Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III EXAMINATION – WINTER 2025

Subject Code:3130608 Date:19-12-2025

Subject Name: Mechanics of Solids

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1 **(a)** State and explain The Lami's theorem. **03**

(b) State and explain **04**

(i) Principle of transmissibility of force,

(ii) Principle of superposition.

(c) Fill in the blanks : **07**

(i) At neutral axis , bending stress in the beam is _____

(ii) The shear taken by the web of an I section is _____ flange.

(iii) _____ Beams have one end fixed and the other free.

(iv) The value of bending moment at the point of contra flexure will always be ___

(v) A _____has the same effect as the combined effect of forces that it replaces.

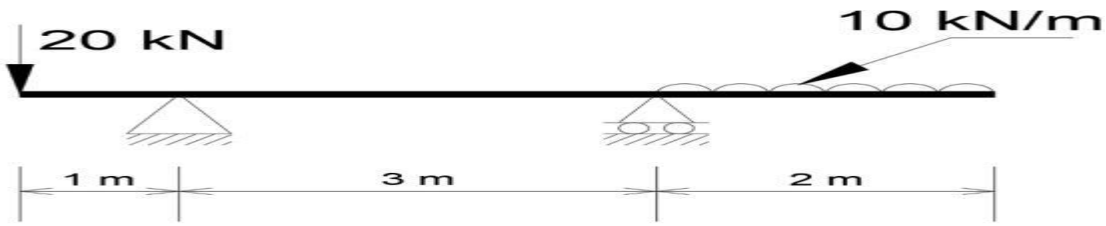
(vi) Mathematical equation of perpendicular axis theorem is _____

(vii) Frictional force will always be in a direction ___ to that in which the body tends to move.

Q.2 **(a)** Define: (1) Shear Force (2) Bending Moment (3) Points of contra flexure. **03**

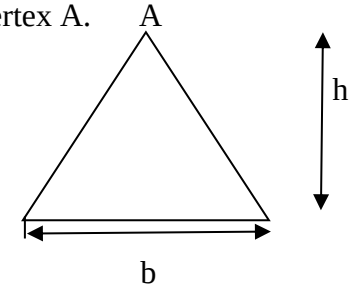
(b) Derive the relationship between rate of loading, shear force and bending moment. **04**

(c) Draw shear force diagram and bending moment diagram for a beam shown in fig.1 **07**



OR

(c) Find the moment of inertia of a triangular area about its centroidal axes and about the vertex A. **07**



Q.3 **(a)** State and explain with an example the Pappus-Guldinus theorems. **03**

(b) A steel bar of 1 meter length is subjected to 120 kN axial tensile force. The C/S of bar is 20 mm x 20 mm. The increase in length is found to be 0.5 mm and decrease in thickness is 0.003 mm. Find the value of Young's modulus and poisson's ratio. Thi **04**

(c) Define following : **07**

i. Moment of inertia of a section,
ii. Polar moment of inertia,
iii. Radius of gyration
iv. Section Modulus

OR

Q.3 **(a)** Using first principle, obtain the distance of centroid of a right-angled triangular lamina from the base. **03**

(b) Find the support reaction for beam which is loaded as shown in **Fig.** **04**

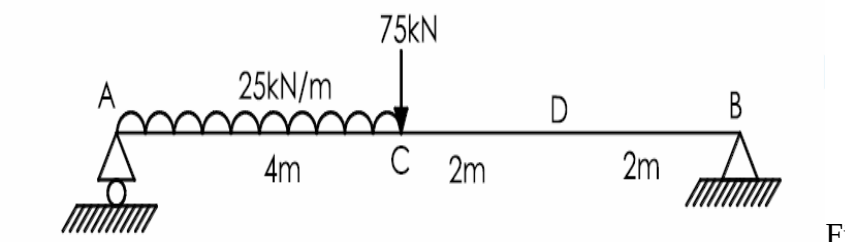


Fig. 2

(c) Calculate the maximum bending stress and maximum shear stress at a section for the beam shown in Figure-2. Beam cross section is 300mm wide × 500mm deep. **07**

Q.4 **(a)** Write down assumptions made in analysis of plane trusses. Enlist methods of analysis of plane trusses. **03**

(b) Define and explain significance of following terms/quantities. **04**

i Volumetric strain,
ii Poisson's ratio,
iii Lateral strain,
iv Modulus of elasticity,

(c) A simply supported beam of span 4.0 m having uniform section of size 200 mm width and 400 mm depth is loaded with uniformly distributed load of 40 kN/m over entire span. Determine the maximum bending moment along the span and draw the bending stress distribution across the section. **07**

OR.

Q.4 **(a)** Derive the formula for shear stress distribution in a rectangular beam section. **03**

(b) Derive theory of pure bending with usual notations. **04**

(c) A "T" section has a flange 160 mm X 12.5 mm and web 188 mm X 8 mm. It is used as a beam over span of 4.0 m to carry uniform load of 16 kN/m. Sketch the shear stress distribution at the section of maximum shear force. **07**

Q.5 **(a)** Describe the Mohr's circle method to calculate principal stresses. **03**

(b) An elastic material is subjected to two direct stresses of 200 N/ mm^2 and 80 N/ mm^2 tensile at right angles to each other. If major principal stress is limited to 210 N/ mm^2 compressive, find the value of shear stress that can be applied to the material. Also find minor principal stress. **04**

(c) Derive the torsion formula for cylindrical shaft. State the assumptions taken in derivation of torsion formula. Define the torsional rigidity. **07**

OR.

Q.5 **(a)** State and explain Varignon's principal of moments. **03**

(b) Derive the equation for deformation and stresses in composite structures. **04**

(c) A solid circular shaft has to transmit 300 kW power at 210 r.p.m. The limiting shear stress is 50 N/mm^2 and the permissible angle of twist is 1° in 3.0 m length of the shaft. Determine the minimum diameter of shaft required to transmit the power. Take G = 0.8 X 10^5 N/$mm^{2.}$ **07**

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