GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03000231   **Date: 19-12-2025**

Subject Name: **Machine Drawing and Elements 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 factor of safety and state important factors affecting factor of safety.	**03**
	(b) Explain basic procedure for design of machine elements.	**04**
	(c) Explain the term: Moment of Inertia and polar moment of inertia. Derive expression for polar moment of inertia of a rectangle using principle of integration.	**07**
Q.2	**(a)** Discuss importance of material selection in machine design.	**03**
	(b) Define: (1) Hook's law (2) Modulus of rigidity (3)Poisson's ratio (4) Bulk modulus	**04**
	(c) Develop knuckle joint using step by step design procedure.	**07**

OR

	(c) Design a cotter joint to connect two steel rods of equal diameter. Each rod is subjected to an axial tensile fore of 50 kN. The cotter is made of steel 30C8 (S_{yt} = 400 N/mm^2) and factor of safety is 6.	**07**
Q.3	**(a)** Explain design of shaft based on rigidity and stiffness.	**03**
	(b) Derive an expression for bending stress in straight beam subjected to bending moment.	**04**
	(c) A rectangle beam 300 mm deep is simply supported over span of 4 m. What uniformly distributed load the beam may carry if the bending stress is not to exceed 120 MPa ? Take I = 8 X 10^6 mm^4 .	**07**

OR

	(a) Discuss different types of sections normally used in design of lever.	**03**
	(b) Define torsional rigidity. Derive equation for angular deflection of shaft subjected to twisting moment.	**04**
	(c) A machine component is subjected to fluctuating stress that varies from 40 to 100 N/mm^2 . The corrected endurance limit stress is 270 N/mm^2 . The ultimate tensile strength and yield strength of the material are 600 and 450 N/mm^2 respectively. Find factor of safety using (i) Gerber theory (ii) Soderberg line (iii) Goodman line. Also, find factor of safety against static failure.	**07**

Q.4 (a) What is key? What are the different types of key used. **03**

(b) What is difference between rigid and flexible coupling. **04**

(c) A rigid flange coupling is used to transmit 20 kW power at 720 rpm. There are four bolts and pitch circle diameter of bolts is 125 mm. The bolts are made of steel 45C8 ($S_{yt} = 38$ N/mm^2) and the factor of safety is 3. Determine the diameter of bolts. Assume that the bolts are finger tight in reamed and ground holes. **07**

OR

(a) State the application of splined shaft. **03**

(b) What is endurance limit? Explain Goodman line in fatigue design. **04**

(c) Explain stress concentration. Explain the causes of stress concentration and discuss remedies for reduce it. **07**

Q.5 (a) Explain terminology of power screw with neat sketch. **03**

(b) Show that η of self locking screw is less than 50%. **04**

(c) A two start, trapezoidal screw is used in screw jack to raise a load of 300 kN. The screw has nominal diameter as 100 mm, pitch as 12 mm and half thread angle is 15^0. Coefficient of friction in screw threads is 0.15. Neglecting collar friction, calculate : (i) Torque required to raise the load (ii) torque required to lower the load (iii) Screw efficiency. **07**

OR

(a) Enlist and explain different types of threads used in power screws with figure. **03**

(b) What is " overhauling" of power screw. Discuss the condition for overhauling and its application. **04**

(c) In a machine vice, a screw with single start square threads with 22 mm nominal diameter and 5 mm pitch is used. A friction collar provided in the body has inner and outer diameter as 45 mm and 55 mm respectively. The coefficient of friction for both the thread and collar is 0.15. The operator can apply 100 N force on handle which is 150 mm long. Assuming uniform wear for collar, Calculate (i) Clamping force develop (ii) Overall efficiency. **07**

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