Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2130003 Date:21-11-2024

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 force. Discuss its characteristics.	**03**
	(b)	Define :(i) Modulus of elasticity (ii) Stain (iii) Volumetric strain (iv) Shear stress	**04**
	(c)	Determine resultant of coplanar concurrent force system shown in fig.1.	**07**
Q.2	**(a)**	Explain: Thermal stress	**03**
	(b)	The equilateral triangle of 50 mm side as shown in fig. 2 is subjected to three forces. Third force is unknown force alongside AC. If the resultant of force system is pure couple, find third unknown force and its direction.	**04**
	(c)	Calculate the total change in length for the steel bar shown in fig.3.	**07**
		OR	
	(c)	The rail in railway track is designed to have no stress at temp of 10˚C. If the temperature rises to 50˚C , find the maximum stress produced in rail. Take E = 200 Gpa , $\alpha = 11.7 \times 10^{-6}$ /˚C (i) If no allowance is made for expansion. (ii) If allowance of 1.25 mm expansion is made for every 10 m length of rail	**07**
Q.3	**(a)**	State Lami's theorem and explain its significance in mechanics.	**03**
	(b)	Differentiate: (i) Resultant & Equilibrant (ii)Moment & Couple	**04**
	(c)	Determine support reactions for the beam shown in fig. 4.	**07**
		OR	
Q.3	**(a)**	Define: (i) Bending moment diagram (ii) Point of Zero shear (iii) Point of contra flexure	**03**
	(b)	Enlist and explain types of beam with necessary sketch.	**04**
	(c)	Draw shear force and bending moment diagrams for the beam shown in fig.5.	**07**
Q.4	**(a)**	Differentiate between static friction, dynamic friction and limiting friction.	**03**
	(b)	State parallel and perpendicular axes theorems and its applications.	**04**
	(c)	A ladder 5.2 m long, weighing 250 N is placed against a smooth vertical wall with its lower end 2 m from the wall. The co-efficient of static friction between the ladder and the floor is 0.25. A man weighing 70 kg starts climbing the ladder; determine the distance 'x' of man from the wall so that the ladder starts slipping.	**07**
		OR	
Q.4	**(a)**	Define: (i) Neutral Layer (ii) Section Modulus (iii) Radius of Curvature	**03**
	(b)	The cross-section of the beam is a rectangle 60 mm x 80 mm deep. The maximum shear stress in the section is 45 MPa. Calculate shear stress at a section: (i) 40 mm above NA (ii) 20 mm above NA	**04**
	(c)	Find centroid of area shown in fig. 6	**07**

Q.5 **(a)** Draw shear stress distribution diagram for I, T and L sections. **03**

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

(c) Prove with usual notations the bending equation: M/I = f/y = E/R **07**

OR

Q.5 **(a)** What do you mean by Principal Planes and Principal Stresses? **03**

(b) A steel shaft 50mm diameter and 0.5m long is subjected to a twisting couple of 10^3 N.m; the total angle of twist being 0.6°. Find the maximum shearing stress developed in the shaft and modulus of rigidity. **04**

(c) At a point in a strained body there are normal stresses of 100 MPa and 60 MPa both tensile together with a shear stress of 30 MPa, acting on two mutually perpendicular planes. Locate the principal planes and principal stresses. Also find the maximum shear stress. **07**

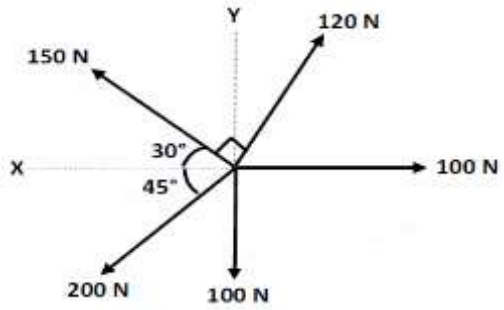

Fig.1

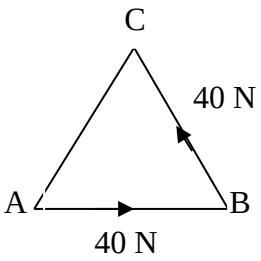

Fig.2

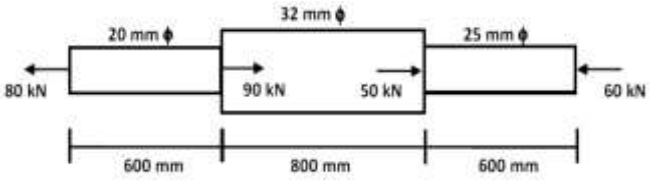

Fig.3

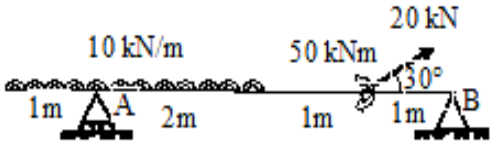

Fig.4

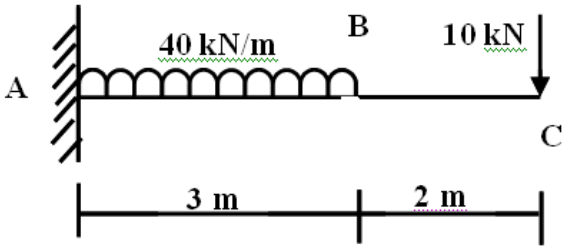

Fig.5

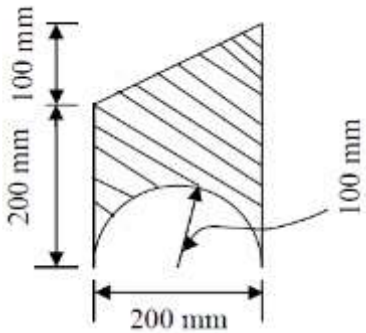

Fig. 6

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