GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV EXAMINATION – SUMMER 2025

Subject Code:3141907   **Date:15-05-2025**
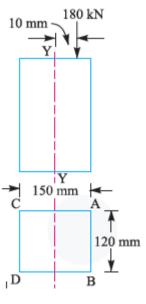
Subject Name:Fundamentals of Machine Design

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 limits, fits and tolerance	**03**
	(b)	Solve, A journal 25 mm in diameter supported in sliding bearings has a maximum end reaction of 2500 N. Assuming an allowable bearing pressure of 5 N/mm2, find the length of the sliding bearing.	**04**
	(c)	Develop spigot and socket cotter joint using step by step design procedure.	**07**
Q.2	**(a)**	What is key? What are the different types of key?	**03**
	(b)	State and explain the different theories of failures and its importance. Explain Distortion energy (von Mises) theory.	**04**
	(c)	Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress = compressive stress = 50 MPa ; shear stress = 35 MPa and crushing stress = 90 MPa.	**07**

OR

	(c)	Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression.	**07**
Q.3	**(a)**	What is a coupling? Classify the couplings	**03**
	(b)	Explain the basic procedure for design of machine elements.	**04**
	(c)	A vertical two start square threaded screw of a 100 mm mean diameter and 20 mm pitch supports a vertical load of 18 kN. The axial thrust on the screw is taken by a collar bearing of 250 mm outside diameter and 100 mm inside diameter. Find the force required at the end of a lever which is 400 mm long in order to lift and lower the load. The coefficient of friction for the vertical screw and nut is 0.15 and that for collar bearing is 0.20.	**07**

OR

Q.3	**(a)**	Explain the Hooke's law with a neat sketch for ductile materials	**03**
	(b)	Derive the equation for simple bending. Also state the assumptions in this derivation.	**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 2500 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 r.p.m. 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.4 **(a)** Define the following terms: **03**
(i) Hooke's law (ii) Poisson's ratio (iii) Preferred series.
(b) Explain :   **04**
(1) Pitch (2) Lead (3) Nominal diameter (4) Core diameter for Power screw.
(c) A mild steel rod supports a tensile load of 50 kN. If the stress in the rod is limited to 100 MPa, find the size of the rod when the cross-section is 1. Circular, 2. Square, and 3. Rectangular with width $= 3 \times$ thickness.   **07**

OR

Q.4 **(a)** Discuss torsion in solid shaft and hollow shaft.   **03**
(b) What do you mean by stress concentration? State the reasons for stress concentration and explain any two of the methods used for reducing it.   **04**
(c) A hollow shaft of 40 mm outer diameter and 25 mm inner diameter is subjectedto a twisting moment of 120 N-m, simultaneously; it is subjected to an axial thrust of 10 kN and a bending moment of 80 N-m. Calculate the maximum compressive and shear stresses.   **07**

Q.5 **(a)** How the hollow shafts are beneficial over the solid shaft?   **03**
(b) What is endurance limit? Discuss the different factors affecting endurance limit   **04**
(c) 45 mm diameter shaft is made of steel with a yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with a yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2.   **07**

OR

Q.5 **(a)** Define self-locking of power screw. Explain the condition for self-locking   **03**
(b) Explain the different types of fits with neat sketch.   **04**
(c) A rectangular strut is 150 mm wide and 120 mm thick. It carries a load of 180 kN at an eccentricity of 10 mm in a plane bisecting the thickness as shown in Fig. Find the maximum and minimum intensities of stress in the section.   **07**

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