

Roll No.

Total Pages : 04

BT-6/M-14

8643

MACHINE DESIGN

ME-310-E

Time : Three Hours]

[Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks. Assume any missing data. Use of Machine Design Data Book is allowed.

Unit I

1. A pair of bevel gears, with 20° pressure angle, consists of 20 teeth pinion meshing with a 30 teeth gear. The module is 4 mm while the face width is 20 mm. The material for pinion and gear is steel 50C4 ($S_{ut} = 750 \text{ N/mm}^2$). The gear teeth are lapped and ground (Class 3) and the surface hardness as 400 BHN. The pinion rotates at 500 rpm and receives 2.5 kW power from the electrical motor. The starting torque of the motor is 150% of the rated torque. Determine the factor of safety against bending failure and against pitting failure.

(1-14) L-8643

P.T.O.

2. Design the teeth of a pair of bevel gears to transmit 18.75 kW at 600 rpm of the pinion. The velocity ratio should be about 3 and the pinion should have about 20 teeth which are full depth 20° involute. Specify the material and heat treatment, which seems best to you; also the module, face width and diameters of gears.

Unit II

3. It is required to select a v-belt drive to connect a 15 kW, 2880 rpm normal torque AC motor to a centrifugal pump, running at approximately 2400 rpm, for a service of 18 hour per day. The centre distance should be approximately 400 mm. Assume that pitch diameter of the drawing pulley is 125 mm.
4. Design a cone clutch to transmit 10 kW at maximum speed of 1000 rpm. The outer cone is of cast iron and forms the part of the I.C. engine flywheel. The overall dimension restricts the mean diameter of the cone to 300 mm. The semi-cone angle is 15° . The inner cone is positioned by means of centrally placed helical spring.

L-8643

2

Unit III

5. A helical compression spring made of circular wire is subjected to an axial force, which varies from 2.5 kN to 3.5 kN. Over this range of force, the deflection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold-drawn steel wire with ultimate tensile strength of 1050 N/mm² and modulus of rigidity is 81370 N/mm². The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate :
- Wire diameter
 - Mean coil diameter
 - Number of active coils
 - Total number of coils
 - Solid strength of spring
 - Free length of the spring,
 - Required spring rate
 - Actual spring rate.

6. Design a suitable journal bearing for a centrifugal pump from the following available data :
Load on the bearing = 13.5 kN; Diameter of the journal = 80 mm; Speed = 1440 r.p.m.; Bearing characteristic number at the working temperature (75°C) = 30; Permissible bearing pressure intensity = 0.7 N/mm² to 1.4 N/mm²; Average atmospheric temperature = 30°C.
Calculate the cooling requirements if any.

Unit IV

7. The cylinder of four stroke diesel engine has the following specifications :
Breake power = 5 kW
Speed = 600 rpm
Indicated mean effective pressure = 0.5 MPa
Make suitable assumptions and calculate :
 - Bore and length of the cylinder liner
 - Thickness of the cylinder line
 - Thickness of the cylinder head
 - Size, number and pitch of studs.
8. Design a crane hook with useful lifting capacity of the crane as 50 kN. The weight of the hook with grabbing tongs is 10 kN.