

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2022**

**Subject Code:3141907****Date:29-06-2022****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.

- Q.1** (a) List the different types of stresses considered in machine design. And explain tensile and shear stress **03**
- (b) Derive the equation for simple bending. Also state the assumptions in this derivation. **04**
- (c) Explain the manufacturing considerations in design of machine component **07**
- Q.2** (a) Discuss the different types of supports / end conditions related to beams with neat sketches. **03**
- (b) Derive the relation between bulk modulus and modulus of rigidity with usual notations. **04**
- (c) Design a knuckle joint to transmit 70 kN. The design stresses may be taken as 70 MPa in tension, compression and crushing for rod. The design stresses may be taken as 120 MPa in tension, 66 MPa in shear and 120 MPa in crushing in shear for pin. **07**
- OR**
- (c) Write a short note on socket and spigot type cotter joint with its design procedure. **07**
- Q.3** (a) Write a detailed note on: Contact stresses and its examples **03**
- (b) Define the factor of safety. State and explain the factors affecting its selection. **04**
- (c) Explain various aspects of materials selection in Machine Design **07**
- OR**
- Q.3** (a) Write a difference between shaft, spindle and axle. **03**
- (b) State the different types of keys and explain the design of key – rectangular cross section with neat sketches stating equations. **04**
- (c) Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 r.p.m. The angle of lap of the belt is  $180^\circ$  and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. **07**
- Q.4** (a) Explain different types of welded joints with neat sketches. **03**
- (b) Explain types of fits **04**

- (c) A bell crank lever is to be designed to lift the load of 75 kN acting at the end of short arm of the lever. The length of short arm and long arm is 100 mm and 500 mm respectively. Allowable shear stress and tensile stress for lever and pin materials is  $60 \text{ N/mm}^2$  and  $60 \text{ N/mm}^2$  respectively. Allowable bearing pressure for pin material is  $10 \text{ N/mm}^2$ . For pin  $L/D=1.5$  and for the rectangular cross section of the lever, ratio of height to width is 4. Assume that the arm of bending moment on the lever extends up to the axis of the fulcrum. Determine: (1) dimension of the fulcrum pin (2) dimensions of lever. **07**

**OR**

- Q.4** (a) Explain the different types of end conditions of column. **03**  
(b) Explain the terms: Moment of inertia and Polar moment of inertia. **04**  
(c) A hollow circular column is having external diameter 85 mm and internal diameter 65 mm. The effective length of column is 3m. Calculate slenderness ratio of column. **07**

- Q.5** (a) Explain the Soderberg and Goodman diagram with neat sketches. **03**  
(b) State the different types of screw threads used in power screw and explain any three of them. **04**  
(c) Give the detail design procedure of Screw Jack. **07**

**OR**

- Q.5** (a) What is self-locking of power screw? Explain the condition for self-locking. **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 power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 KN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 r.p.m. Assuming uniform wear condition at the collar and allowable thread bearing pressure of  $5.8 \text{ N/mm}^2$ , find: 1. the torque required to rotate the screw; 2. the stress in the screw; and 3. the number of threads of nut in engagement with screw. **07**

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