Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI • EXAMINATION – SUMMER 2013**

**Subject Code: 162001** **Date: 24-05-2013**

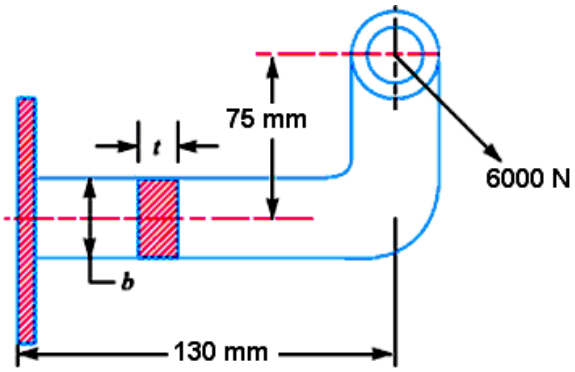
**Subject Name: Design of Mechanisms-I**

**Time: 10.30 am - 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.**

**Q.1** **(a)** A mild steel bracket as shown in figure below is subjected to a pull of 6000 N acting at 60° to its vertical axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross-sectional dimensions of the bracket, if the permissible tensile stress in the material of the bracket is limited to 60 MPa. **07**




**(b)**
1. Briefly explain the steps of generalized procedure of design. **04**
2. Discuss the factors, which govern the selection of a material of a machine component. **03**

**Q.2** **(a)** 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 **07**

1. circular
2. square and
3. rectangular with width= 3x thickness

**(b)** An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at screw thread is 0.1. Estimate power of the motor. **07**

**OR**

**(b)** Derive the expression for torque required to raise the load by square threaded screws. **07**

**Q.3** **(a)**
1. Explain the words Hoop Stress and Longitudinal stress. **02**
2. A thin cylinder pressure vessel of 500 mm diameter is subjected to an internal pressure of 3 N/mm$^2$. If the thickness of the vessel is 20 mm, find the hoop stress, longitudinal stress and the maximum shear stress. **05**

**(b)** Design a turnbuckle to connect the two tie rods. The pull in the tie rod is to be 100 KN. Take allowable tensile stress =75 N/mm$^2$ and shear stress = 30 N/mm$^2$. **07**

**OR**

**Q.3** Design a spigot and socket type cotter joint for following data: P = 50 KN, Allowable tensile stress = 90 MPa, Allowable shear stress is 50 MPa and permissible crushing stress = 100 MPa. Cotter is safe in Bending. **14**

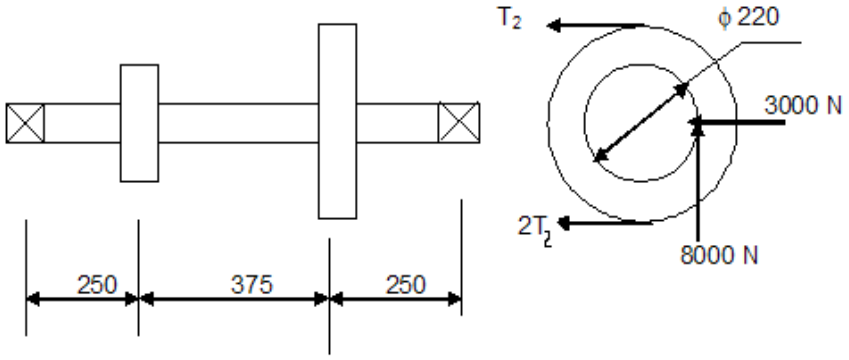
**Q.4** **(a)** A lever loaded safety valve is 70 mm in diameter and is to be designed for a boiler to blow off at a pressure of 10 bar. Design a suitable mild steel lever of rectangular cross section width= 3 x thickness using the following permissible stresses: **08**

Tensile stress = 70 N/mm$^2$
Shear stress = 50 N/mm$^2$
Bearing pressure = 25 N/mm$^2$
The pin is also made of mild steel. The distance from the fulcrum to the weight of the lever is 880 mm and the distance between the fulcrum and pin connecting the valve spindle links to the lever is 80 mm. take l/d = 1.25

**(b)** Explain the following terms: **06**
Derived series, Basic Series and Factor of Safety

**OR**

**Q.4** A pulley of 500 mm diameter is driven by a horizontal belt drive. The power is transmitted through a solid shaft to a pinion keyed to the shaft which in turn meshes with a gear. The belt tension and the components of gear reaction on the pinion are shown in fig. Design the shaft. Permissible shear stress of the shaft material is 55 N/mm$^2$. **14**
The shock and fatigue factors are: kb = 2 and kt =1.5.




**Q.5** **(a)**
1. Explain the bolts of uniform strength. **05**
2. Determine the diameter of the hole that must be drilled in an M 48 bolt such that the bolt becomes of uniform strength. Assume dc= 41.8 mm. **02**

**(b)** Design a helical spring for a Rams bottom safety valve for the following specifications: **07**
Dia of the valve=50 mm
Pressure Range= 0.7 to 0.75 MPa
Extension of the spring when pressure rise from 0.7MPa to 0.75MPa = 5 mm.
Spring index=6,
shear stress for spring =420 MPa,
G= 0.84x10$^5$ MPa.

**OR**

**Q.5** **(a)** A machine member 50 mm diameter and 200 mm long can be treated as a cantilever for stress analysis. The member is estimated to be subjected to a combination of the following loads: **07**

1. An axial tensile load of 10 kN,
2. A transverse point load of 3.5 kN at a distance of 20 mm from free end, and
3. A torque of 4.0 kN-m at the free end.

Determine combined stresses at the most critical section.

**(b)** A rod of length l may be considered as a strut with the ends free to turn on the crank pin and the gudgeon pin. In the directions of the axes of these pins, however, it may be considered as having fixed ends. Assuming that Eulerôs formula is applicable, determine the ratio of the sides of the rectangular cross- section so that the connecting rod is equally strong in both planes of bucking. **07**

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