Enrolment No./Seat No_______________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – SUMMER 2024

Subject Code:3130608 **Date:04-07-2024**

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.**

			Marks
Q.1	**(a)**	Write the assumptions made in the analysis of plane trusses.	**03**
	(b)	State following Principles (i) Principle of superposition (ii) Principle of Transmissibility	**04**
	(c)	Calculate the magnitude and direction of the resultant of a concurrent force system shown in **Figure-1**. Use analytical method.	**07**

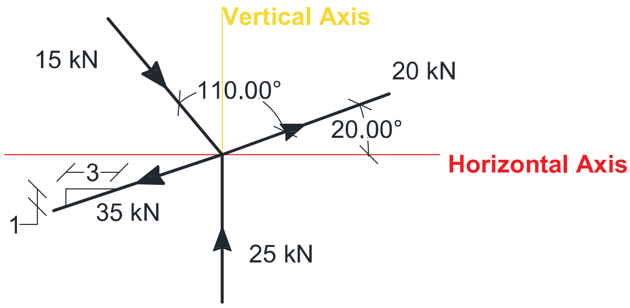

Figure-1

Q.2	**(a)**	Write down the characteristics of a couple.	**03**
	(b)	Calculate the Bending Stress at a section 2m from the left support for the beam shown in **Figure-2**. Beam cross section is 300 mm × 600 mm deep and the modulus of elasticity is 25000 MPa.	**04**
	(c)	Analyze the beam shown in **Figure-2**. Plot Bending Moment Diagram. Also, calculate maximum Bending Moment in the beam.	**07**

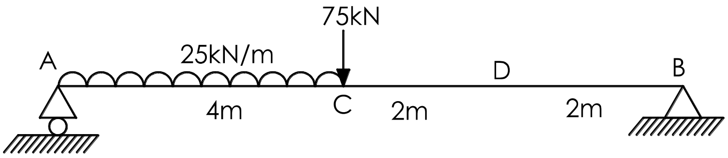

Figure-2

OR

	(c)	Analyze the beam shown in **Figure-2**. Plot Shear Force Diagram. Also, locate the point of maximum Bending Moment.	**07**
Q.3	**(a)**	Write assumptions made in the derivation of torsion equation.	**03**
	(b)	Using first principle, obtain the distance of centroid of a right-angled triangular lamina from the base.	**04**
	(c)	With usual notations, derive the formula for calculating Shear stress at a section in beams. Also, draw qualitative shear stress distribution across the section for an I-Section.	**07**

OR

Q.3 (a) State the Pappus-Guldinus Theorem-1 and Theorem-2. **03**

(b) Derive the torsion equation with usual notations for the circular solid shaft subjected to pure torsion. **04**

(c) Calculate the Shear Stress at a section 2m from the left support for the beam shown in **Figure-2**. Beam cross section is 300 mm × 600 mm deep and the modulus of elasticity is 25000 MPa. **07**

Q.4 (a) State following theorems **03**

(i) Parallel axes theorem

(ii) Perpendicular axes theorem

(b) For the two-dimensional system, a section is subjected to direct tensile stresses of σ_x and σ_y along two perpendicular directions. Derive the equation to obtain principal stresses. **04**

(c) Locate the centroid of the cross section with semicircular hole shown in **Figure-3**. **07**

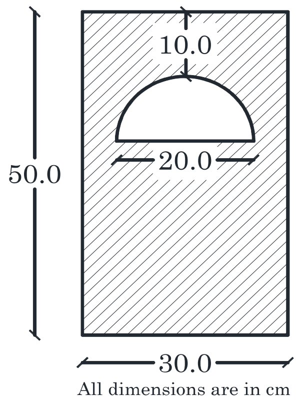

Figure-3

OR

Q.4 (a) Derive the equation to obtain moment of inertia of rectangular section about stronger axis of bending. **03**

(b) For the two-dimensional system, a section is subjected to direct tensile stresses of σ_x and σ_x along two perpendicular directions. Explain the step by step process of Mohr's circle method to obtain direct and tangential stresses on an inclined plane. **04**

(c) Obtain moment of inertia about centroidal x-axis for the section shown in **Figure-3**. **07**

Q.5 (a) Derive the relation among modulus of elasticity, modulus of rigidity and Poisson's ratio with usual notations. **03**

(b) A wire is tied straight between two rigid poles 10m apart has initial tensile stress $10 N/mm^2$ at 32° C. Calculate stress in wire if temperature reduces to 27° C. Take modulus of elasticity $(E)=2.1\times10^5 N/mm^2$ and the coefficient of thermal expansion $(\alpha)=20\times10^{-6}/°C$. **04**

(c) A point in two-dimensional stressed body is shown in **Figure-4**. Determine the magnitudes and directions of principal stresses, using analytical method. **07**

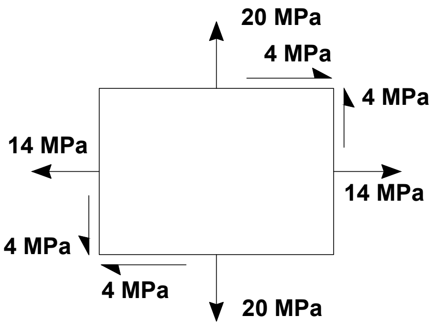

Figure-4

OR

Q.5 **(a)** A copper rod of 150mm diameter and 5m length is subjected to an axial pull of 500kN. Calculate stress and change in length of bar, if the modulus of elasticity E=100000N/mm^2. **03**

(b) Derive the relation among modulus of elasticity, Bulk Modulus and Poisson's ratio with usual notations. **04**

(c) A member is formed by connecting end to end a 200mm long steel bar of 50mm × 50mm square section with 500 mm long aluminum bar of 100mm × 100mm square section as shown in **Figure-5**. Determine the total change in length of the member, if the member carries an axial tensile load of 1000kN. Also calculate stress in each part of the member. Take $E_{Steel} = 2\times10^5$ MPa and $E_{Aluminum}=1\times10^5$ MPa. **07**

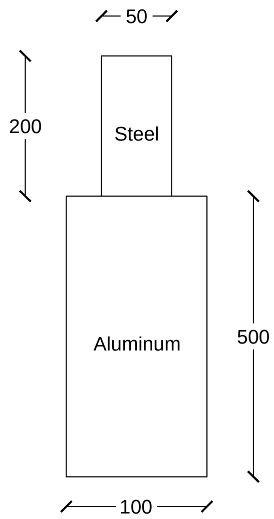

Figure-5

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