Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – WINTER 2023

Subject Code:3130608 Date:23-01-2024

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)**	State following laws: 1) Principle of Superposition 2) Principle of Transmissibility of Forces	**03**
	(b)	State and explain parallelogram law of forces.	**04**
	(c)	For the concurrent force system shown in **Figure-1**, calculate the magnitude and direction of Resultant force **using Graphical method**.	**07**

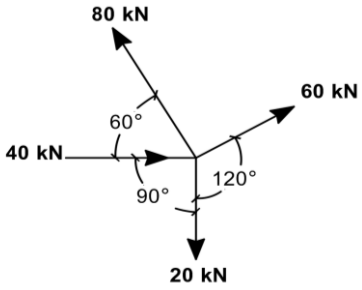

Figure-1

Q.2	**(a)**	Write down assumptions made in analysis of plane trusses. Also, enlist methods of analysis of plane trusses.	**03**
	(b)	Calculate support reactions for the beam shown in **Figure-2**.	**04**

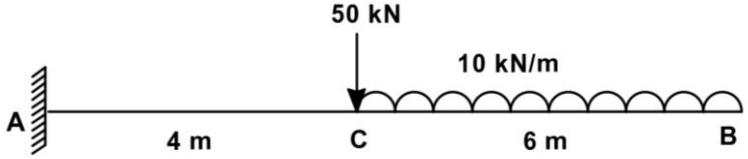

Figure-2

	(c)	For the beam shown in **Figure-3**, calculate support reactions and plot shear force diagram. Also, obtain value of maximum positive shear force.	**07**

OR

(c) For the beam shown in **Figure-3**, calculate support reactions and plot Bending Moment Diagram. Also, obtain value of maximum bending moment in the beam. **07**

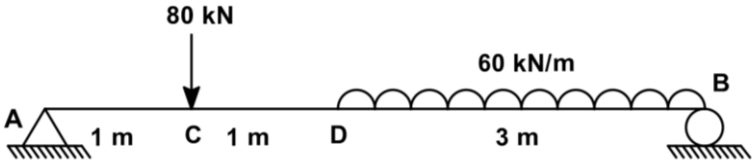

Figure-3

Q.3 **(a)** Plot shear stress distribution across the section for **03**
(1) Circular cross section (2) Symmetric 'I'-Section

(b) Obtain value of maximum shear stress at a section for rectangular cross section using first principle. **04**

(c) For the beam shown in **Figure-2**, calculate the maximum Bending stress induced at a section. Take beam cross section 300mm (width) x 600mm (depth). Also, plot bending stress variation across the section. **07**

OR

Q.3 **(a)** Write assumptions made in derivation of equation of bending. **03**

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

(c) For the beam shown in **Figure-2**, calculate the maximum shear stress induced at a section. Take beam cross section 300mm (width) x 600mm (depth). Also, plot shear stress variation across the section. **07**

Q.4 **(a)** Give statement of Pappus-Guldinus **First theorem** and state its application. **03**

(b) Using first principle, obtain the location of centroid of semi-circular plate from the straight face of the section. **04**

(c) For the beam section shown in **Figure-4**, obtain the moment of inertia about x-x axis passing through the base of the section. **07**

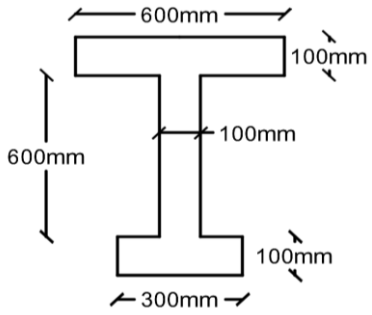

Figure-4

OR

Q.4 **(a)** State assumptions made in derivation of Torsion formula. **03**

(b) State and explain Parallel axes theorem. **04**

(c) For the beam section shown in **Figure-4**, obtain the location of centroid. **07**

Q.5 **(a)** Define Elasticity and State Hook's law. **03**

(b) For a two dimensional system subjected to tensile stresses along on both perpendicular directions, derive an equation to obtain principal stress on any one principal plane. **04**

(c) A steel rod having 30 mm diameter and 500 mm length is subjected to rise in temperature through 80˚C. Calculate the extension of the rod due to rise in temperature. Also, calculate the value of 'P', if the rod is held in position by axial force 'P' to prevent the expansion. Take $E_s = 200GN/m^2$ and $\alpha_s = 12 \times 10^{-6}$ per °C. **07**

OR

Q.5 **(a)** Describe the Mohr's circle method to obtain stress at a point on an incline plane for the two dimensional system subjected to tensile stresses on both perpendicular directions. **03**

(b) For a two dimensional system subjected to tensile stresses along on both perpendicular sides, derive an equation to obtain inclination of principal plane. **04**

(c) A bar ABCD of circular section is rigidly fixed at ends A and D. The bar is subjected to axial loads as shown in **Figure-5**. Length AB = BC = CD = 400 mm. The diameter of portions AB, BC and CD are 25mm, 50mm and 75mm, respectively. Find the loads shared by each portion of the bar and change in length of each portion of the bar, neglecting any bending effects. Take $E=200kN/mm^2$. **07**

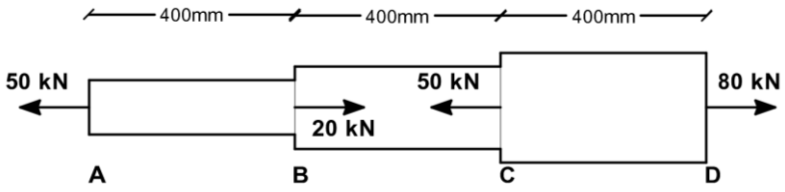

Figure-5

****