KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.E.
Year : II

Course : CIEG 208
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

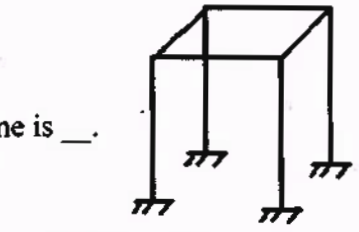
Registration No.:

Date 28 NOV 2023

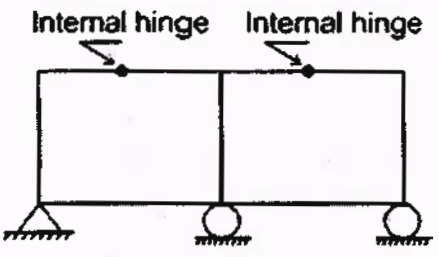
SECTION "A"
[20 Q. × 0.5 = 10 marks]

Encircle the most appropriate option.

1. The number of equilibrium equations for the following space frame is __.
   a. 1 b. 3 c. 6 d. 4



2. Degree of static indeterminacy for the frame shown is _____.
   a. 8
   b. 7
   c. 6
   d. 5



3. A tensile test is performed on a round bar. After fracture, it has been found that the diameter remains approximately same at fracture. The material under test was
   a. Mild steel b. Cast iron c. Copper d. Aluminum

4. For uniformly varying load, the number of point of contraflexture in simply supported beam are
   a. 3 b. 1 c. 2 d. 0

5. The stresses on two perpendicular planes through a point are 60 N/mm^2 (tension), 40 N/mm^2 (compression) and 30 N/mm^2 (shear). What is the normal stress on a plane at 60° to that of the tensile stress?
   a. 10.98 N/mm^2 b. 17.63 N/mm^2 c. 20.98 N/mm^2 d. 32.63 N/mm^2

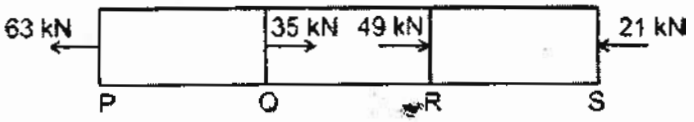
6. If a piece of material neither expands nor contracts in volume when subjected to stresses, then the Poisson's ratio must be
   a. Zero b. 0.25 c. 0.33 d. 0.5

7. A rod 3 m long is heated from 10°C to 90°C. Find the expansion of rod. Take Young's modulus = 1.0 × 10^5 MN/m^2 and coefficient of thermal expansion = 0.000012 per degree centigrade.
   a. 0.288 cm b. 0.208 cm c. 0.168 cm d. 0.348 cm

8. In the Biaxial stress condition and if stress along x and y axis are same then the shear stress is

a. $\tau_{max} = -\sigma_x$ b. $\tau_{max} = \frac{\sigma_x}{2}$ c. $\tau_{max} = \sigma_x$ d. $\tau_{max} = \sigma_x + \sigma_y$

9. A cross – section of bar of area 700 mm^2 is subjected to an axial load as shown in the figure below. What is the value of stress (MPa) in the section PQ?



a. 30 b. 90
c. 40 c. 50

10. A boiler of 1.6 m diameter is made of a 20 mm thick plate. What will be the permissible steam pressure in the boiler in the maximum tensile stress in the plates must **NOT** exceed 80 MPa?

a. 2 MPa b. 2 GPa c. 20 MPa d. 20 GPa

11. For a thin spherical shell subjected to internal pressure, the ratio of volumetric strain to diametrical strain is ____.

a. 5 : 4 b. 3 : 2 c. 2 : 1 d. 3 : 1

12. Which of the following is the **INCORRECT** statement related to the theory and analysis of torsion?

a. A member is said to be under pure torsion when it is subjected to two equal and opposite torques.
b. If a moment is applied in a vertical plane containing the longitudinal axis of the beam, it will be subjected to torque, causing torque in the member.
c. Shear stress is maximum at the surface of a shaft and zero at its longitudinal axis.
d. It is assumed that the material of the shaft is home and isotropic.

13. A circular shaft of diameter D and length L is subjected to a torque T and a bending moment M. The ratio of maximum shear stress to bending stress is:

a. $\frac{2T}{M}$ b. $\frac{T}{4M}$ c. $\frac{T}{M}$ d. $\frac{T}{2M}$

14. A cantilever beam of length L, with uniform cross section and flexural rigidity, EI is loaded uniformly by a vertical load of w kN/m. The maximum vertical deflection of the beam is given by:

a. $\frac{wL^4}{16\,EI}$ b. $\frac{wL^4}{8\,EI}$ c. $\frac{wL^4}{4\,EI}$ d. $\frac{wL^4}{24\,EI}$

15. Consider the following assumptions for pure bending theory:

i. The material is heterogeneous and isotropic.
ii. The stress is purely longitudinal and local effects near concentrated loads will be neglected.
iii. The radius of curvature is large compared with the dimensions of the cross-section.

Which of the above statements are **CORRECT**?

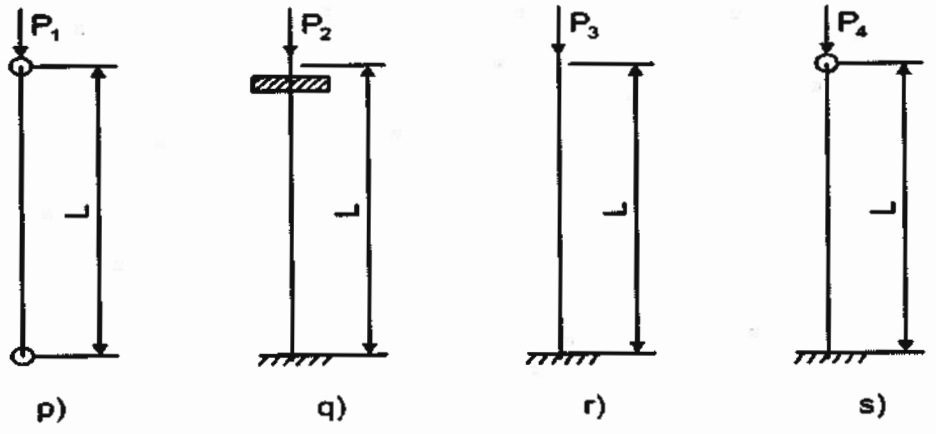
a. i and ii only b. ii and iii only c. i and iii only d. i, ii and iii

16. The bending stress is ___
    a. Directly proportional to the distance of layer from the neutral layer
    b. Inversely proportional to the distance of layer from the neutral layer
    c. Directly proportional to the neutral layer
    d. Does not depend on the distance of layer from the neutral layer

17. Which geometric property contributes to the moment of inertia of a rotating object?
    a. Area b. Volume c. Shape d. Density

18. A rectangular c/s beam of size 300 mm × 500 mm is subjected to shear force of 20 kN. What is the shear stress at 150 mm above neutral axis?
    a. 0.30 MPa b. 0.60 MPa c. 0.26 MPa d. 0.13 MPa

19. Buckling loads (Pi) of 4 columns of equal length and cross section, but with different end conditions are shown below. Which of the following is **TRUE?**



    a. P1< P2< P3 < P4
    b. P3< P1 < P4< P2
    c. P1< P4< P2 < P3
    d. P3 < P4 < P1< P2

20. Which one of the following is **NOT** the assumption of Euler's column theory?
    a. The direct stress is very small compared to the bending stress.
    b. The self-weight of the column is considerable.
    c. The cross-section of the column is uniform throughout.
    d. The column will fail by buckling only.

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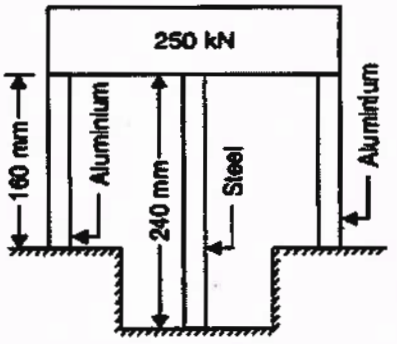
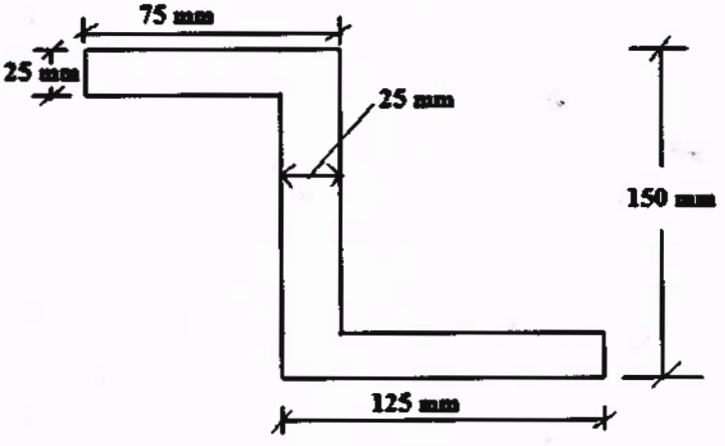
SECTION "B"

Attempt *ALL* Questions. Assume suitable data if necessary.

1. Derive an expression for normal and shear stresses on an inclined plane subjected to pure shear. Three pillars, two of aluminium and one of steel support a rigid platform of 250 kN as shown in Figure. If area of each aluminium pillar is 1200 mm^2 and that of steel pillar is 1000 mm^2, find the stresses developed in each pillar. Take Es = 2 × 105 N/mm^2 and Ea = 1 × 106 N/mm^2. [3+4 =7]

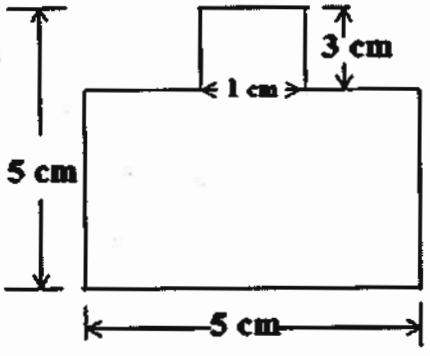


2. Determine the orientation of principal axes and principal moment of inertia about centroidal axes of the composite section shown in figure. [6]



3. A hollow shaft having internal diameter 40% of its external diameter, transmits 562.5 kW power at 100 RPM. Determine the external diameter of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5 m should not exceed 1.3 degrees. Assume maximum torque is equal to 1.25 times of mean torque and modulus of rigidity as 9×10^4 N/mm^2. [5]

4. Prove that the neutral passes through the centroid of beam under pure bending moment. Determine the variation of horizontal shear stress for following section shown when shear force is 50 kN. [2+5 = 7]



5. A boiler shell is to made of 15 mm thick plate having tensile stress of 120 MN/m^2. If the efficiency of the longitudinal and circumferential joints are 70% and 30% respectively, determine, (i) maximum permissible diameter of the shell for an internal pressure of 2 MN/m^2 and permissible intensity of internal pressure when the shell diameter is 1.5 m. [4]

6. Explain the concept of Euler's theory of buckling of column stating with the effective length, and derive the relation for crippling load when both the ends of the columns are fixed. [1+3 = 4]

7. Draw axial force, shear force and bending moment diagrams for the frame shown in figure, indicating the principal numerical values at salient point. [7]