Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination May 2011

Subject code: 162001
Subject Name: Design of Mechanisms-I

Date: 16/05/2011 **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)** Explain general design procedure in detail. **07**

(b) Write short note on 'Selection of materials in mechanical design-A systematic approach. **07**

Q.2 **(a)** Define Strain, Stress, Elasticity and Modulus of Elasticity, Bulk modulus of Elasticity, Yield strength and Ultimate strength. **07**

(b) If T_e is the equivalent torque for combination of Moment M and Torque T then for a shaft of diameter d prove that $T_e=\sqrt{M^2 + T^2}$ **07**

OR

(b) What is meant by: Dynamic loads, static loads or dead loads, live loads, impact loads, inertia loads, and Resilience? What type of stress is produced because of centrifugal force? **07**

Q.3 **(a)** In a steam engine the maximum steam pressure is 1.0 N/mm^2 absolute and the back pressure is 0.014 N/mm^2 absolute. The cylinder diameter is 0.3 m. Determine the diameter of the screwed end of the piston rod when the allowable stress of mild steel is 45.0 N/mm^2 in tension. **07**

(b) Design a cotter joint to support a load varying from 29430 N in compression to 29430 N 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 = 0.4905N/mm^2; Shear stress= 0.3433 N/mm^2 and Crushing stress = 0.8829 N/mm^2. **07**
Find out 1. Diameter of the rods, 2. Diameter of spigot and thickness of cotter, 3.Outside diameter of socket, 4. Width of cotter.

OR

Q.3 **(a)** Each bolt of a steel structure is subjected to a tensile load of 7 kN. It is initially tightened to a load of 6 kN. Calculate the bolt size if permissible tensile stress is 60 MPa. Calculate the size of the washer needed with this bolt if permissible crushing stresses are 10 MPa. **07**

(b) Design a knuckle joint to transmit 147.15kN. The design stresses may be taken as 0.7357N/mm^2 in tension, 0.5886N/mm^2 in shear and 1.4715N/mm^2 in **07**

compression. Design the join by considering 1.Failure of the solid rod in tension, 2.Failur of the knuckle pin in shear, 3.failure of the single eye or rod end in tension, 4.Failure of the single eye or rod end in shearing.

Q.4 **(a)** A 45 mm diameter shaft is made of steel with yield strength of 392.4N/mm^2. A parallel key of size 14 mm wide and 9 mm thick made of steel with yield strength of 333.54 N/mm^2 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**

(b) A shaft made of mild steel is required to transmit 100 kW at 300 rpm. The supported length of the shaft is 3 meters. It carries two pulleys each weighing 1500 N, supported at a distance of 1 meter from the ends respectively. Assuming the safe value of stress, determine the diameter of the shaft. **07**

OR

Q.4 **(a)** A foot lever is 1 m from the centre of shaft to the point of application of 800 N loads. Find: 1. Diameter of the shaft, 2. Dimensions of the key. The allowable tensile stress may be taken as 73 N/mm^2 and allowable shear stress as 70 N/mm^2 **07**

(b) Design and draw the fulcrum pin of a bell crank lever to raise a vertical load of 5.886kN. The longer and shorter arms of the lever are 40 cm and 10 cm respectively. **07**

Q.5 **(a)** An I-section 400 mm x 200 mm x 10 mm and 6 m long is used as a strut with both ends fixed. Find Euler's crippling load. Take Young's modulus for the material of the section as 200 kN/mm^2. **07**

(b) A thin cylindrical pressure vessel of 500 mm diameter is subjected to an internal pressure of 2 N/mm^2. If the thickness of the vessel is 20 mm, find the hoop stress, longitudinal stress and the maximum shear stress. **07**

OR

Q.5 **(a)** 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**

(b) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 N/mm^2 and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn neglecting the effect of curvature. **07**

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