

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VI • EXAMINATION – WINTER 2013

Subject Code: 162001

Date: 27-11-2013

Subject Name: Design of Mechanisms-I

Time: 02:30 pm to 05:00 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 is stress concentration? Explain different methods to reduce stress concentration with sketch. (7)
- (b) What is standardization? Explain importance of it. Explain preferred numbers and Basic series and Derived series. (7)

- Q:2** (a) What do you mean by Principal stresses? Explain in brief different theories of failures (7)
- (b) A C- clamp as shown in fig.1 is carrying a load of 25KN. The cross section of the clamp at section X-X is rectangular having width equal to twice the thickness. The clamp is made from steel casting with allowable stress of 100 N/mm^2 . Find dimensions of cross section; also determine stresses at section Y-Y. (7)

OR

- Q:2** (a) 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? (7)
- (b) A bolt is subjected to a direct tensile load of 9 KN and a shear load of 5 KN. Find suitable size of bolt according to (a) maximum principal stress theory (b) maximum shear stress theory (c) strain energy theory. Take factor of safety as 2.5, yield strength as 280 N/mm^2 and Poisson ratio as 0.3. (7)

- Q:3** (a) A bell crank lever is to be designed to raise a load of 5 KN at the short arm end. The lengths of short and long arms are 100mm and 450mm respectively. The lever and pin are made from 30C8 having yield strength in tension = 400 N/mm^2 . Take factor of safety 5. The permissible bearing pressure on pin is 10 N/mm^2 . The lever has rectangular cross section with width = 3 times the thickness. The length to diameter ratio of fulcrum pin is 1.25. Find: (i) The diameter and length of fulcrum pin. (ii) The shear stress in pin. (iii) The dimensions of cross section of lever. (7)
- (b) The maximum load on a petrol engine push rod 400 mm long is 2000 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. (7)

OR

- (a) Explain Euler's column theory with assumptions and limitations. (7)
- (b) A shaft is transmitting 40KW power at 300 r.p.m. Design a rectangular key if the permissible stresses for shaft and key material are 40 N/mm^2 in shear and 80 N/mm^2 in crushing. (7)

- Q:4 (a) A turbine shaft transmits 400kW power at 800 rpm. The permissible shear stress is 60 N/mm^2 while the twist is limited to 0.5 degree in a length of 2.5m. Calculate the shaft diameter. Take $k_t=1.1$, $G=8 \times 10^4 \text{ N/mm}^2$. If the shaft is chosen hollow with $d_i/d_o=0.6$, calculate the percentage saving in material and increase in radial dimensions of the shaft. Assume 10% overload. (7)
- (b) A shaft made of mild steel is required to transmit 90 kW at 260 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. (7)

OR

- Q:4 (a) What is a toggle jack? How is it designed? Enlist the steps of designing a screw of the toggle jack assuming the required data are available. (7)
- (b) A cylindrical thin drum 900 mm in diameter and 3 meter long has a shell thickness of 12 mm. If the drum is subjected to an internal pressure of 3 N/mm^2 , determine: 1. The change in diameter. 2. Change in length. Take $E=2 \times 10^5 \text{ N/mm}^2$ and $1/m=0.25$ (7)
- Q:5 (a) Two rods made of plain carbon steel are to be connected by means of a cotter joint. The yield strength of plain carbon steel is 380 N/mm^2 . The diameter of each rod is 50mm and the cotter is made from steel plate of 15mm thickness. Calculate the dimensions of the socket end considering factor of safety =6. Yield strength in compression is twice the yield strength in tension and yield strength in shear is half the yield strength in tension. (7)
- (b) A power screw is used to raise a load of 5kN. The nominal diameter is 60mm and the pitch is 8mm. The threads are achme type for which $2\theta = 29^\circ$ and coefficient of friction at screw thread is 0.15. Calculate: (i) Torque required to Raise the load and lower the load (ii) Efficiency of screw for lifting the load. (7)

OR

- Q:5 (a) It is required to design a knuckle joint to connect two circular rods subjected to an axial tensile force of 50 kN. The rods are co-axial and a small amount of angular movement between their axis is permitted. Design the joint and specify dimensions of its components. Take permissible tensile, shear and crushing stress for joint material to be 80, 40 and 80 N/mm^2 respectively. (7)
- (b) Design a helical compression spring for an engine valve from following data: (7)
Maximum load=2000N, Minimum load=1000N, Lift of the valve=8mm Spring index=5, Allowable stress=500 MPa, Modulus of rigidity= $8 \times 10^4 \text{ N/mm}^2$

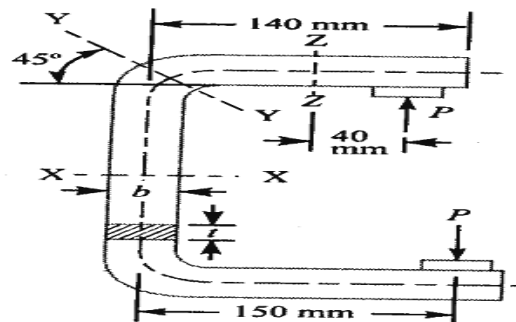


Figure : 1
