

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – WINTER 2023****Subject Code:3141907****Date:19-01-2024****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) Explain the basic procedure for design of machine elements.	03
	(b) Define the following term: (i) Hook's law (ii) Modulus of Rigidity (iii) Poisson's ratio (iv) Bulk modulus	04
	(c) Give the different theories of failures and explain maximum shear stress theory in detail with its region of safety.	07
Q.2	(a) Explain Manufacturing considerations in design.	03
	(b) Explain the parallel and perpendicular axes theorem for finding moment of inertia of planer cross-sections.	04
	(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
OR		
	(c) Write down the design procedure of cotter joint with neat figure.	07
Q.3	(a) Define factor of safety. Why it is required?	03
	(b) Write a difference between shaft, spindle and axle.	04
	(c) A mild steel shaft transmits 20 kW at 200 r.p.m. It carries a central load of 900 N and is simply supported between the bearings 2.5 metres apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads? The shock and fatigue factors for bending and twisting are 1.5 and 1.0 respectively.	07
OR		
Q.3	(a) What do you understand by overhauling of screw?	03
	(b) What is a key? Discuss the different types of keys.	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 (a) the power required to drive the screw; and (b) the efficiency of the lead screw. Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar.	07
Q.4	(a) Explain the following term: (i) Endurance limit (ii) Surface finish factor (iii) Notch sensitivity	03
	(b) Derive an equation for finding torque required to raise the load by square threaded screws with usual notations.	04

- (c) A machine component is subjected to fluctuating stress that varies from 40 to 100 N/mm². 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/mm² respectively. Find the factor of safety using (i) Gerber theory (ii) Soderberg line (iii) Goodman line Also, find the factor of safety against static failure. 07

OR

- Q.4** (a) Explain any three terminologies of screw threads with neat sketch. 03
- (b) Determine the moment of inertia for rectangular cross-section about X-axis and Y-axis passing from their CG. 04
- (c) The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory; 3. Maximum principal strain theory. Take permissible tensile stress at elastic limit = 100 MPa and poisson's ratio = 0.3 07

- Q.5** (a) Define: (i) Leverage (ii) Contact Stress (iii) Slenderness ratio. 03
- (b) A T-section 150 mm × 120 mm × 20 mm is used as a strut of 4m long hinged at both ends. Calculate the crippling load, if Young's modulus for the material of the section is 200 kN/mm². 04
- (c) Design a right angled bell crank lever. The horizontal arm is 500 mm long and a load of 4.5 kN acts vertically downward through a pin in the forked end of this arm. At the end of the 150 mm long arm which is perpendicular to the 500 mm long arm, a force P act at right angles to the axis of 150 mm arm through a pin into a forked end. The lever consists of forged steel material and a pin at the fulcrum. Take the following data for both the pins and lever material: Safe stress in tension = 75 MPa, Safe stress in shear = 60 MPa, Safe bearing pressure on pins = 10 N/mm² 07

OR

- Q.5** (a) Discuss the different types of supports / end conditions related to beams with neat sketches. 03
- (b) List the different theories of fatigue failure. Explain the Modified Goodman criteria of fatigue failure with diagram. 04
- (c) The frame of a hydraulic press consisting of two identical steel plates is shown in Fig. 2. The maximum force P acting on the frame is 20 kN. The plates are made of steel 45C8 with tensile yield strength of 380 N/mm². The factor of safety is 2.5. Determine the plate thickness. 07

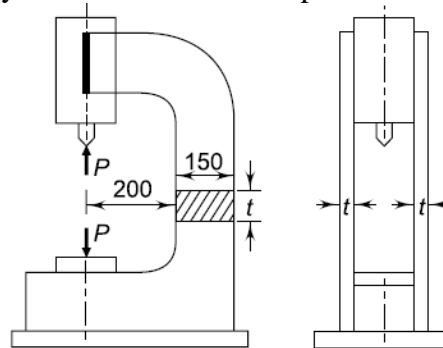


Fig.2
