Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 3130608 Date: 06-12-2024

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)**	Define following terms; i) Rigid body ii) Mass iii) Equilibrant	**03**
	(b)	State any two assumptions made in analysis of plane trusses. Plot neat sketch of perfect truss, deficient truss and redundant truss.	**04**
	(c)	Obtain the magnitude and direction of equilibrant force for the force system shown in Figure-1.	**07**

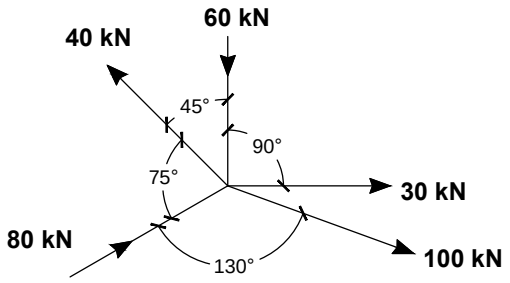

Figure-1

Q.2	**(a)**	State and explain the Law of polygon of forces.	**03**
	(b)	Derive the relation, with usual notations, among loading, shear force and bending moment at a section for a determinate beam.	**04**
	(c)	Calculate support reactions for the beam shown in Figure-2. Also plot Bending Moment and Shear Force diagrams showing values at important locations.	**07**
		OR	
	(c)	Calculate support reactions for the beam shown in Figure-2. Also obtain the location of maximum Bending Moment, Maximum Bending Moment and Maximum Shear Force in the beam.	**07**

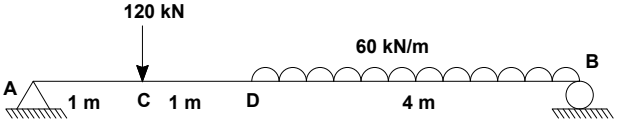

Figure-2

Q.3	**(a)**	State Pappus-Guldinus Theorems.	**03**
	(b)	From first principle obtain the location of center of gravity of semi-circular lamina.	**04**
	(c)	Calculate the bending stress at point ‘C’ for the beam shown in Figure-2. Given that the beam cross section 300mm wide × 600mm deep and modulus of elasticity as 25000MPa.	**07**

OR

Q.3 **(a)** State parallel axes theorem and perpendicular axes theorem. **03**

(b) Using first principle obtain the equation to obtain moment of inertia of a circular section about centroidal x-axis. **04**

(c) Calculate the shear stress at point 'D' for the beam shown in Figure-2. Given that the beam cross section 300mm wide × 600mm deep and modulus of elasticity as 25000MPa. **07**

Q.4 **(a)** Define the following terms; **03**

i) Modulus of elasticity
ii) Poisson's ratio
iii) Modulus of rigidity

(b) With usual notations, derive the relationship among Modulus of elasticity, Poisson's ratio and Bulk modulus. **04**

(c) A solid shaft of 250 mm diameter has the same cross-sectional area as that of hollow shaft of the same material of inside diameter 200 mm. Find the ratio of power transmitted by the two shafts at same angular velocity. Also, compare angle of twist in equal lengths of these shafts when stressed to the same intensity. **07**

OR

Q.4 **(a)** Give assumptions made in the theory of torsion. **03**

(b) For the shaft subjected to pure torsion, derive the torsion equation with usual notations. **04**

(c) Calculate the stress and elongation of each part of the bar shown in Figure-3. Also, calculate total change in length of the bar. Take E = 200000MPa. **07**

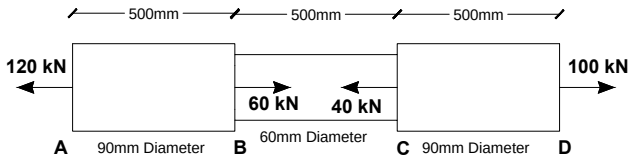

Figure-3

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

(b) Explain Mohr's circle method with neat sketch for a section subjected to direct stresses along two perpendicular directions. **04**

(c) A bar held straight between two rigid supports 5 m apart has initial tensile stress 5 MPa at 30° Celsius. Calculate the stress in wire if temperature reduces to minus 5° C. Take E= 2×10^5 MPa and coefficient of thermal expansion as 2×10^{-6} per °C. **07**

OR

Q.5 **(a)** Define Stress, Strain and Bulk modulus. **03**

(b) Explain Mohr's circle method with neat sketch for a section subjected to direct stresses along two perpendicular directions and accompanying shear stresses. **04**

(c) Determine the compressive stress developed in a punch of 10 mm diameter, used to make a hole of 10mm diameter in 6mm thick mild steel plate. The shear strength of mild steel is 200MPa. **07**

****