Printed Page:- 05 **Subject Code:- AME0403**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: IV - THEORY EXAMINATION (2023 - 2024)
Subject: Strength of Materials

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. The ratio of modulus of rigidity to modulus of elasticity for a Poisson's ratio of 0.25 would be. [CO1] 1

(a) 0.5
(b) 0.4
(c) 0.3
(d) 1

1-b. The normal stress on an oblique plane at an angle θ to the cross-section of a body which is subjected to a direct tensile stress (σ) is equal to. [CO1] 1

(a) $(\sigma/2)\sin 2\theta$
(b) $\sigma \cos \theta$
(c) $\sigma \cos 2\theta$
(d) $\sigma \sin 2\theta$

1-c. Maximum deflection of a cantilever beam of length l carrying uniformly distributed load w per unit length will be: [CO2] 1

(a) wl4/ (16EI)
(b) wl3/ (24EI)
(c) wl3/ (48EI)
(d) wl4/ (8EI)

1-d. The neutral axis of a section is an axis, at which the bending stress is (CO2) 1

(a) Minimum
(b) Zero
(c) Maximum
(d) Infinity

1-e. Slenderness ratio is defined as the ratio of. [CO3] 1

(a) Equivalent length of the column to the minimum radius of gyration
(b) Length of the column to the minimum radius of gyration
(c) Length of the column to the area of cross-section of the column
(d) Minimum radius of gyration to the area of cross-section of the column.

1-f. A column of length l is hinged at its both ends. Its equivalent length will be equal to (CO3) 1

(a) 2l
(b) l
(c) 0.5 l
(d) 0.707 l

1-g. The maximum shear stress in a thin cylindrical shell, when subjected to an internal pressure (p) is equal to (CO4) 1

(a) pD/4t
(b) pD/8t
(c) pD/2t
(d) pD/t

1-h. Thin cylinder shell designed is based on (CO4) 1

(a) Hoop stress
(b) Longitudinal stress
(c) Shear stress
(d) None of the above

1-i. Shear stress at top most fibre of rectangular section is _____[CO5] 1

(a) Maximum
(b) Minimum
(c) Zero
(d) Uniform through out

1-j. For the same loading, the maximum bending moment for a fixed beam as compared to simply supported beam is. [CO5] 1

(a) More
(b) Less
(c) Same
(d) None of the above.

2. Attempt all parts:-

2.a.	What do you mean by ultimate tensile strength and yield strength? [CO1]	2
2.b.	Compare the strength of hollow and solid shaft if their weights, materials and lengths are same. [CO2]	2
2.c.	Write the relation between length of column and equivalent length in various end conditions. [CO3]	2
2.d.	What is the effect of riveting a thin cylinder shell? [CO4]	2
2.e.	Give the reasons of unsymmetrical bending.[CO5]	2

SECTION-B 30

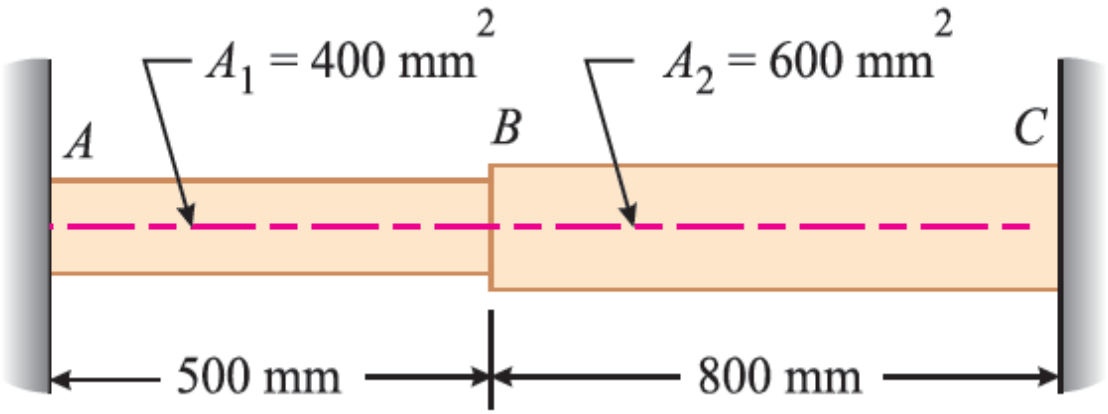
3. Answer any five of the following:-

3-a.	Derive an expression for strain energy stored in a body when the load is suddenly applied. [CO1]	6
3-b.	Define the following terms 'Poisson ratio, Volumetric strain, Modular ratio and Strain energy'. [CO1]	6
3-c.	Derive an expression for strength of hollow circular shaft of outer diameter D and inner diameter d, when subjected to shear stress(τ). [CO2]	6
3-d.	Define torsion of shaft. Derive an expression for torsion equation of solid circular shaft subjected to torque T. [CO2]	6
3.e.	Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Take E = 205 GPa. Also determine crippling load by Rankine's formula using constants as 335 MPa and 1/7500. [CO3]	6
3.f.	Drive an expression for circumferential stress in a thin cylindrical shell subjected to an internal pressure. [CO4]	6
3.g.	What do you mean by curved beams? How bending of beams with large initial curvature if differ from small initial curvature? [CO5]	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	A steel rod ABC is firmly held between two rigid supports A and C as shown in Fig below. Find the stresses developed in the two portions of the rod, when it is heated through 15 K. Take a = 12×10^{-6} / K and E = 200 GPa.[CO1]	10



4-b. The stresses at a point of a machine component are 200 MPa (tensile) and 100 MPa (compressive). Find the intensities of normal, tangential, and resultant stress on a plane inclined at an angle of 60° with the axis of major tensile stress. Also determine the direction of the resultant stress and the magnitude of the maximum intensity of shear stress. Solve this problem by Mohr's circle. [CO1] 10

5. Answer any <u>one</u> of the following:-

5-a. Determine the slope and deflection of simply supported beam of length l subjected a uniformly distributed load w over the length of beam by Macaulay's method.[CO2] 10

5-b. A solid shaft of 200 mm diameter has the same cross-sectional area as a hollow shaft of the same material with inside diameter of 150 mm. Find the ratio of (a) powers transmitted by both the shafts at the same angular velocity. (b) angles of twist in equal lengths of these shafts, when stressed to the same intensity.[CO2] 10

6. Answer any <u>one</u> of the following:-

6-a. Drive an expression for deflection and stiffness of closed coiled helical spring subjected to axial load W.[CO3] 10

6-b. A leaf spring 750 mm long is required to carry a central point load of 8 kN. If the central deflection is not to exceed 20 mm and the bending stress is not greater than 200 MPa, determine the thickness, width, and number of plates. Also compute the radius, to which the plates should be curved. Assume width of the plate equal to 12 times its thickness and E equal to 200 GPa.[CO3] 10

7. Answer any <u>one</u> of the following:-

7-a. A cylindrical shell of 500 mm diameter is required to withstand an internal pressure of 4 MPa. Find the minimum thickness of the shell, if maximum tensile strength in the plate material is 400 MPa and efficiency of the joints is 65%. Take factor of safety as 5. [CO4] 10

7-b. A thick metallic cylindrical shell of 150 mm internal diameter is required to withstand an internal pressure of 8 N/mm^2. Find the necessary thickness of the shell, if the permissible tensile stress in the section is 20 N/mm^2. [CO4] 10

8. Answer any <u>one</u> of the following:-

8-a. A hook carries a load of 7.5 kN and the load line is at a distance of 20 mm from the inner edge of the section which is trapezoidal. The load line also passes through the centre of curvature of the hook. The dimensions of the central horizontal trapezoidal section are: inner width = 30 mm; outer width = 15 mm, depth = 30 mm. Calculate the maximum and minimum stresses.[CO5] 10

8-b. A channel section has flanges 12 cm × 2 cm and web 16 cm × 1 cm. Determine the shear centre of the channel.[CO5] 10