Total No. of Questions : 8]

SEAT No. :

PB3705

[Total No. of Pages : 3

[6261]-113

S.E. (Robotics and Automation)

DESIGN OF MACHINE ELEMENT

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

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.***
2) ***Use of scientific calculator is allowed.***
3) ***Figures to the right side indicate full marks.***

Q1) a) Discuss the different types of threads used in power screw. **[6]**

b) Derive the expression Maximum Efficiency of a Square Threaded Screw. **[5]**

c) A vertical two start square threaded screw of a 100 mm mean diameter and 20 mm pitch supports a vertical load of 18 kN. The axial thrust on the screw is taken by a collar bearing of 250 mm outside diameter and 100mm inside diameter. Find the force required at the end of a lever which is 400 mm long in order to lift and lower the load. The coefficient of friction for the vertical screw and nut is 0.15 and that for collar bearing is 0.20. **[7]**

OR

Q2) a) In a machine tool application, the tool holder is pulled by means of an operating nut mounted on a screw. The tool holder travel at a speed of 5 m/min. The screw has single start square thread of 48 mm nominal diameter and 8 mm pitch. The operating nut exerts a force of 500 N to drive the tool holder. The mean radius of the friction collar is 40 mm. The coefficient of friction at thread and collar surfaces is 0.15. Calculate power and efficiency. **[7]**

b) Explain concept of overhauling and self-locking screws. **[5]**

c) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 r.p.m. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm^2, find: **[6]**

i) the torque required to rotate the screw;
ii) the stress in the screw; and
iii) the number of threads of nut in engagement with screw.

P.T.O.

Q3) a) Define the Following Terms **[4]**

i) Solid length

ii) Spring index

iii) Free length

iv) Spring rate

b) Deflection of Helical Springs of Circular Wire derive the expressions. **[6]**

c) A Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced. **[8]**

OR

Q4) a) Design a helical spring for a spring loaded safety valve (Ramsbottom safety valve) for the following conditions: Diameter of valve seat = 65 mm ; Operating pressure = 0.7 N/mm^2; Maximum pressure when the valve blows off freely = 0.75 N/mm^2; Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm^2 = 3.5 mm ; Maximum allowable stress = 550 MPa; Modulus of rigidity = 84 kN/mm^2; Spring index = 6. Draw a neat sketch of the free spring showing the main dimensions. **[8]**

b) Derive the relegation ship between Springs in Series and Parallel. **[6]**

c) Write a short Note on Surge in Spring. **[4]**

Q5) a) 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 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength. **[9]**

b) Discuss Advantages and Disadvantages of Gear Drives. **[4]**

c) Explain different causes of gear tooth failure. **[4]**

OR

Q6) a) Explain the terms used in gears: **[4]**

i) Pressure Angle, and

ii) Module

b) How are the gears classified and what are the various terms used in spur gear terminology? **[5]**

c) A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate center distance between the shafts may be taken as 600 mm. The teeth has 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. Check the design for dynamic and wear loads. The deformation or dynamic factor in the Buckingham equation may be taken as 80 and the material combination factor for the wear as 1.4. **[8]**

Q7) a) Explain along with fig Types of Rolling Contact Bearings. **[4]**

b) Write a short note on Reliability of a Bearing. **[5]**

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. **[8]**

OR

Q8) a) 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, 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]**

b) How do you express the life of a bearing? What is an average or median life? **[4]**

c) Design a self-aligning ball bearing for a radial load of 7000 N and a thrust load of 2100 N. The desired life of the bearing is 160 million of revolutions at 300 r.p.m. Assume uniform and steady load. **[7]**