Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 3 – EXAMINATION – SUMMER 2026

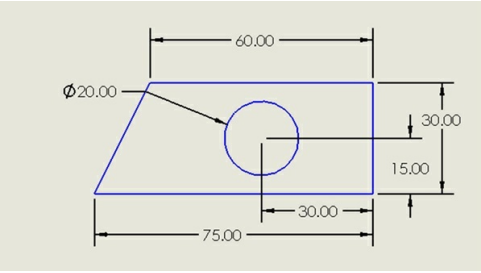
Subject Code: BE03000231 **Date: 24/06/2026**

Subject Name: MACHINE DRAWING AND ELEMENTS OF MACHINE DESIGN

Time: 02:30 PM TO 05:00 PM **Total Marks: 70**

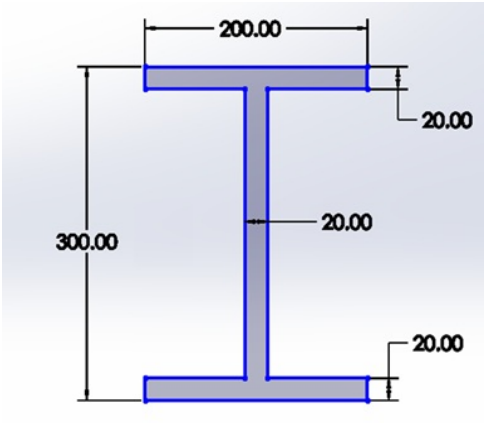
Instructions:

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)**	Discuss the different types of supports conditions related to beam with neat sketch.	**03**
	(b)	Define factor of safety and state the important factors affecting the factor of safety.	**04**
	(c)	Explain the following terms: Tensile stress, Compressive stress, Bearing Pressure, Lateral strain, Hook's law, Poisson's ratio, Modulus of Elasticity	**07**
Q.2	**(a)**	Explain design consideration of machine components.	**03**
	(b)	Compare: Elasticity and Plasticity	**04**
	(c)	Find center of gravity of plane shown in figure 1 and moment of inertia of section about X axis passing through C.G. 	**07**
		OR	
Q.2	**(c)**	Design a knuckle joint to connect mild steel bars under a tensile load of 30 kN. The allowable stress are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing.	**07**
Q.3	**(a)**	Explain aesthetic and ergonomic considerations in the design of machine components.	**03**
	(b)	Explain parallel axis theorem for finding moment of inertia of planer cross-sections.	**04**

(c) An I section girder, 200 mm wide by 300 mm depth flange and web of thickness is 20 mm is used as simply supported beam for a span of 7 m. The girder carries a uniformly distributed load of 5 KN/m and a concentrated load of 20 KN at mid-span. Refer figure 2. Determine the following: **07**

1. Moment of inertia for the cross-section
2. The maximum bending stress



OR

Q.3 **(a)** Discuss torsion in solid shaft and hollow shaft. **03**

(b) Derive relation between bulk modulus and modulus of rigidity with usual notation. **04**

(c) Derive strength equations of sunk key based on shear and crushing failures. Show that square key is equally strong in shearing and crushing compare to rectangular key. **07**

Q.4 **(a)** Explain cotter joint with all components. **03**

(b) Derive the equation of simple bending. Also state the assumptions in this derivation. **04**

(c) Derive Soderberg's equation and state its application to different types of loadings. **07**

OR

Q.4 **(a)** Explain polar moment of inertia. **03**

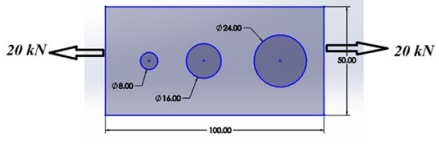
(b) Define torsional rigidity. Derive an expression for angular deflection of a shaft subjected twisting moment. **04**

(c) The lead screw of a lathe has acme threads of 50 mm outside diameter and 8 mm pitch. The screw must exert an axial pressure of 2400 N in order to drive the tool carriage. The thrust is carried on a collar 110 mm outside diameter and 55 mm inside diameter and the lead screw rotates at 30 RPM. Determine the power required to drive the screw. Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar. **07**

Q.5 **(a)** Explain limit, fits and tolerance. **03**

(b) Derive the design equation for shaft subjected to twisting moment only. **04**

(c) A rectangular plane, 15 mm thick, made of a brittle material is shown in figure 3. Calculate the stress at uncut section and at each holes. **07**



OR

Q.5 **(a)** Why cotter is provided with tapper? Enlist applications of cotter joint. **03**

(b) Prove that efficiency of self-locking square thread is less than 50%. **04**

(c) Determine the diameter of a solid shaft used for transmission of 30 kW power at 240 RPM. Determine the diameter of hollow shaft, if the solid shaft is to be replaced by the hollow shaft. Take the ratio of inside to outside diameter is 6:8 and allowable shear stress of shaft as 50 MPa. **07**

*****