TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Bhadra

Exam.	Regular (New Course)		
Level	BE	Full Marks	60
Programme	BCE	Pass Marks	24
Year / Part	I / II	Time	3 hrs.

Subject: - Strength of Materials *(ENCE 151)*

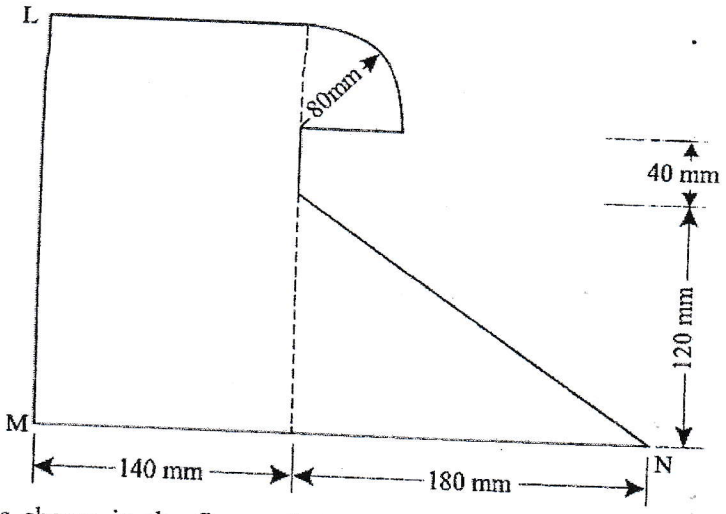
- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Derive the relation between Young's Modulus (E) and Shear Modulus (G). [4]

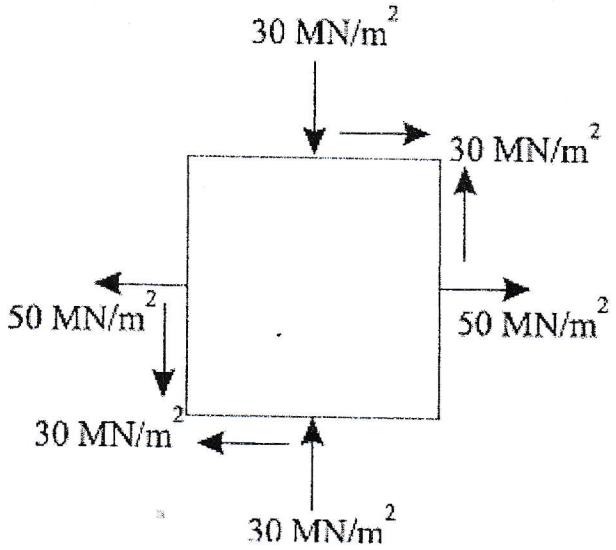
   b) A C.I. flat, 300 mm long and of 30 mm × 50 mm uniform section, is acted upon by the following forces uniformly distributed over the respective cross-section; 25 kN in the direction of length (tensile); 350 kN in the direction of the width (compressive); and 200 kN in the direction of thickness (tensile). Determine the change in dimensions and volume of the flat. Take E = 140 GN/m^2, and Poisson's ratio (υ) = 1/4. [6]

   c) A rigid bar is supported by three rods at one end in the same vertical plane and equidistant. The other end of rods is rigidly fixed. The outer rods are of brass and of length 600 mm and diameter 30 mm. The central rod is of steel of 900 mm length and of 37.5 mm diameter. Calculate the forces in the bars due to an applied force 100 kN, if the bar remains horizontal after the load has been applied. Take $E_s / E_b = 2$. [4]

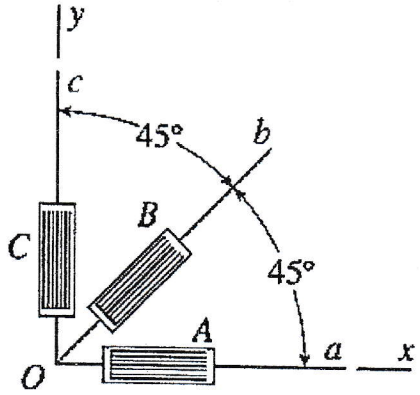
2. Define product moment of inertia. Calculate principal moment of inertia and show their orientation of the following homogenous plate. [1+6]



3. For the stresses shown in the figure, find the normal and tangential stress at a plane inclined at 60 degrees with major axis. Also determine principal stresses and their orientation. Verify the results with Mohr's circle. [4+3]



4. A ~~rectangular~~ strain rosette, shown in figure, gives following readings in a strain measurement task, $\epsilon^a = 1000 \times 10^{-6}$, $\epsilon^b = 800 \times 10^{-6}$, $\epsilon^c = 600 \times 10^{-6}$. Determine the principal strain and principal planes. [4]



5. Define hoop and longitudinal stress. Prove that longitudinal stress is half of the circumferential stress for the thin cylinder with neat sketch. [1+3]

6. a) Show that hollow shaft is more strong than solid shaft when material, weight and length are same. [4]

   b) A solid circular shaft transmits 75 kW power at 200 RPM. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1° in 2 meters length of shaft, and shear stress is limited to 50 MN/m^2. Take G = 100 GN/m^2. [3]

7. a) Derive pure bending equation. [4]

   b) A cantilever beam 4m carries anunfirmly distributed load of 50kN/m over the whole span. The beam is of T-section with web 45cm x 3cm and flange is 35cm x 5cm making overall depth of 50cm. Find the maximum tensile and compressive stresses if the flange is at the bottom and horizontal. Also determine the stress and its nature at 3 cm from top. [6]

8. Derive Euler's formula of critical load for a steel column with one end fixed and other hinged. Derive the condition of no tension in rectangular column. [4+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Ashwin

Exam.	Regular (New Course -2080 Batch)		
Level	BE	Full Marks	60
Programme	BCE	Pass Marks	24
Year / Part	I / II	Time	3 hrs.

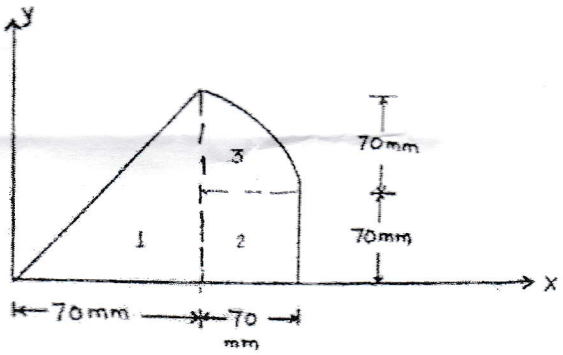
Subject: - Strength of Materials *(CE 151)*

- ✓ 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.*

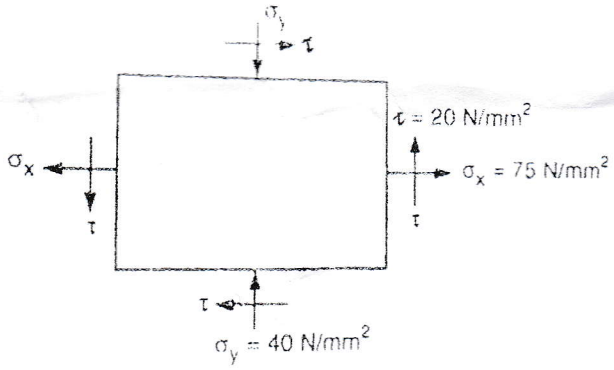
1. a) Derive the expression for the extension in a bar of length ℓ, uniformly tapering from a diameter d_1 at one end to a diameter d_2 at another end subjected to an axial tensile load P. [7]

   b) A reinforced concrete column is 300mm x 300mm in section. The column is provided with 8 bars of 20 mm diameter. The column carries a load of 360kN.Find the stresses in concrete and the steel bars. Take $E_s = 2.1 \times 10^5$ N/mm^2 and $E_c = 0.14 \times 10^5$ N/mm^2. [5]

2. State the parallel axis theorem. Determine principal MOI for the section shown below. [1+6]



3. a) State the state of stress at a point in a two-dimensional strained material is as shown in the figure. Determine the magnitude of principal stresses, orientation of principal planes and maximum shear stress. Also, determine resultant stress on the plane of maximum shear stress. [7]



   b) Draw the Mohr's circle diagram for plane strain and show on it the value of principal strains. [5]

4. a) A thin cylindrical shell is 4 m long and has 2m internal diameter and 14 mm metal thickness. Calculate the maximum intensity of shear produced and change in dimension of shell if it subjected to an internal pressure of 3 N/mm^2. Take $E = 2\times10^5$ N/mm^2 and $v = 0.3$. [4]

b) Mention the physical meaning of torsional rigidity. A solid shaft transmits 250 kW at 100 rpm. If the shear stress is not to exceed 75 MPa, what should be the diameter of the shaft. Let the shaft is replaced by a hollow shaft whose internal is 0.6 times the outer diameter. Determine the size and percentage saving in weight if the maximum shear stress being the same. [2+6]

5. A symmetrical I-section beam has 200 mm wide flanges and overall depth 500 mm. Each flange is 25 mm thick and the web is 20 mm thick. Determine (i) the maximum bending moment that should be imposed in the section if the tensile or the compressive stress is not exceed 40 N/mm^2 (ii) Determine the shear stress variation in this section. [6+4]

6. Mention the limitations of Euler's formula for buckling. Derive the relation of crippling load for a long column with one end hinged and other end fixed. [2+5]

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