GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–I & II EXAMINATION – WINTER 2024

Subject Code:BE01000091   **Date:09-01-2025**

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.**

			Marks
Q.1	**(a)**	What are the methods for finding out the resultant forces for a given system of forces ?	**03**
	(b)	State (1) parallelogram law of forces. and (2) two characteristics of a couple	**04**
	(c)	**Objective Question (MCQ)**	**07**

1. In order to determine the effects of a force acting on a body we must know (a) Its magnitude and direction of the line along which it acts (b) Its nature (whether push or pull), (c) Point through which it acts on the body (d) All of the above
2. The lami's theorem is applicable only for (a) coplanar forces, (b) concurrent forces, (c) coplanar & concurrent forces, (d) any type of forces
3. A body is said to be in equilibrium if it has no linear motion, (a) true , (b) False
4. Lami's theorem cannot be applied in case of concurrent forces. (a) Agree, (b) Disagree.
5. The shape of shear force diagram for cantilever beam subjected to couple at free end is (a) Horizontal straight line, (b) Zero, (c) Parabola, (d)Hexagonal
6. The reaction at the roller support end of a beam is always (a) Vertical, (b) Horizontal, (c) None of the above
7. At free end of a cantilever bending moment is always_____ unless a concentrated moment is applied at the free end. (a) one (b) two (c) Three (d) Zero

			Marks
Q.2	**(a)**	Three concurrent coplanar forces act on a body at a point O, Determine two additional force along OA and OB such that resultant of the five forces is Zero as shown in **Fig-1**	**03**
	(b)	A boat is pulled along the river by two ropes with pulls P & Q inclined at 30 & 40 to the X-axis as shown in **Fig-2** find a) P and Q if their resultant R is 1000N parallel to X-axis b) if P is inclined at 30 to X-axis. find the minimum value of Q if R is same.	**04**
	(c)	A simply supported beam having a Maximum bending moment is 10 KN-m. the cross section of the beam is shown in **Fig-3** Determine bending stress in tension and compression.	**07**

OR

| | **(c)** | Explain (1) Types of Beam, Support, Load 2) Condition of Equilibrium | **07** |

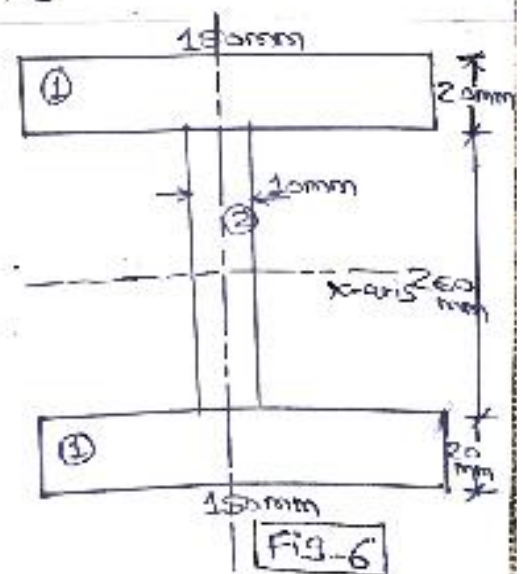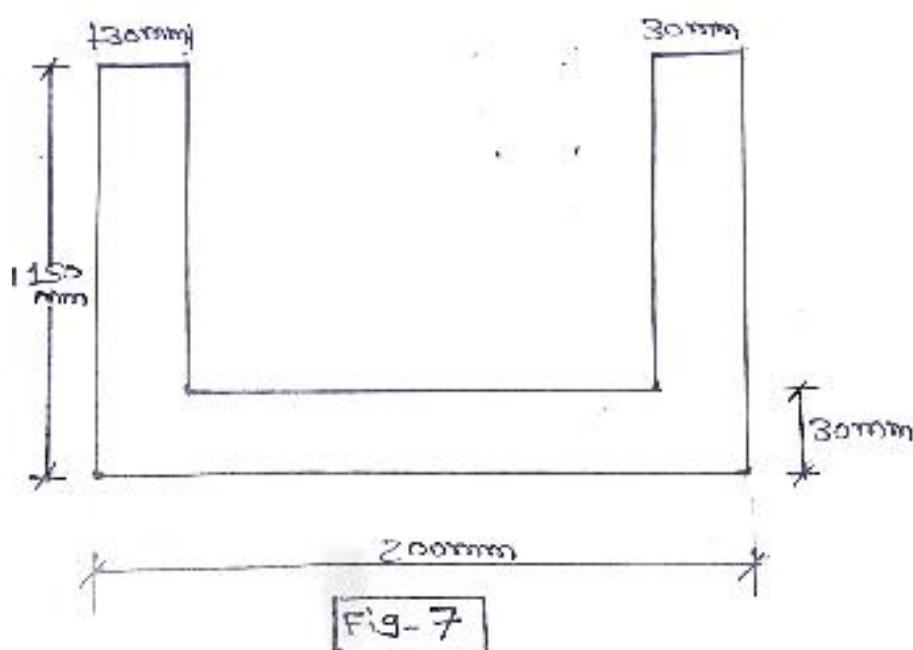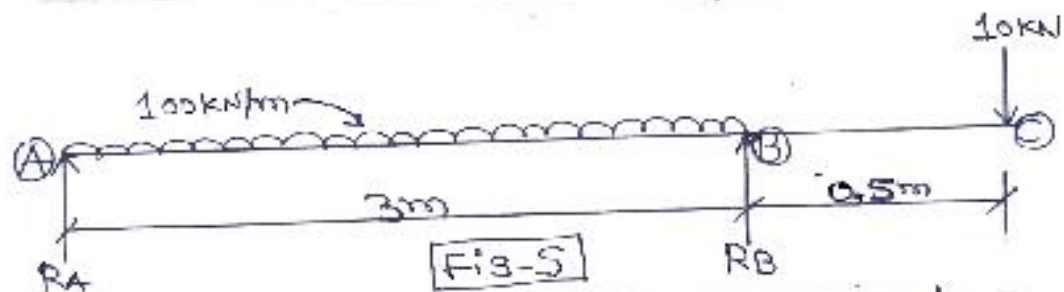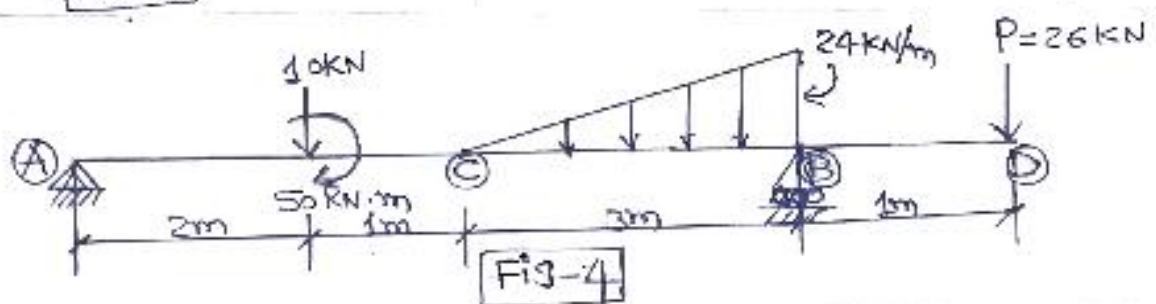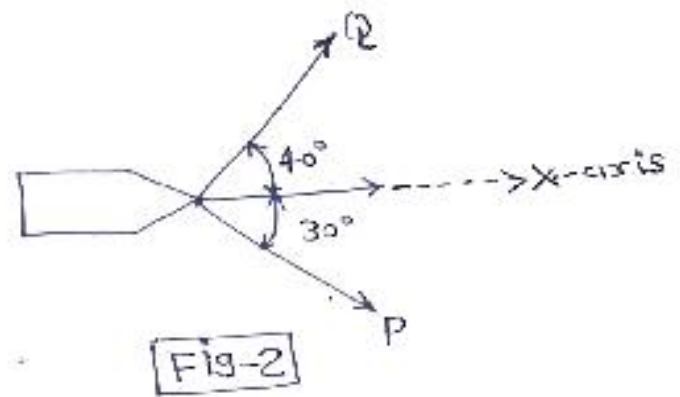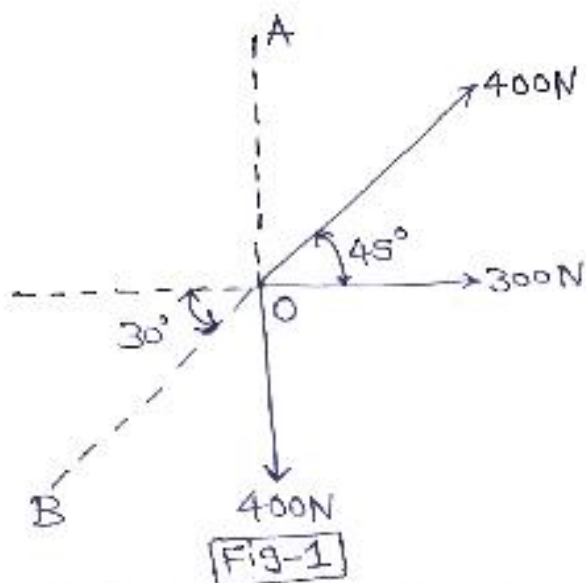|			
Q.3	**(a)**	Find analytically the support reaction at B for the beam shown in **Fig-4** if reaction at support A is zero	**03**
	(b)	Draw shear force, bending moment diagram for the beam shown in **Fig-5**	**04**
	(c)	A circular rod of 25mm diameter and 500mm long is subjected to a tensile force of 50 KN. Determine modulus of rigidity, bulk modulus and change in volume if poissions ratio is 0.3 and young's modulus E is 2×10^5 N/mm^2	**07**

Q.3 **(a)** Explain (a) Center of mass(b) center of gravity (c) centroid | **03**
(b) For an I-Section shown in **Fig-6** find I_{xx} and I_{yy} | **04**
(c) Find centroidal M.I I_{xx} and I_{yy} of a channel section shown in **Fig-7** | **07**

Q.4 **(a)** Write any three Assumption made in the theory of torsion | **03**
(b) A stepped bar made of steel, copper and brass are as under axial force as shown in **Fig-8** and is in equilibrium. The diameter of steel is 12 mm diameter of copper is 16mm and the diameter of brass is 20mm. determine total change in length of the bar take E_{Steel}= 200 x10^{3}mpa E_{Copper}=100 x10^{3}mpa, E_{Brass}=80 x 10^{3}mpa | **04**
(c) The sum of two concurrent forces P and Q is 270 N and their resultant is of 180 N. if resultant is perpendicular to R. find P and Q | **07**

Q.4 **(a)** How would you find out the moment of inertia of a plane area? | **03**
(b) Define the term (1) force (2) Couple Moment (3) Maximum Bending moment (4) Point of Contra flexure. | **04**
(c) Derive the equation of Bending Stress in Beam (Derivation of flexure Formula for pure Bending) | **07**

Q.5 **(a)** Short notes on (a) Moment of resistance (b) section modulus (c) Neutral Axis | **03**
(b) A beam of T-Section, 4m long carries a uniformly distributed load w per meter run thought its length. The beam is simply supported at its ends the T-section is 20 x 10 x 1.2cm and web is 18.8 x 1.2 cm and flange is 10 x 1.2cm what is the maximum value of W so that the stress in the section does not exceed 60 mpa | **04**
(c) A simply supported beam 7m long is carrying three-point load 100N, 600N, and 175 N acting at 2m, 4m and 5.5 m from left support. Determine support reaction and draw S.F and B.M Diagram. | **07**

Q.5 **(a)** Short notes on followings (1) Lateral strain (2) Hooks Law (3) Poisson's ratio | **03**

(b) Determine the stress, strain, modulus of elasticity and poissions ratio from the following results for a bar tested on UTM diameter 20mm, gauge length 150mm, increase in gauge length 14mm, decrease in diameter 0.8mm, tensile load 6 kN | **04**

(c) A rectangular bar of steel 50mm x 30 mm is 1m long carries a pull of 93.9 KN. Find the tensile stress in the bar strain and change in length. Take E 200 Gpa | **07**
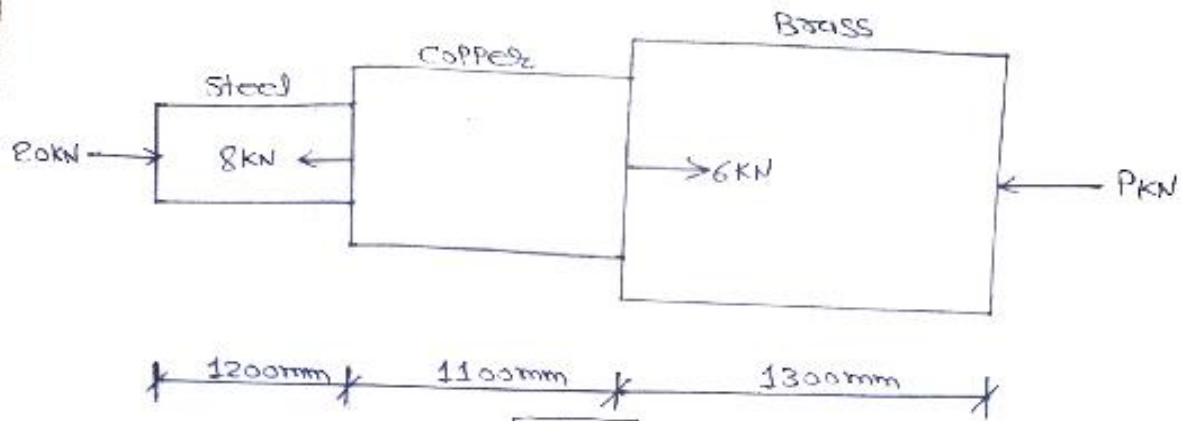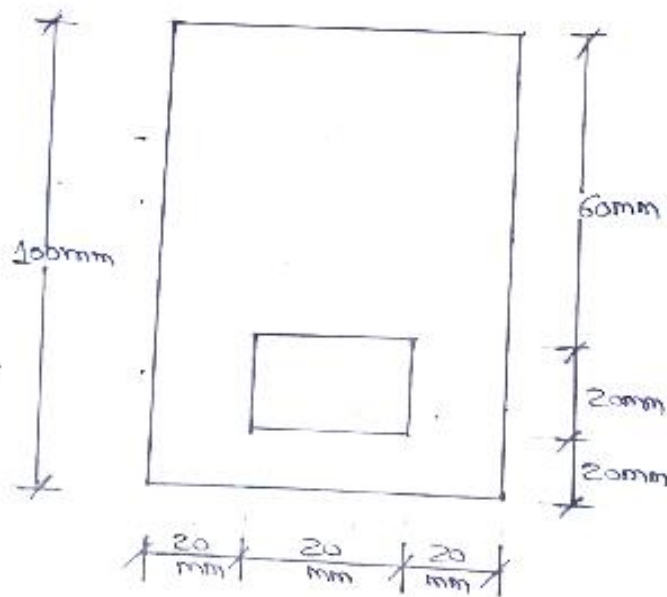
Fig-1

Fig-2

Fig-4

Fig-5

Fig-7

Fig-6

3

Steel
Copper
Brass
P0KN →
8KN ←
→6KN
←— PKN

|← 1200mm →|← 1100mm →|← 1300mm →|

Fig-8

100mm

60mm

20mm

20mm

|← 20 mm →|← 20 mm →|← 20 mm →|

Fig-3

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