KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Marks Scored:

Level : B.E.
Year : II

05 FEB 2024

Course : CIEG 208
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"
[20Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate answer.

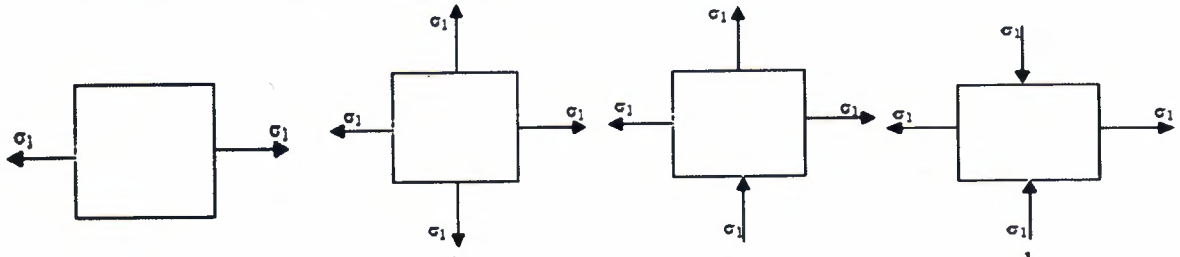
1. The neutral axis of a beam cross-section must
   a. Pass through the centroid of the section b. Be equidistant from the top of bottom films
   c. Be an axis of symmetry of the section d. None of these

2. A steel rod of diameter 1 cm and 1 m long is heated from 20°C to 120°C. Its $\alpha = 12 \times 10^{-6}\ /K$ and E=200 GN/m$^2$. If the rod is free to expand, the thermal stress developed in it is:
   a. $12 \times 10^4$ N/m$^2$ b. 240 kN/m$^2$ c. zero d. infinity

3. The unit of elastic modulus is the same as those of
   a. Stress, shear modulus and pressure b. Strain, shear modulus and force
   c. Shear modulus, stress and force d. Stress, strain and pressure.

4. A body is subjected to a pure tensile stress of 100 units. What is the maximum shear produced in the body at some oblique plane due to the above?
   a. 100 units b. 75 units c. 50 units d. 0 unit

5. A material element subjected to a plane state of stress such that the maximum shear stress is equal to the maximum tensile stress, would correspond to




a. b. c. d.

6. The ratio of the area under the bending moment diagram to the flexural rigidity between any two points along a beam gives the change in
   a. Deflection b. Slope c. Shear force d. Bending moment

7. A cantilever of length L, moment of inertia I. Young's modulus E carries a concentrated load W at the middle of its length. The slope of cantilever at the free end is:
   a. $\frac{WL^2}{2EI}$ b. $\frac{WL^2}{4EI}$ c. $\frac{WL^2}{8EI}$ d. $\frac{WL^2}{16EI}$

8. Two beams, one having square cross section and another circular cross-section, are subjected to the same amount of bending moment. If the cross sectional area as well as the material of both the beams are the same then
   a. Maximum bending stress developed in both the beams is the same
   b. The circular beam experiences more bending stress than the square one
   c. The square beam experiences more bending stress than the circular one
   d. As the material is same both the beams will experience same deformation

9. The transverse shear stress acting in a beam of rectangular cross section, subjected to a transverse shear load, is:
   a. Variable with maximum at the bottom of the beam
   b. Variable with maximum at the top of the beam
   c. Uniform
   d. Variable with maximum on the neutral axis

10. A solid circular shaft of 60 mm diameter transmits a torque of 1600 N.m. The value of maximum shear stress developed is:
   a. 37.72 MPa  b. 47.72 MPa  c. 57.72 MPa  d. 67.72 MPa

11. For the two shafts connected in parallel, find which statement is **TRUE**?
   a. Torque in each shaft is the same  b. Shear stress in each shaft is the same
   c. Angle of twist of each shaft is the same  d. Torsional stiffness of each shaft is the same

12. A thin cylindrical shell of diameter d, length 'L' and thickness 't' is subjected to an internal pressure p. What is the ratio of longitudinal strain to hoop strain in terms of Poisson's ratio (1/m)?
   a. $\frac{m-2}{2m+1}$  b. $\frac{m-2}{2m-1}$  c. $\frac{2m-1}{m-2}$  d. $\frac{2m+2}{m-1}$

13. A metal pipe of 1m diameter contains a fluid having a pressure of 10 kg/cm$^2$. Lf the permissible tensile stress in the metal is 200 kg/cm$^2$, then the thickness of the metal required for making the pipe would be:
   a. 5 mm  b. 10 mm  c. 20 mm  d. 25 mm

14. For which one of the following columns, Euler buckling load $=\frac{4\pi^2 EI}{L^2}$ ?
   a. Column with both hinged ends  b. Column with one end fixed and other end free
   c. Column with both ends fixed  d. Column with one end fixed and other hinged

15. The buckling load for a given material depends upon:
   a. Slenderness ratio and cross sectional area
   b. Slenderness ratio and modulus of elasticity
   c. Poisson's ratio and modulus of elasticity
   d. Poisson's ratio and Slenderness ratio

16. The product of inertia for an area is required so as to_____.
   a. Determine maximum moments of inertia for an area
   b. Determine maximum moments of inertia for a line
   c. Determine maximum moments of inertia for a volume
   d. Determine maximum moments of inertia for a rectangle

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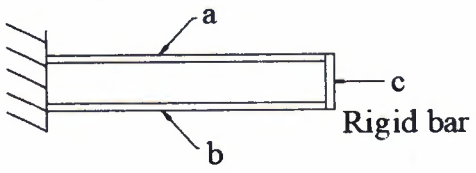
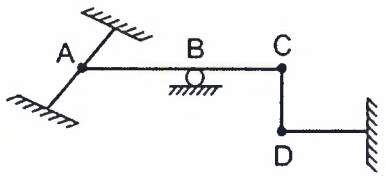
17. A composite member shown in figure was formed at 25°C and was made of two materials "a" and "b". If the coefficient of thermal expansion of "a" is more than that of "b" and the composite member is heated up to 45°C, then




a. "a" will be in tension and "b" in compression
b. Both will be in compression
c. Both will be in tension
d. "a" will be in compression and "b" in tension

18. The total (both external and internal) degrees of indeterminacy of the plane frame structure shown in the figure is




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

19. If there are m unknown member forces, r unknown reaction components and j number of joints, then the degree of static indeterminacy of a pin-jointed plane frame is given by
a. m+r-3j b. m-r+2j c. m+r-2j d. m+r+2j

20. A compressive member always tends to buckle in the direction
a. Axis of load
b. minimum cross-section
c. perpendicular to the axis of load
d. Least radius of gyration

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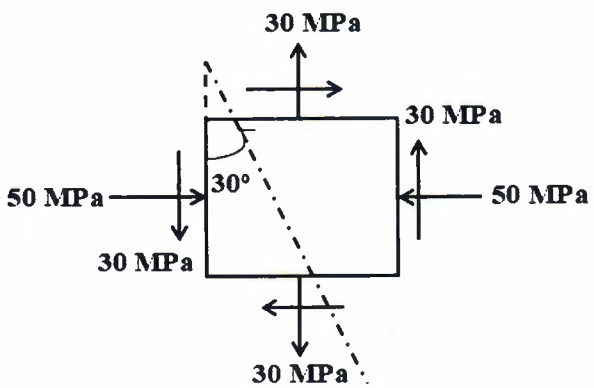
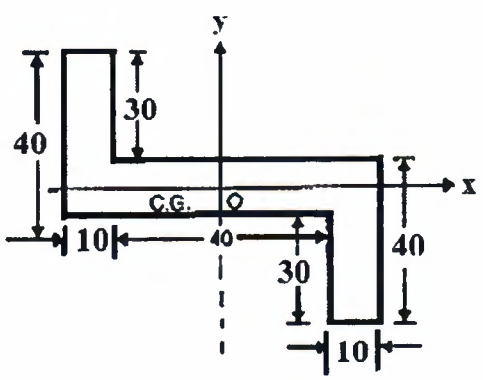
SECTION "B"

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

1. Derive the expression for the total elongation of uniformly tapering rectangular bar. 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 30° with vertical. Also calculate principal stresses, their planes, maximum shear stresses and their planes. [3+5=8]

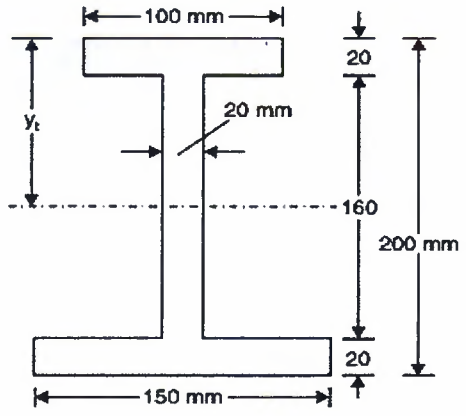



2. Determine the orientation of principal axes and principal moment of inertia about centroidal axes of the composite section shown in figure. ***All dimensions are in cm.*** [6]




3. A solid circular shaft and a hollow circular shaft whose inside diameter is ( $\frac{3}{4}$ ) of the outside diameter, are of the same material, of equal length and are required to transmit a given torque. Compare the weights of these two shafts if the maximum shear stress developed in the two shafts are equal. [4]

4. Write the assumptions made in the theory of pure bending. The unsymmetric I-section shown in figure is the cross-section of a beam, which is subjected to a shear force of 60 kN. Draw the shear stress variation diagram across the depth. [1+6=7]




5. A cylindrical vessel, whose ends are closed by means of rigid flange plates, is made of steel plate 3 mm thick. The length and the internal diameter of the vessel are 50 cm and 25 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical shell due to an internal fluid pressure of 3 $N/mm^2$. Also calculate the increase in length, diameter and volume of the vessel. Take $E = 2\times10^5$ $N/mm^2$ and Poisson's ratio = 0.3. [4]

6. State the limitation of Euler's formula for calculating critical load on columns. A cast iron hollow cylindrical column 4 m long is hinged at both ends and its critical buckling load is P kg. When the same column is fixed at both the ends, its critical load rises to (P + 50,000) kg. If the ratio of external diameter to internal diameter is 1.30 and $E = 1 \times 10^6$ $kg/cm^2$, determine the external diameter of the column. [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 if any. [7]