

**Indian Maritime University**  
**(A Central University, Govt of India)**  
**End Semester Examinations – December 2022**  
**Programme Name: B Tech (NAOE)**  
**Semester: III**  
**Subject Code: UG12T2301**  
**Subject Name: Strength of Materials**

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Date : 12.12.2022	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

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General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.

**Section A**

Ten MCQs– Choose the correct answer as applicable. (10M)

1. If the principal stresses in a plane stress problem 100 MPa and 40 MPa, the magnitude of the maximum shear stress (in MPa) will be  
a. 60      b. 50      c. 30      d. 20
2. If a part is constrained to move and heated it will develop  
a. Tensile stress      b. Compressive stress  
c. Shear stress      d. Principal stress
3. The crippling load for a column by Euler's formula when both the ends are fixed .  
a.  $(\pi^2 EI) / l^2$       b.  $(\pi^2 EI) / 4l^2$       c.  $4 (\pi^2 EI) / l^2$       d.  $2(\pi^2 EI) / l^2$
4. The radial pressure  $P_x$  at any radius  $x$  in case of the thick cylinder is given by  
a.  $P_x = b/x^2 - a$       b.  $P_x = b/x^2 + a$   
c.  $P_x = x^2 / b + a$       d.  $P_x = b/2x^2 - a$
5. Shear forces between any two vertical loads  
a. maximum      b. minimum      c. constant      d. none
6. For a simply supported beam carrying a UDL over the entire span and propped at the centre the bending moment at the centre  
a.  $Wl^2 / 32$       b.  $-Wl^2 / 32$       c.  $Wl^2 / 16$       d.  $-Wl^2 / 16$

7. The bending stresses at the neutral axis is  
 a. maximum    b. minimum    c. zero    d. all the above
8. The maximum shear stress is at the Neutral axis for a rectangular section is  
 a.  $T_{\max} = 1.5 T_{\text{avg}}$     b.  $T_{\max} = 2 T_{\text{avg}}$     c.  $T_{\max} = 2.5 T_{\text{avg}}$     d.  $T_{\max} = T_{\text{avg}}$
9. An inverted T-section is subjected to shear force  $F$  the maximum shear stress will occur at  
 a. Top of the section    b. Junction of the web and flange  
 c. Neutral axis of the section    d. Bottom of the section
10. Torque per unit twist of the shaft  
 a. Stiffness of the shaft    b. strength of the shaft  
 c. Deflection of the shaft    d. curvature of the shaft

### Section B

Five Questions of 02 Marks each

(10M)

11. What is the volumetric strain of the cylindrical rod which is subjected to the axial tensile load?
12. Write short notes on a Mohr's circle of stresses.
13. Draw the shear force and bending moment diagram of the cantilever of length  $L$  carrying a UDL of  $W$  per meter length over its entire length.
14. What do you mean by pure bending?
15. What are the assumptions made in the derivation of shear stress produced in a circular shaft when it is subjected to torsion?

### Section C

ANSWER ANY FIVE

(5x10=50M)

16. A point in a strained material is subjected to the stresses shown in Figure 1. Using the Mohr's circle method determine the tangential stress across the oblique's plane. Check the answer analytically

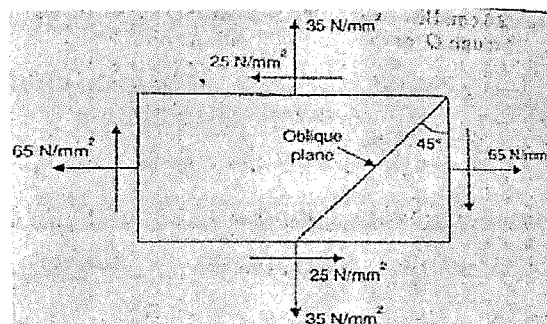


Figure 1

17. What do you mean by point of contra flexure? Draw the shear force and bending moment diagram for the beam loaded as shown in the Figure 2 . Also locate the point of contra flexure. (UDL- 30kN/m and point load 80kN)

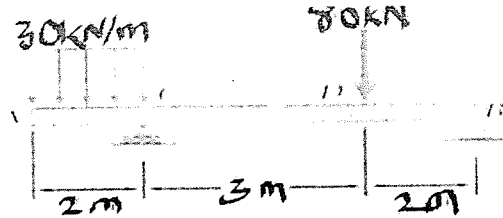


Figure 2

18. A fixed beam of length 6m carries a point load of 160kN and 120kN at a distance of 2m and 4m from the left end A. Find the fixed end moments and the reactions at the supports .Draw bending moment shear force diagrams and find the maximum deflection.

19. A cast iron beam is of I section as given in Figure 3 .The beam is simply supported on a span of 5 meters. If the tensile stress is not exceeding 20 N/mm<sup>2</sup>, find the safe UDL which the beam can carry. Find also the maximum compressive stress.

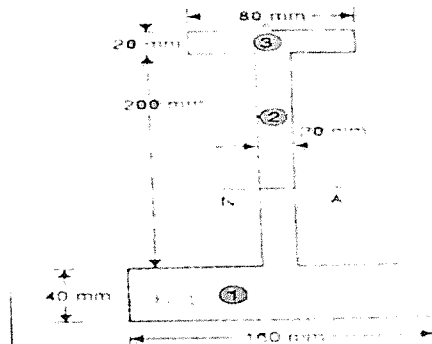


Figure 3

20. Derive the expression for the circumferential stress, longitudinal stress and maximum shear stress for a thin shell subjected to the internal fluid pressure.

21. (a) Find an expression for crippling load of a long column when one end is fixed and the other end is pinned. (6M)

(b) A solid round bar 3m long and 5cm in diameter is used as a strut with both ends hinged. Determine the crippling load. (4M)

22. What is the deflection of the simple supported beam carrying a point load at the centre .And calculate the deflection at the centre and slope at the centres for the beam of length of 6m simply supported at the ends , carrying a point load of 50kN at the centre. The moment of inertia is given as equal to  $78 \times 10^6 \text{ mm}^4$ .  $E = 2.1 \times 10^5 \text{ N/mm}^2$ . (10M)