Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3141907 Date:22-11-2024

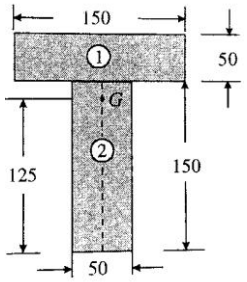
Subject Name:Fundamentals of Machine Design

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

Instructions:

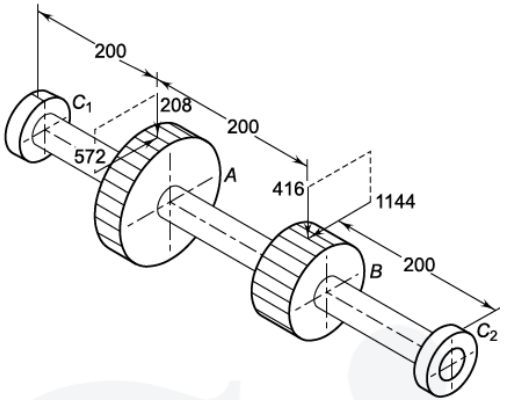
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Derive the relation between the three elastic constants.	**03**
	(b)	Derive an expression for bending stress in a straight beam subjected to bending moment.	**04**
	(c)	Explain the design considerations in the casting.	**07**
Q.2	**(a)**	Explain the terms self-locking and overhauling of power screws.	**03**
	(b)	Differentiate between beam and column. Enlist different types of beams with line diagram.	**04**
	(c)	Find the moment of inertia of a T section shown in the figure about X-X and Y-Y axes through the center of gravity of the section.	**07**



OR

	(c)	An intermediate shaft of a gearbox, supporting two spur gears A and B and mounted between two bearings C_1 and C_2, is shown in figure. The pitch circle diameters of gears A and B are 600 and 300 mm respectively. The shaft is made of alloy steel 20MnCr5 having UTS 620 N/mm^2 and yield point stress 480 N/mm^2. The factors k_b and k_t of the ASME code are 2 and 1.5 respectively. The gears are keyed to the shaft. Determine the shaft diameter using the ASME code.	**07**



Q.3 **(a)** Differentiate between axle, spindle and shaft. **03**

(b) Explain the maximum principal shear stress theory. **04**

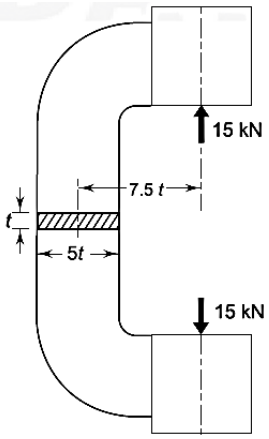
(c) Two wires, one of steel and the other of copper, are of the same length and are subjected to the same tension. If the diameter of the copper wire is 2 mm, find the diameter of the steel wire, if they are elongated by the same amount. Take E for steel as 200GPa and for copper as 100GPa. **07**

OR

Q.3 **(a)** Define factor of safety and state the important factors affecting the factor of safety. **03**

(b) Differentiate between: (a) crushing and bearing stresses, (b) torsional and transverse shear stress. **04**

(c) A C-frame subjected to a force of 15 kN is shown in figure, is made of grey cast iron FG300 and the factor of safety is 2.5. Determine the dimensions of the cross-section of the frame. **07**



Q.4 **(a)** Explain the ergonomic considerations in the controls and display. **03**

(b) Classify the basic types of screw fastening. Differentiate between bolt and screw. **04**

(c) The cutter of a broaching machine is pulled by square threaded screw of 55 mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400 N on a flat surface of 60 mm and 90 mm internal and external diameters respectively. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut when the cutting speed is 6 m/min or speed is 600 rpm. Also find the efficiency of the screw. **07**

OR

Q.4	**(a)**	Discuss the various types of power threads with their relative advantages and disadvantages.	**03**
	(b)	Define: (i) Poisson's ratio (ii) Bulk modulus (iii) Hooke's law (iv) Volumetric strain.	**04**
	(c)	Find Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thickness. The length of the column is 2.3 m hinged at both ends. Take E = 205 GPa. Also find crippling load by Rankine's formula. Take σ_c = 335 KN/mm^2 and Rankine's constant a = 1 / 7500.	**07**
Q.5	**(a)**	Explain the assumptions made in theory of bending.	**03**
	(b)	Define torsional rigidity. Derive an expression for angular deflection of a shaft subjected to twisting moment.	**04**
	(c)	Explain stress concentration. Explain the causes of stress concentration and remedies for reducing it.	**07**

OR

Q.5	**(a)**	Explain the steps to be follow for the design of any machine element.	**03**
	(b)	Explain the effect of different alloying elements on the properties of steels.	**04**
	(c)	A machine component is subjected to fluctuating stress that varies from 40 to 100 N/mm^2. The corrected endurance limit stress for the machine component is 270 N/mm2. The ultimate tensile strength and yield strength of the material are 600 and 450 N/mm^2 respectively. Find the factor of safety using (i) Gerber theory (ii) Soderberg line (iii) Goodman line	**07**

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