Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination-Nov/Dec-2011

Subject code: 162001 **Date: 21/11/2011**
Subject Name: Design of Mechanisms-I
Time: 10.30 am -1.00 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)** What do you mean by preferred numbers? State their significance in mechanical engineering design. Explain the concept of derived series and basic series with suitable example. **07**

(b) 1. What is stress concentration? Suggest the remedies for it. **03**

2. It is desired to bend a strip 6 mm thick and 20 mm wide of spring steel into a loop with ends overlapping and riveted. Find the minimum radius of the loop if the stresses due to bending are limited to 100 MPa. Also determine the bending moment required to bend the strip. Take E= 2,10,000 MPa. **04**

Q.2 **(a)** What do you mean by Principal stresses? Enlist theories of failures. Explain any two of them. **07**

(b) Write a short note on Factor of Safety and standardization. **07**

OR

(b) A single start square threaded screw is used to raise a load of 30 KN. The screw has a mean diameter of 45 mm and pitch 8 mm. Height of the nut = 40 mm. Coefficient of friction between the screw and nut is 0.12. Find out Max Shear stress & Max Principal stress induced in the screw. Also check whether the self locking is present or not. **07**

Q.3 **(a)** 1. Determine the smallest size of a hole that can be punched in 17 mm thick plate having an ultimate shear stress of 350 MPa. The allowable crushing stress for the punch material is 1200 MPa. **05**

2. Explain the word yield strength and ultimate strength. **02**

(b) The maximum load on a petrol engine push rod 450 mm long is 1500 N. It is hollow having outer diameter 1.3 times the inner diameter. The modulus of elasticity for the material of the push rod is 210 kN/mm^2. Find suitable size of the push rod. Assume both the ends are hinged and take factor of safety =2. **07**

OR

Q.3 **(a)** 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**

(b) Explain Euler's column theory with assumptions and limitations. **07**

Q.4 **(a)** The shaft running at 120 rpm transmit 430 KW Power. The working condition to be satisfy by the shaft are **07**

(i) The shear stress must not exceed 56 MPa

(ii) The angle of twist must not be more than 1^0 on a length of 16d

Calculate the diameter of shaft. Take G= 0.85×10^5 MPa

(b) A right angled bell lever is used to raise a load of 10 kN at the end of shorter arm, which is 150 mm long. The mechanical advantage of the lever is 1.8. If the allowable stresses for lever and pin are σ_t = 100 N/mm^2 and τ = 80 N/mm^2, P_b = 20 MPa for pin, design the lever completely. Take l/d for pin =1.25 and use concept of interchangeability. Given t = 3/8 h, boss is safe in bending. **07**

OR

Q.4 **(a)** Find out the length of a rectangular key of 16x10 mm which is to be mounted on the shaft of 50 mm diameter. The shearing and crushing stresses for the key and shaft material are 42 MPa and 70 MPa. Assume that the shaft is loaded to transmit the maximum permissible torque. **07**

(b) Design a cranked lever for the following dimensions: **07**

Length of the handle = 320 mm

Length of the lever arm = 450 mm

Overhung of the journal = 120 mm

The lever is operated by a single person exerting a maximum force of 400 N at a distance of 1/3rd length of the handle from its free end. The permissible stresses may be taken as 50 MPa for lever material and 40 MPa for shaft material. Assume h = 2t.

Q.5 **(a)** Force acting on bolt consists of two components. An axial pull of 12 kN and transverse shear force of 6 kN. The bolt is made of cast steel FeE 310 (σut =310 N/mm^2) and factor of safety is 3. Determine the diameter of bolt. **07**

(b) Design a helical compression spring for a maximum load of 1500 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm^2. **07**

OR

Q.5 **(a)** A cylindrical thin drum 800 mm in diameter & 3 meter long has a shell thickness of 10 mm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine **07**

1. The change in diameter
2. Change in length
3. Change in volume

Take E= 2×10^5 N/mm^2 and 1/m= 0.25

(b) A composite spring has two closed coil helical springs. The outer spring is 15 mm larger than the inner spring. The outer spring has 10 turns of mean diameter 48 mm and wire diameter 8 mm. The inner spring has 8 turns of mean diameter 30 mm and wire diameter 5 mm. When the spring is subjected to an axial load of 600 N. Find **07**

(i) Compression of each spring

(ii) Load shared by each spring

(iii) Shear stress induced in each spring

Take G= 0.84×10^5 MPa
