

GUJARAT TECHNOLOGICAL UNIVERSITY
B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 162001**Date: 02/01/2013****Subject Name: Design of Mechanisms -I****Time: 02.30 pm - 05.00 pm****Total Marks: 70****Instructions:**

1. Attempt any five questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Define 1) Preferred number 2) Preferred series 3) limit 4) fits. **07**
(b) Classify the engineering materials. Explain the selection of materials for Mechanical design. **07**

- Q.2** (a) Define 1) volumetric strain 2) Factor of safety 3) Resilience **07**
(b) A steel bolt of 1.8 cm diameter passes co-axially through a copper tube, which has 20mm inner diameter, and 30mm outer diameter, and 500mm length. Washers are placed at both the ends of the tube. The bolt has threads at one end with a pitch of 2.4mm. The nut is turned on the bolt through 45° so as to tighten the assembly. Determine the stress developed in the bolt and in the tube. Give $E_s = 2E_c = 2,00,000\text{N/mm}^2$ **07**

OR

- (b) A Solid shaft transmit 2,000kW at the rate of 200 r.p.m. The maximum torque developed in the shaft is 1.8 times the mean torque. The distance between the bearing is 1.8m with a flywheel weighing 5000kg midway between the bearings, as shown in **fig.1** Determine the shaft diameter if a) the maximum permissible stress is 60N/mm^2 and b) the maximum permissible tensile stress is 40N/mm^2 **07**
- Q.3** (a) The maximum load on a push rod of an IC engine is 1.5kN. The length is 280mm, and the push rod is hollow with inner diameter $d = 0.8D$, where D is the outer diameter of the section of the push rod. Spherical seated bearing are used for the push rod, $E = 207\text{kN/mm}^2$. Taking factor of safety 2, determine the section of push rod. **07**
(b) Design a cotter joint for the transmission of 25kN tensile or compressive load. Allowable stresses for all the three components socket, spigot and cotter may be taken as follows: 50N/mm^2 , 80N/mm^2 , 40N/mm^2 Determine 1) Diameter of rods. 2) Thickness of cotter 3) Outside diameter of socket. 4) Width of cotter. 5) Length of socket. 6) length of cotter. **07**

OR

- Q.3** (a) Determine the cross-section of the leaves of a carriage spring of semi elliptic-shape, used as a suspension of truck. There are a 2 full-length leaves (including the master leaf) and 8 graduated leaves. Spring eyes are located at 1180mm. take factor of safety as 2. Maximum load on spring may be taken as 40kN of the material of spring, Take ultimate strength is 1400Mpa. **07**
(b) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70kN. The ultimate strength of the material of the rod against tearing is 420Mpa. The ultimate tensile and shearing **07**

strength of the pin are 510Mpa and 396Mpa respectively. Determine the tie rod section and pin section. Take factor of safety = 6.

Q.4 (a) The following data relate to screw jack **07**

Pitch of the threaded screw = 8mm, Diameter of the threaded screw = 40mm, Coefficient of friction between screw and nut = 0.1, Load = 20kN, Determine 1) Ratio of torque required to raise the load and lower the load. 2) The efficiency of the machine.

(b) A lever loaded safety valve is 70mm in diameter and is to be designed for a boiler to blow-off a pressure of 1N/ mm² gauge. Design a mild steel lever of rectangular cross-section using the following permissible stresses: Tensile stress = 70Mpa; Shear stress = 50Mpa; Bearing pressure intensity = 25N/mm². The pin is also made of mild steel. The distance from the fulcrum to the weight of the lever is 880mm and the distance between the fulcrum and pin connecting the valve spindle links to the lever is 80mm. **07**

OR

Q.4 (a) What is the function of screw jack? Enlist the steps of designing a screw of screw jack assuming the required data are available. **07**

(b) Design a right angle bell-crank lever of elliptical section, to compress a spring by 10mm. The spring stiffness is 500N/ mm. Effort arm is 500mm, and the other arm is 200mm. determine the diameter of the pin. Use the following data: 1) Material of pin is mild steel with allowable shear stress = 40Mpa and allowable direct stress = 60Mpa. 2) Material of bell-crank lever, is medium carbon steel with allowable direct stress = 80Mpa. 3) Safe bearing pressure on bush = 10N/ mm² **07**

Q.5 (a) Find diameter of solid steel shaft to transmit 20kW at 200r.p.m. The ultimate shear stress for the steel may be taken as 360Mpa and a factor of safety as 8. If a hollow shaft is to be need in place of the solid shaft, find the inside and outside diameter when the ratio of inside and outside diameter is 0.5. **07**

(b) Explain bolt of uniform strength with neat sketches. **07**

OR

Q.5 (a) Explain with neat sketch stresses in thin cylindrical shell due to internal pressure. **07**

(b) A shaft made of mild steel is required to transmit 100kW at 300r.p.m. The supported length of the shaft is 3m from the ends respectively. The safe value of stress is 60N/ mm², determine the diameter of the shaft. **07**

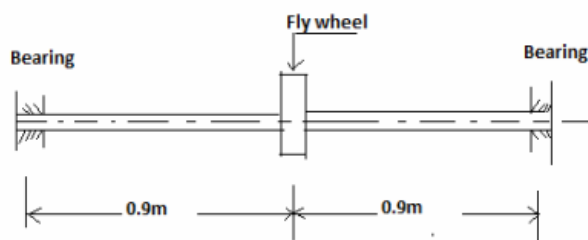


fig.1
