Total No. of Questions : 8]

SEAT No. :

PD-4155

[Total No. of Pages : 4

[6402]-116

S.E. (Robotics & Automation)

DESIGN OF MACHINE ELEMENT

(2019 Pattern) (Semester - IV) (211510)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q.l or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q. 7or Q.8.***
2) ***Use of scientific calculator is allowed.***
3) ***Figures to the right side indicate full marks.***

Q1) a) Explain Along with Sketch different Types of Screw Threads. **[4]**

b) Derive expression for efficiency of square threads and Maximum efficiency of square threads. **[8]**

c) An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300mm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at screw threads is 0.1. Estimate power of the motor. **[6]**

OR

Q2) a) A power transmission screw of a screw press is required to transmit maximum load of 100 kN and rotates at 60 r.p.m. Trapezoidal threads are as under The screw thread friction coefficient is 0.12. Torque required for collar friction and journal bearing is about 10% of the torque to drive the load considering screw friction. Determine screw dimensions and its efficiency. Also determine motor power required to drive the screw. Maximum permissible compressive stress in screw is 100 MPa **[9]**

Nominal dia, mm	40	50	60	70
Core dia, mm	32.5	41.5	50.5	59.5
Mean dia, mm	36.5	46	55.5	65
Core area, mm²	830	1353	2003	2781
Pitch,mm	7	8	9	10

P.T.O.

b) The lead screw of a lathe has single-start ISO metric trapezoidal threads of 52 mm nominal diameter and 8 mm pitch. The screw is required to exert an axial force of 2 kN in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 100 mm outer diameter and 60 mm inner diameter. The values of coefficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm. Calculate (i) the power required to drive the lead screw; and (ii) the efficiency of the screw. **[9]**

Q3) a) List out the Different Material Used in Spring. **[5]**

b) Define the Following Terms : Solid length, Free length, Spring index, Spring rate. **[4]**

c) Helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn. **[8]**

OR

Q4) a) Explain the concept of Surge in Springs. **[4]**

b) Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity, G = 84 kN/mm^2. Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils. **[6]**

c) At the bottom of a mine shaft, a group of 10 identical close coiled helical springs are set in parallel to absorb the shock caused by the falling of the cage in case of a failure. The loaded cage weighs 75 kN, while the counter weight has a weight of 15 kN. If the loaded cage falls through a height of 50 metres from rest, find the maximum stress induced in each spring if it is made of 50 mm diameter steel rod. The spring index is 6 and the number of active turns in each spring is 20. Modulus of rigidity, G = 80 kN/mm^2 **[7]**

Q5) a) Write a short note classification of Gear. **[4]**

b) Comparison Between Involute and Cycloidal Gears Explain. **[4]**

c) A pair of straight teeth spur gears is to transmit 20 kW when the pinion rotates at 300 r.p.m. The velocity ratio is 1 : 3. The allowable static stresses for the pinion and gear materials are 120 MPa and 100 MPa respectively. The pinion has 15 teeth and its face width is 14 times the module. Determine: 1. module; 2. face width; and 3. pitch circle diameters of both the pinion and the gear from the standpoint of strength only, taking into consideration the effect of the dynamic loading. The tooth form factory can be taken as Y = 0.154 - 0.912/ No of Teeth and Velocity factor Cv = 3/3+v **[10]**

OR

Q6) a) Explain Causes of Gear Tooth Failure in detail. **[4]**

b) A reciprocating compressor is to be connected to an electric motor with the help of spur gears. The distance between the shafts is to be 500 mm. The speed of the electric motor is 900 r.p.m. and the speed of the compressor shaft is desired to be 200 r.p.m. The torque, to be transmitted is 5000 N-m. Taking starting torque as 25% more than the normal torque, determine: 1. Module and face width of the gears using 20 degrees' stub teeth, and 2. Number of teeth and pitch circle diameter of each gear. Assume suitable values of velocity factor and Lewis factor. **[9]**

c) A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4 : 1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105 MPa respectively. The pinion has 16 standard 20° full depth involute teeth of module 8mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength. **[5]**

Q7) a) Explain in Details Types of Bearing. **[4]**

b) A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20 × 106 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing. **[7]**

c) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load. **[6]**

OR

Q8) a) Write A short on Lubrication and Mounting of Bearing. **[5]**

b) A 22KW, 1440 rpm Electric Motor is directly coupled to a shaft of 25 mm diameter, which supported by cylindrical roller bearing. The shaft transmits power to another line shaft through the flat pulley of 300 mm diameter which is placed mid-way between two bearing. The coefficient of friction between the belt and pulley.is 0.3,while angle of lap is 180°. The belt is horizontal, the load factor is 1.5 if expected life is 50,500 hours, select bearing from manufacturing catalogues Bearing No - NU2205 and NU-2305 having basic dynamic Capacity C KN is 15.99 and 31.39 Respectively. **[8]**

c) Write a short note on Selection of Bearing Life **[4]**