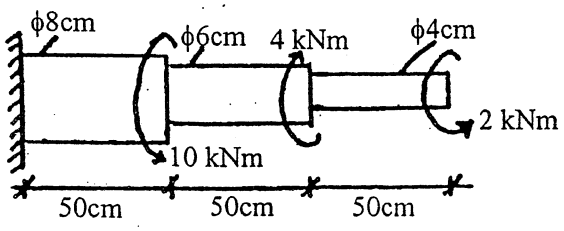


b) The modulus of rigidity for a material is 0.5×10^5 N/mm². A 10mm diameter rod of the material was subjected to an axial pull of 10kN and the change in diameter was observed to be 3×10^{-3}mm. Calculate the Poisson's ratio and the modulus of elasticity. [8]

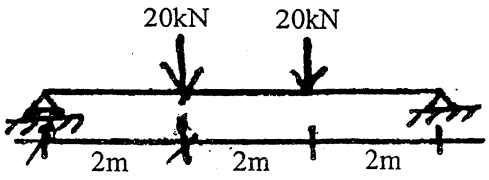
4. a) Derive the torsional equation $T/J = \tau/R = G\theta/L$. [6]

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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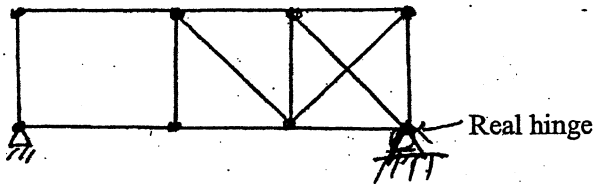
03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

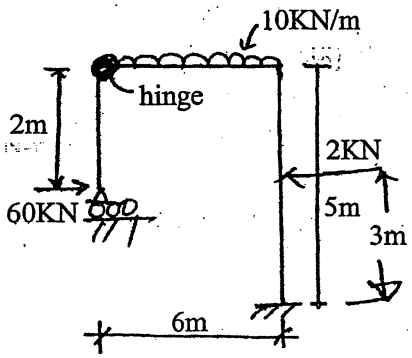
Subject: - Strength of Materials

- ✓ 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.*

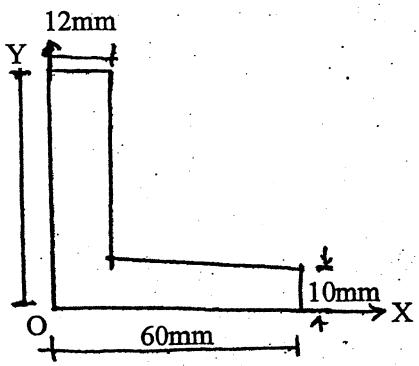
1. a) Explain static determinacy and stability of the following truss. [4]



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



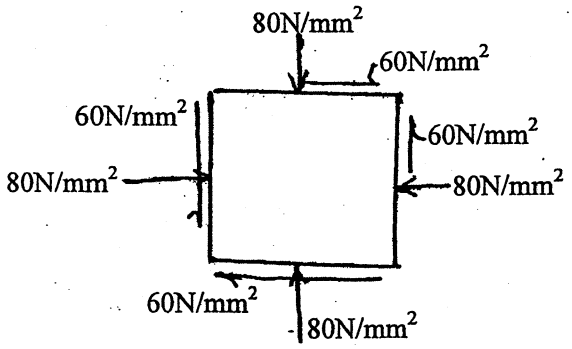
2. a) Calculate the principal MoI and their orientation for the following section about X-Y axes. [12]



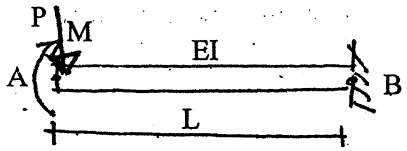
b) Neatly sketch stress-strain diagram for mild-steel showing salient points. [4]

3. a) Derive the relation of modulus of rigidity (G) with modulus of elasticity (E) and Poisson's ration (γ). [4]

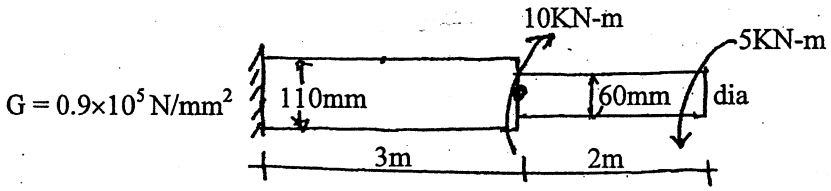
b) For the following stress condition of an element, obtain principal stresses and their orientation. Show the results in a neat sketch. [12]



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

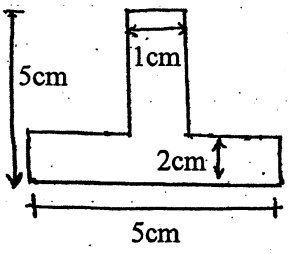


b) For the following shaft, obtain the angle of twist at free end. [8]



5. a) For thin cylinders loaded with internal pressure p, obtain the relation for Hoop stress, longitudional 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 elastopastic 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]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

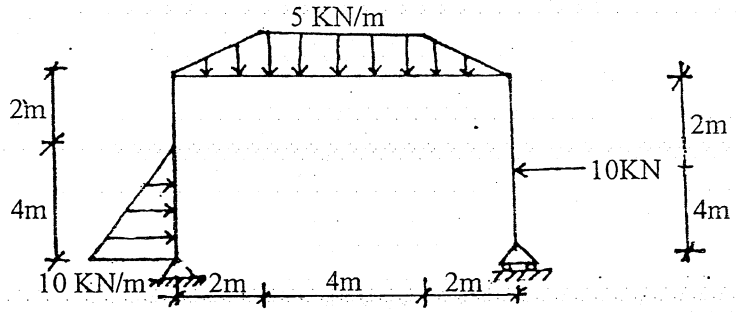
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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.*

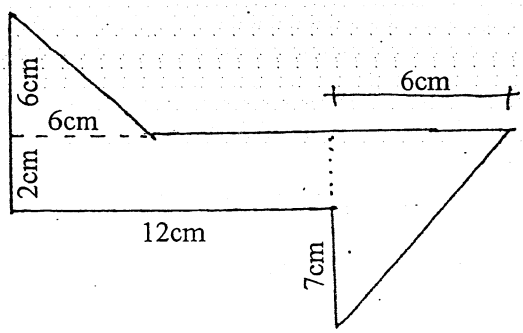
1. a) Describe the types of supports and their reactions with necessary sketches. [4]

   b) Draw axial force, shear force and bending moment diagrams for the frame shown indicating salient points with their values. [12]

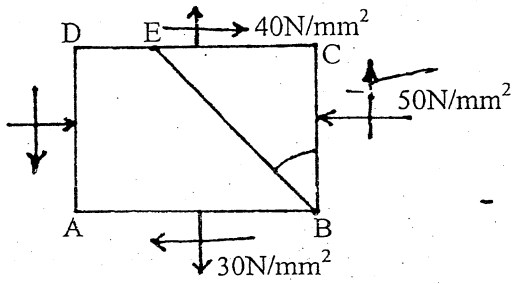


2. a) Define principal axes and principal moment of inertia. [4]

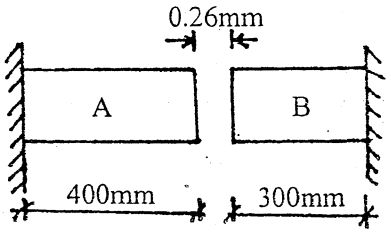
   b) Determine the orientation of principal axes and the principal moment of inertia about centroidal axes of the composite section shown in figure. [12]



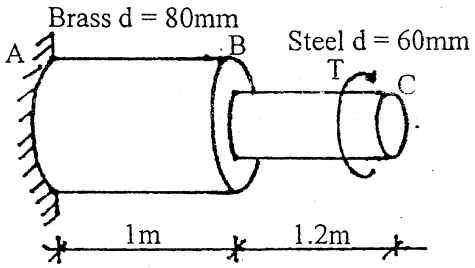
3. The state of stress in a two dimensionally stressed body is as shown in figure below. Determine principal stresses, principal planes and maximum shear. Determine also the normal and tangential stresses on plane BE and verify the results by drawing Mohr's circle. [16]



4. a) The gap between bar A of cross-sectional area $1000mm^2$ 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: $E_A = 2 \times 10^5$ N/mm^2, $\alpha_A = 12 \times 10^{-6}$/°C and $E_B = 1 \times 10^5$ N/mm^2, $\alpha_B = 23 \times 10^{-6}$/°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 $G_{brass} = 400$ kN/mm^2 and $G_{steel} = 80$ 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. [8]

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. [8]

6. a) Derive a relation between Young's modulus, bulk modulus and Poisson's ratio. [6]

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? [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Jestha

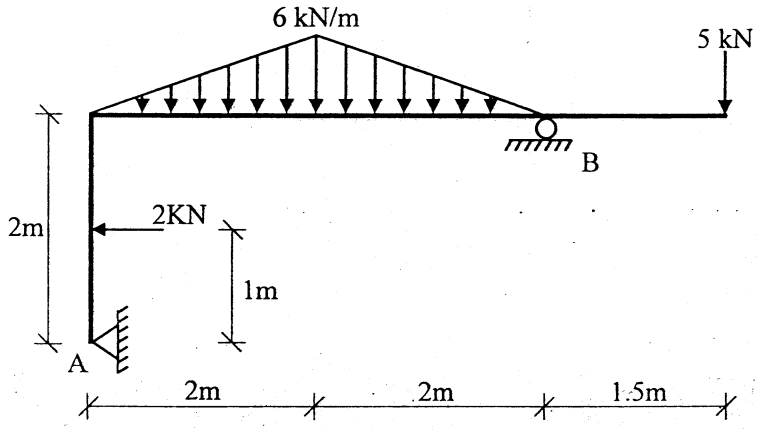
Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Strength of Materials

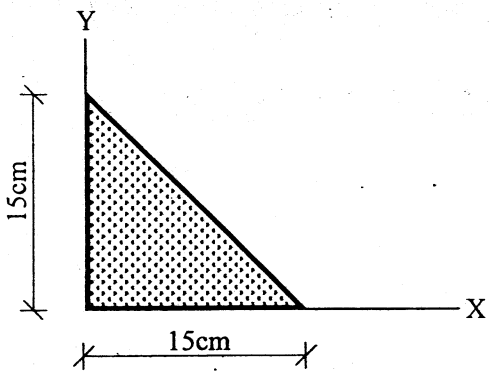
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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 × 15cm sides. [8]

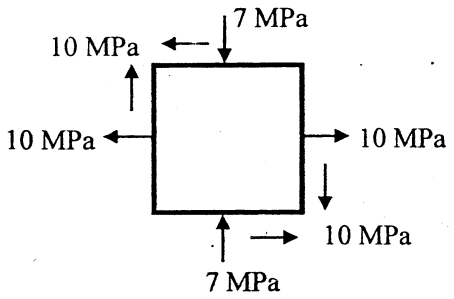


   b) Prove that the volumetric strain is three times the longitudinal strain for a cube subjected to equal stresses in the three mutually perpendicular directions. [8]

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. $E_{steel} = 2\times10^5$ MPa $E_{brass} = 1\times10^5$ 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 N/mm^2, $\nu = 0.3$. For water, K = 2100 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 = 2×10^5 N/mm^2 and factor of safety is 3. [8]

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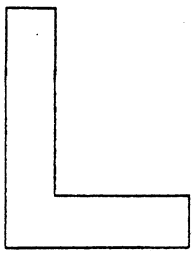
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Chaitra

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

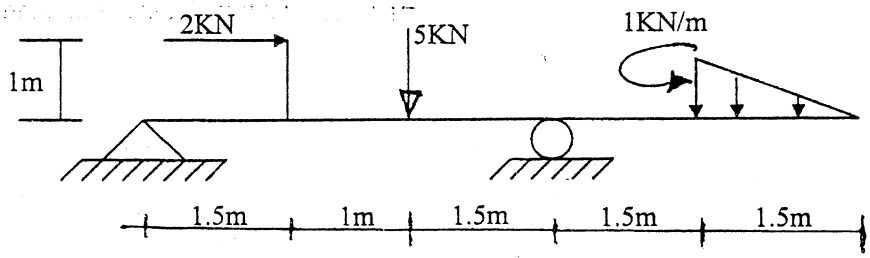
Subject: - Strength of Materials

- ✓ 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 Poison's ratio, Young's modulus and modulus of rigidity. [6]

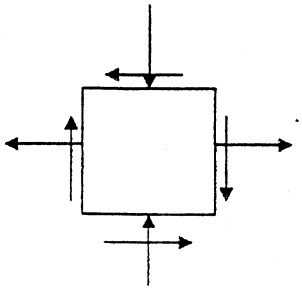
   b) A compound tube consists of a steel tube 15cm internal diameter and 1cm thickness and an outer brass tube of 17cm internal diameter and 1cm thickness. Two tubes are of the same length. The compound tube carries an axial load of 1000 kN. Find the stresses and the load carried by each tube. [10]

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

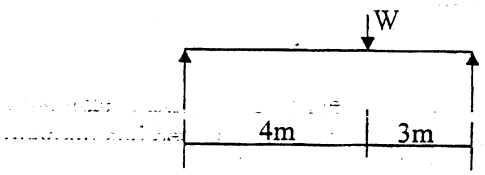
b) A plane element is subjected to the stresses as shown in figure. Determine analytically or graphically, the principal stresses and their directions. Tensile stress is 50 MPa, Compressive stress is 20 MPa, Shear stress is 30 MPa. [10]



5. A timber beam 160mm wide and 300mm deep is simply supported on a span of 5m. It carries an 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 × 250mm
Point Load W = 10 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 GPa and ν = 0.25. [8]

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