Registration No. : | | | | | | | | | | |

Total number of printed pages – 4

B. Tech

PCME 4303

Fifth Semester Examination – 2013

DESIGN OF MACHINE ELEMENTS

BRANCH : MECH

QUESTION CODE : C-347

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **four** from the rest.*
The figures in the right-hand margin indicate marks.
Draw neat sketches wherever necessary. Assume any missing data suitably..
Use of Prescribed Design Data Book is permitted.

1. Answer the following questions : 2×10

(a) Explain the following terms and what is their importance in the design of machine elements ?
   (i) Standardization
   (ii) Tolerances

(b) Where the designers use diamond riveting ?

(c) Differentiate between parallel and transverse weld. What do you mean by leg and throat of a fillet weld ?

(d) What do you mean by a bolt of uniform strength ? State one method to make bolt of uniform strength.

(e) Explain the bending failure of knuckle pin.

(f) How is strength of a shaft affected by the keyway ?

(g) What is nipping in leaf spring ? Discuss its role in spring design.

(h) What is a lever ? Explain the principle on which it works.

(i) Why is the nut of a power screw made of a soft material ?

(j) What types of stresses are produced in a belt while using for power transmission ?

P.T.O.

2. Design a riveted joint for the longitudinal and circumferential seams of a boiler having 1.5 meter diameter to withstand maximum pressure of $2N/mm^2$. The longitudinal joint is triple-riveted, double-cover plate butt joint with straps of unequal width and the circumferential joint is double-riveted lap joint. Material for the boiler plate and rivets are C20 having allowable limits of tensile, shear and crushing strengths are 85 N/mm^2, 45 N/mm^2 and 125 N/mm^2. Efficiency of the longitudinal joint is 85%. Corrosion allowance is 1.5 mm. 12.5

3. Design a socket and spigot cotter joint to connect two rods of equal diameter. Each rod is subjected to an axial tensile force of 20 kN. The rods are made of mild steel having allowable limits of tensile, shear and crushing strengths are 80 N/mm^2, 45 N/mm^2 and 70 N/mm^2. 12.5

4. A line shaft receives power through a gear and pinion. The pinion is connected to an electric motor delivering 40 kW at 1000 rpm. Out of this 40 kW power, 25 kW is supplied to a milling machine through a horizontal pulley drive at P_1 and the remainder of the power is supplied to a planner machine through pulley P_2 by a vertical belt. The pitch circle diameters of gear and pinion are 350 mm and 150 mm respectively. Pressure angle of both gear and pinion are 20°. The diameters of pulleys P_1 and P_2 are 700 mm and 900 mm respectively. Ratio of belt tensions in both drives is 2.5. The layout of the shaft is shown in figure 4.1. Design the shaft on the basis of strength. The combined shock and fatigue factors for tension and bending may be taken as 1.5 and 2.0 respectively. The shaft is made of plain carbon steel having allowable shear strength 85 N/mm^2. 5

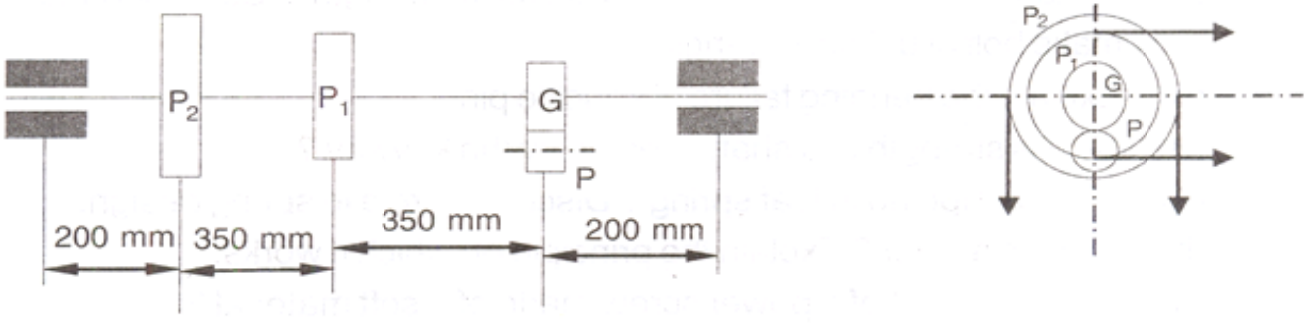

Figure 4.1

5. A bushed-pin type flexible coupling is used to connect the output shaft of an electric motor to the shaft of a compressor. The electric motor delivers transmitting 25 kW power at 650 rpm. The overload capacity is 1.5 times the average torque. Design the bushed-pin type flexible coupling. The shaft, keys and pins are made of plain carbon steel C40 having yield tensile strength 360 N/mm^2. The flange is made of Grey cast-iron FG200 (Ultimate tensile strength is 200 N/mm^2). 12.5

6. A helical compression spring is used to absorb the shock. The spring is subjected to a maximum force of 1 kN. The deflection of the spring corresponding to the maximum force should be 40 mm. The spring index is 6. Material of the spring is cold-drawn steel wire having ultimate tensile strength and modulus of rigidity as 1090 N/mm^2 and 81400 N/mm^2 respectively. The permissible shear stress for the spring wire is 57.7% of the ultimate tensile strength. The spring has square and ground ends and 1 mm gap should be maintained between two consecutive coils when the spring is subjected to the maximum force. Design the spring. 12.5

7. Design a screw jack for supporting of machine parts. The load carrying capacity of the screw jack is 40 kN and maximum lifting height is 250 mm. The power screw of the screw jack is made of plain carbon steel C45 having yield strength of 350 N/mm^2 and E = 207, 000 N/mm^2. The nut of the screw jack is made of phosphor bronze having allowable tensile strength of 35 N/mm^2. Coefficient of friction between steel screw and bronze nut is 0.15. Coefficient of friction between cup and screw head is also 0.15. The lever is made of C20 having allowable strength of 150 N/mm^2. The operator can apply 400N at the end of the lever. Limiting pressure between the mating threads of the screw and the nut is 12 N/mm^2. Consider the material for screw jack frame and cup as Grey cast-iron of grade FG200 having ultimate tensile stress as 200 N/ mm^2. 12.5

8. (a) Design a simple lever of a safety valve for a boiler having a gauge pressure of 2.5 MN/m^2. The valve diameter is 100 mm. The lever is 1 meter long and

the distance between the fulcrum and the valve point is 125 mm. The cross-section of the lever is rectangular having width to height ratio is 4:1. The lever is made of C20 steel having allowable strength of 90 N/mm^2. The bearing pressure at the pin is 20 N/mm^2. 6

(b) A steel plate is subjected to a force of 5 kN and fixed to a vertical channel by means of four identical bolts as shown in figure 8.1. All the bolts are made from plain carbon steel 30C8 having allowable shear strength 160 N/mm^2. Determine the size of the bolt. 6.5

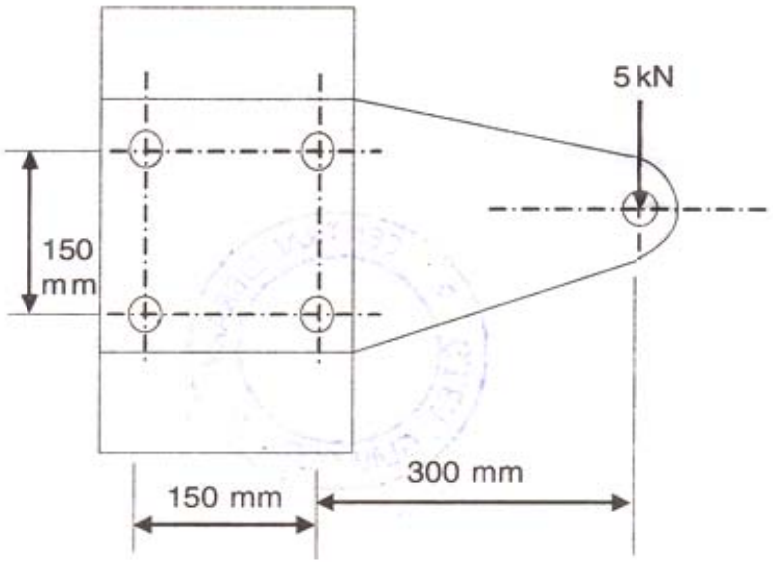

Figure 8.1