

KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.Arch.
Year : II

Course : CIEG 241
Semester : II

Exam Roll No. : Time: 30 mins.

F. M. : 10

Registration No.:

Date 27 FEB 2025

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option from each set of choices

1. Torsional rigidity is defined as the torque required to introduce unit angle of twist in unit shaft length and is given by
a. GI b. GJ c. EI d. GL
2. Euler's formula holds good only for
a. Short columns b. Long columns c. Weak columns d. Strong Columns
3. A body is subjected to a tensile stress of 1200 MPa on one plane and another tensile stress of 600 MPa on a plane at right angles to the former. It is also subjected to a shear stress of 400 MPa on the same planes. The maximum normal stress will be
a. 1300 MPa b. 1600 MPa c. 1500 MPa d. 1400 MPa
4. What is the moment generated for a cantilever beam of length 'l' m loaded with uniform load of 'w' kN/m
a. wl b. wl/2 c. wl² d. wl²/2
5. The neutral axis of the cross-section a beam is that axis at which the bending stress is
a. Zero b. minimum c. maximum d. One
6. The tearing strength per pitch length of a riveted joint is equal to
a. (p - d) * t * σ_c b. (p - d) * t * σ_t
c. (p - d) * t * τ d. (p - 2d) * t * σ_t
Where, p=pitch, d= rivet dia, t= plate thickness
7. For a cantilever beam, bending moment is zero at
a. One fourth from the free end b. Fixed end
c. Center of beam d. Free end
8. The crippling load according to Euler theory of long column when one end is fixed and other is pinned is equal to
a. $\frac{4\pi^2 EI}{l^2}$ b. $\frac{\pi^2 EI}{l^2}$ c. $\frac{\pi^2 EI}{4l^2}$ d. $\frac{2\pi^2 EI}{l^2}$
9. The relationship between modulus of rigidity G, modulus of elasticity E and Poisson's Ratio ν is expressed as
a. $E = \frac{G}{1+\nu}$ b. $G = \frac{E}{2+\nu}$ c. $G = \frac{E}{1+2\nu}$ d. $G = \frac{E}{2(1+\nu)}$

10. The strain energy stored in a body when the load is applied gradually is equal to
 a. $\frac{\sigma^2}{2E} V$ b. $\frac{\sigma^2}{E} V$ c. $\frac{\sigma^2}{2V} E$ d. $\frac{\sigma^2}{V} E$
11. Angle of Obliquity is given by ϕ as
 a. $\tan\phi = \tau/\sigma_n$ b. $\tan\phi = 1 - \tau/\sigma_n$ c. $\tan\phi = \sigma_n/\tau$ d. $\tan\phi = \tau/\sigma_n + 1$
12. When a rectangular section of the beam is subjected to a shearing force, the ratio of maximum shear stress to the average shear stress is
 a. 2 b. 1.75 c. 1.5 d. 1.25
13. A simply supported beam carries a point load at its center. The slope at its support is given as
 a. $\frac{WL^2}{16EI}$ b. $\frac{WL^3}{48EI}$ c. $\frac{WL^3}{16EI}$ d. $\frac{WL^2}{48EI}$
14. Parallel Axis theorem states that
 a. $I_{AB} = I_G + Ah^2$ b. $I_G = I_{AB} + Ah^2$ c. $I_{AB} = I_G + Ah^3$ d. $I_{AB} = I_G - Ah^2$
- where, I_{AB} is MOI about axis AB, I_G is MOI about Centroidal axis, A is area of lamina and h is perpendicular distance between centroid and AB.
15. A shaft is revolving at N rpm transmits torque, T kg-m. The power developed is given as
 a. $2\pi NT$ kW b. $2\pi NT/30$ kW c. $2\pi NT/60$ kW d. $2\pi NT/120$ kW
16. _____ support allows rotation & lateral movement but no vertical movement.
 a. Fixed b. Roller c. Pin d. Free
17. The polar moment of inertia of a solid shaft of diameter D is
 a. $\frac{\pi d^3}{16}$ b. $\frac{\pi d^2}{32}$ c. $\frac{\pi d^3}{32}$ d. $\frac{\pi d^4}{32}$
18. For a column of length l, with one end fixed and other end hinged its effective length is given as
 a. $2l$ b. $0.5l$ c. $0.707l$ d. l
19. The deformation per unit length is called
 a. Tensile stress b. compressive stress
 c. shear stress d. strain
20. A rectangular block 100 cm^2 is subjected to an axial load of 20 kN. Find shear stress if inclined to 30 degrees with normal cross section of bar.
 a. 0.86 MPa b. 0.5 MPa c. 1.73 MPa d. 1 MPa

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SECTION "B"

Attempt *ALL* questions.

1.
 - a. Draw and explain the various regions of the stress-strain curve for a mild steel. [2]
 - b. Explain how will you draw the shear stress distribution diagram for a composite? [2]

2. A composite beam is shown in **Figure 1**. Calculate
 - a. Moment of Inertia (MoI) about Centroidal axis.
 - b. its principal moment of inertia and their orientation.
 - c. What will be MoI about new axis when the beam is rotated by 35 degrees anticlockwise? [2+2+2]

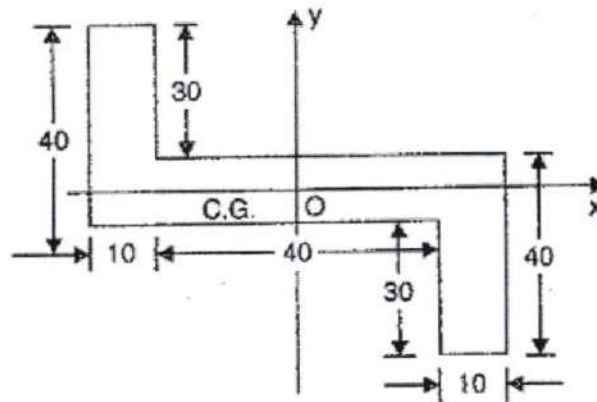


Figure 1 (All dimensions are in cm).

3. A plane element in a boiler is subjected to tensile stresses of 400 MPa on one plane and 150 MPa on the other at right angles to the frame. Each of the above stresses is accompanied by a shear stress of 100 MPa such that when associated with minor tensile stress tends to rotate the element in anticlockwise direction. Calculate
 - a. Principal stresses and their directions
 - b. Maximum shearing stresses and the directions of the plane on which they act. [2.5+2.5]

OR

Derive the relation for normal and shear stress for a member subjected to a 2D stress system. Also derive their maximum and minimum normal stress along with the direction. [5]

P.T.O.

4. A steel rod of 5cm diameter and 5m long is connected to two grips and the rod is maintained at temperature of 95 degree. Determine stress and pull exerted when temperature fall to 30 degree if
- The ends do not yield and
 - Ends yield by 0.12 cm. Take $E=2 \times 10^5 \text{ MN/m}^2$ and coefficient of expansion $=12 \times 10^{-6} / \text{degree}$. [2.5+2.5]
5. A beam of rectangular section 20 cm wide and 40 cm deep is simply supported over a span of 5 m. It is loaded with a point load of 10 kN at the center as shown in **Figure 2**. Find the maximum bending stress at the quarter span and midspan. [2.5+2.5]

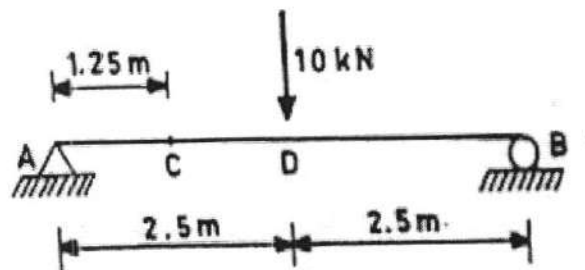


Figure 2

6. Double riveted lap joints are made in the following 2 ways:
- Diameter of rivets=2cm and pitch of rivet is 6cm
 - Diameter of rivets=3cm and pitch of rivet is 8cm. If tensile stress (σ_t) =120 N/mm², Shear stress (τ)=90 N/mm² and Crushing stress (σ_c) =160 N/mm², calculate efficiency of both joints and find out which joint has lower efficiency. Thickness of plate of 1.2cm in each case. [2.5+2.5]

OR

A beam 5m long simply supported at its ends is carrying a uniformly distributed load of 9 kN/m. The beam is of uniform rectangular section of size 20cm width by 30cm depth. If Young's Modulus of beam is $1 \times 10^4 \text{ MPa}$, calculate deflection at the midspan and slope at supports in degree. [2.5+2.5]

7. A steel shaft of 4 m length and 10 cm diameter is fixed at one end. It is twisted at the free end by the force of 5 kN acting at a radius of 50 cm. Calculate
- The angle of twist.
 - The displacement of the point of application of the force. [2.5+2.5]
- Apply $E=200 \text{ GPa}$ and Poisson ratio (ν) =0.20

8. State assumptions of Euler Formula and find Euler's buckling load (critical load) for a column with both end support pinned. [5]

OR

Derive the Torsional equation for a circular shaft of diameter D. [5]