Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–III(NEW) EXAMINATION – SUMMER 2023**

**Subject Code:2130003 Date:24-07-2023**

**Subject Name:Mechanics of Solids**

**Time:02:30 PM TO 05:00 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.**

| | | | |
|---|---|---|---|
| **Q-1** | **(a)** | Define the following terms : (1) Resultant Force, (2) Law of superposition, (3) Moment | **03** |
| | **(b)** | State and prove Parallelogram Law of Forces. | **04** |
| | **(c)** | The following forces are acting in North, East, South and West directions as shown in **Fig-1**.Find out magnitude and direction of resultant of forces system | **07** |
| **Q-2** | **(a)** | Define the following terms : (1)Rigid body, (2) Concurrent force system, (3) Couple | **03** |
| | **(b)** | Find out the support reactions $R_A$ and $R_B$ for a simply supported beam as shown in **Fig- 2** | **04** |
| | **(c)** | Four forces having magnitudes of 200 N, 400 N, 600 N and 800 N respectively, are acting along the four sides (1 m each) of a square ABCD taken in order, as shown in **Fig- 3.** Find out magnitude, direction and location of resultant with respect to point A | **07** |
| | | **OR** | |
| | **(c)** | An I-section has the following dimensions in mm units as shown in **Fig-4**.Determine mathematically the position of centre of gravity of the section. | **07** |
| **Q-3** | **(a)** | Enlist various type of loads and type of supports | **03** |
| | **(b)** | Define (1) Thermal stress (2) Bulk modulus (3) Poisson's ratio (4) Coefficient of friction | **04** |
| | **(c)** | A bar of 25 mm diameter is tested in tension. It is observed that when a load of 60 kN is applied, the extension measured over a guage length of 200 mm is 0.12 mm and contraction in diameter is 0.0045 mm. Find Poisson's ratio and Modulus of Elasticity | **07** |
| | | **OR** | |
| **Q-3** | **(a)** | State assumptions made in theory of pure bending. | **03** |
| | **(b)** | State Hook's law. Draw stress strain curve for Mild Steel Specimen and explain each point in detail | **04** |
| | **(c)** | Determine the moment of inertia for given lamina about Horizontal and vertical axes as shown in **Fig-5** | **07** |
| **Q-4** | **(a)** | Define the following terms : (1) Point of contra flexure, (2) Moment of resistance (3) Limiting friction | **03** |
| | **(b)** | Draw only shape of shear stress distribution diagram for the following sections : (1) T section, (2) symmetrical I section, (3) Rectangular section and (4) circular section | **04** |
| | **(c)** | Determine the reactions and construct the shear force and bending moment diagrams for the beam shown in **Fig-6**. Mark the salient points and the values at those points | **07** |
| | | **OR** | |
| **Q-4** | **(a)** | Explain first theorem of Pappus-Guldinus | **03** |

**(b)** The stepped bar shown in **Fig-7** is made up of two different materials. The material1 has Young's modulus = $2 \times 10^5$ N/mm$^2$, while that of material 2 is $1 \times 10^5$ N/mm$^2$. Find the extension of the bar under a pull of 30 kN if both the portions are 20 mm in thickness **04**

**(c)** A 40 mm diameter shaft of length 1200 mm is used to transmit 50 kW between a motor and pump. Determine the lowest speed of rotation at which stress does not exceed 60 Mpa and angle of twist does not exceed $2^0$ **07**

**Q-5** **(a)** Enlist the assumptions made in theory of pure torsion **03**

**(b)** A rectangular beam 300 mm depth and 200 mm wide is subjected to shear force of 19 KN. Calculate the value of maximum shear stress and sketch the variation of shear stress along the depth of beam **04**

**(c)** A body of weight 500 N is lying on a rough plane inclined at an angle of 25° with the horizontal. It is supported by an effort (P) parallel to the plane as shown in **Fig-8.** Determine the minimum and maximum values of P, for which the equilibrium can exist, if the angle of friction is 20° **07**

**OR**

**Q-5** **(a)** Define the following terms : (1) Principal stress (2) Principal Plane (3) Angle of Repose **03**

**(b)** A circular bar of simply supported span 1 m has to carry a central concentrated load of 800 N. Find the diameter of the bar required, if permissible stress is 150 N/mm$^2$ **04**

**(c)** The direct stresses at a point in the strained material are 120 N/mm$^2$ compressive and 80 N/mm$^2$ tensile as shown in **Fig.-9.** There is no shear stress. Find the normal and tangential stresses on the plane AC. Also find the resultant stress on AC. **07**

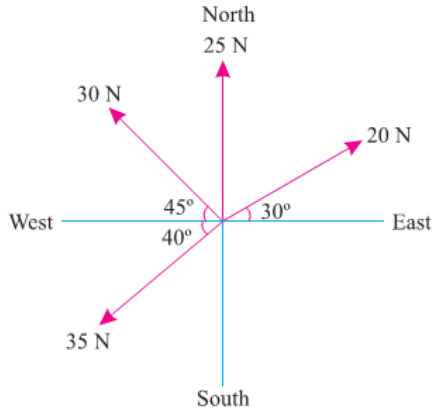


**Fig-1**

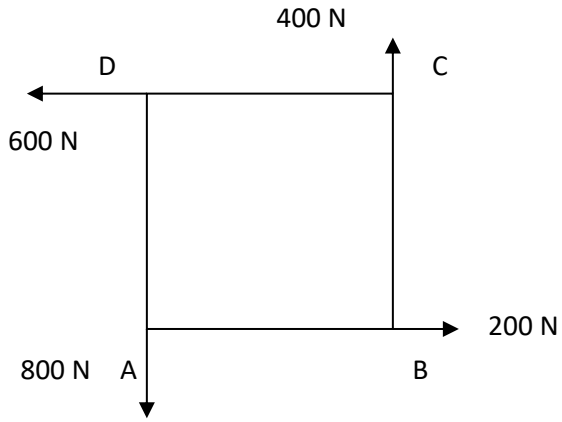


**Fig-3**

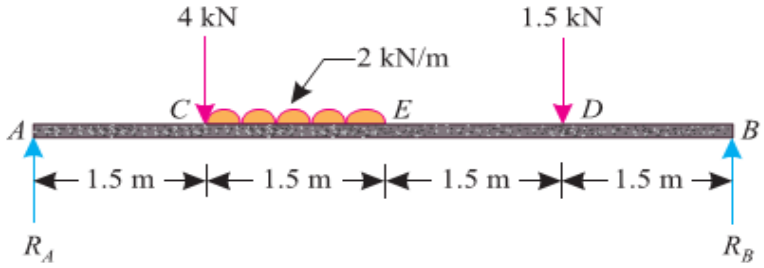


**Fig-2**

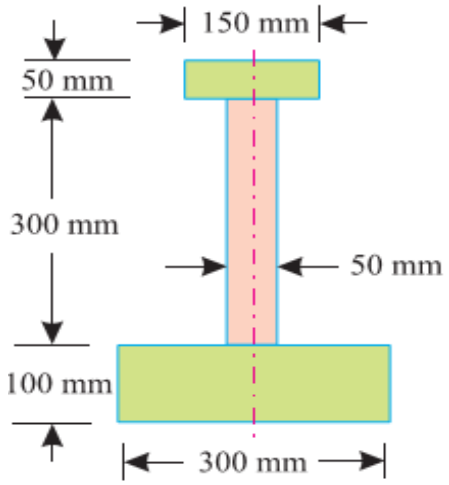


Fig-4

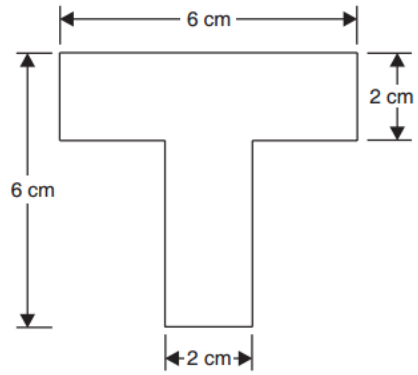


Fig-5

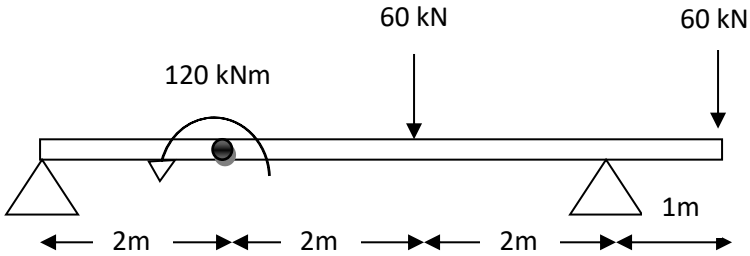


Fig-6

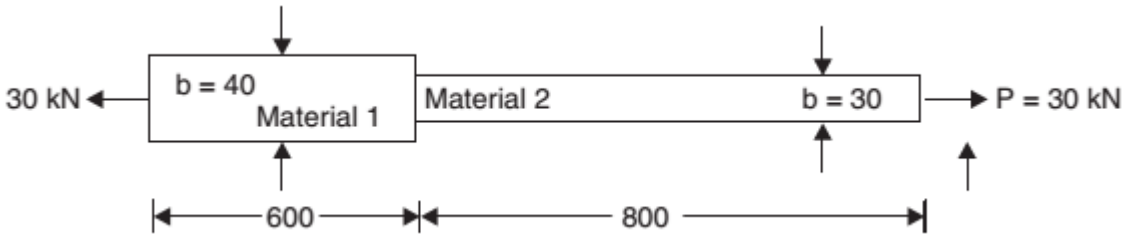


Fig-7

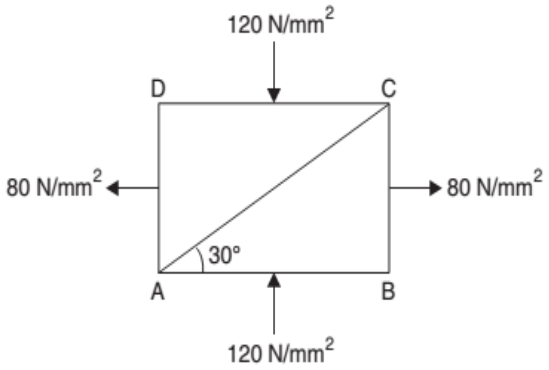


Fig-8

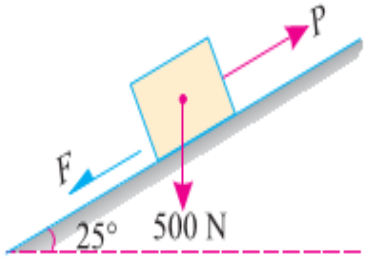


Fig-9