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 thermal strain is given by. **[CO1]** 1

(a) α*ΔT

(b) EΔT/α

(c) Eα/ΔT

(d) 1/EαΔT

1-b. In terms of Poisson's ratio the ratio of young's modulus and bulk modulus of an elastic material is. **[CO1]** 1

(a) 3(1+μ)

(b) 3(1-2μ)

(c) 2(1+μ)

(d) 2(1-2μ)

1-c. Maximum slope of a cantilever beam of length l carrying uniformly varying load w per unit length will be. **[CO2]** 1

(a) $wl^2/(16EI)$

(b) $wl^3/ (24EI)$

(c) $wl^3/ (48EI)$

(d) $wl^2/ (4EI)$

1-d. When a cantilever is loaded at its free end, maximum compressive stress shall develop at. **[CO2]** 1

(a) Bottom fibre

(b) Top fibre

(c) Neutral axis

(d) Centre of gravity

1-e. A laminated spring 1 m long is made up of plates each 50 mm wide and 10 mm thick. If the bending stress in the plates is limited to 100 MPa, how many plates are required to enable the spring to carry a central point load of 2 kN?. **[CO3]** 1

(a) 8

(b) 6

(c) 10

(d) 4

1-f. A close-coiled helical spring is required to carry a load of 150 N. If the mean coil diameter is to be 8 times that of the wire, calculate wire diameter. Take maximum shear stress as 100 MPa. **[CO3]** 1

(a) 5.53 mm

(b) 6.8 mm

(c) 4.2 mm

(d) 8 mm

1-g. The hoop or circumferential stress in a thin cylindrical shell of diameter (D), length (L) and thickness (t), when subjected to an internal pressure (p) is equal to- (CO4) 1

(a) pD/4t

(b) pD/2t

(c) 2pD/t

(d) 4pD/t

1-h. The longitudinal stress in case of thick cylinders (CO4) 1

(a) Is uniformly distributed

(b) Varies from maximum at the outer circumference to minimum at inner circumference

(c) Varies from maximum at the inner circumference to minimum at outer circumference

(d) None of the above.

1-i. Neutral axis of a beam always coincides with (CO5) 1

(a) Axis passing through bottom of beam

(b) Axis passing through height h/2 from bottom

(c) Axis passing through height h/3 from bottom

(d) Axis passing through centroid

1-j. A body having similar properties throughout its volume is said to be _____**[CO5]** 1

(a) Isotropic

(b) Homogeneous

(c) Continuous

(d) Uniform

2. Attempt all parts:-

2.a. Explain how principal of super position is used while analyzing an axially loaded member. **[CO1]** 2

2.b. Differentiate between the terms section modulus and flexural rigidity. **[CO2]** 2

2.c. What is slenderness ratio? **[CO3]** 2

2.d. What are the failure criteria for thin cylinder shell? **[CO4]** 2

2.e. Discuss the stresses induced in unsymmetrical bending. **[CO5]** 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. Derive an expression for deformation of a bar of length l, uniformly tapering circular section with bigger end and smaller end diameter is d_1 and d_2 subjected to axial force P. **[CO1]** 6

3-b. A 2 m long alloy bar of 1500 mm^2 cross-sectional area hangs vertically and has a collar securely fixed at its lower end. Find the stress induced in the bar, when a weight of 2 kN falls from a height of 100 mm on the collar. Take E = 120 GPa. Also find the strain energy stored in the bar. **[CO1]** 6

3-c. Derive an expression for bending moment equation of pure bending of a beam. also write down the assumption taken. **[CO2]** 6

3-d. Find out section modulus of hollow circular section of a beam with outer diameter and inner diameter is D and d, respectively. **[CO2]** 6

3.e. Drive an expression for bending stresses of leaf spring of span length l, width b, thickness t, number of plates n, subjected to load w. **[CO3]** 6

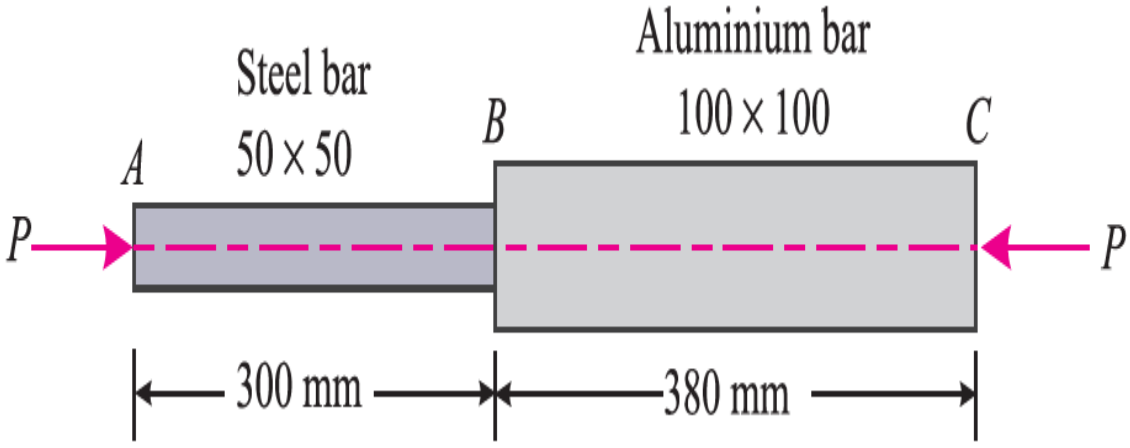
3.f. Drive an expression for longitudinal stress in a thin cylindrical shell subjected to an internal pressure. **[CO4]** 6

3.g. What do you mean by unsymmetrical bending? What are the stresses induced in a beam during bending? Explain in brief. **[CO5]** 6

SECTION C **50**

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

4-a. A member formed by connecting a steel bar to an aluminium bar is shown in Fig. Assuming that the bars are prevented from buckling sidewise, calculate the magnitude of force P, that will cause the total length of the member to decrease by 0.25 mm. The values of elastic modulus for steel and aluminium are 210 GPa and 70 GPa respectively. **[CO1]** 10



4-b. A plane element in a body is subjected to a tensile stress of 100 MPa accompanied by a shear stress of 25 MPa. Find (i) the normal and shear stress on a plane inclined at an angle of 20° with the tensile stress and (ii) the maximum shear stress on the plane.**[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 point load w at centre of a beam by Macaulay's method. **[CO2]** 10

5-b. A solid steel shaft has to transmit 100 kW at 160 r.p.m. Taking allowable shear stress as 70 MPa, find the suitable diameter of the shaft. The maximum torque transmitted in each revolution exceeds the mean by 20%. **[CO2]** 10

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

6-a. Derive an expression for Euler's crippling load for a long column when both end of column is hinged. **[CO3]** 10

6-b. A closely-coiled helical spring of round steel wire 5 mm in diameter having 12 10

complete coils of 50 mm mean diameter is subjected to an axial load of 100 N. Find the deflection of the spring and the maximum shearing stress in the material. Modulus of rigidity (C) = 80 GPa. **[CO3]**

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

7-a. What are the effects on the dimensions of thin cylindrical shell subjected in internal fluid pressure? Derive an expression for its change in dimensions. **[CO4]** 10

7-b. A pipe of 200 mm internal diameter and 50 mm thickness carries a fluid at a pressure of 10 MN/m^2. Calculate the maximum and minimum intensities of circumferential stresses across the section. Also sketch the radial stress (pressure) distribution and circumferential stress distribution across the section. **[CO4]** 10

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

8-a. A close circular ring made up of 20 mm diameter steel bar is subjected to a pull of 10 kN, whose line of action passes through the centre of the ring. Find the maximum value of tensile and compressive stresses in the ring, if the mean diameter of the ring is 160 mm. **[CO5]** 10

8-b. Derive an expression for h^2 of a rectangular section of a beam. **[CO5]** 10