Total No. of Questions : 8]

SEAT No. :

P-1611

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S.E. (Robotics & Automation Engineering)

DESIGN OF MACHINE ELEMENTS

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

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

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

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

b) Define lead angle, major diameter, lead, and pitch interms of power screw. **[4]**

c) The cutter of a broaching machine is pulled by square threaded screw of 55 mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400 N on a flat surface of 60 mm and 90 mm internal and external diameters respectively. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut when the cutting speed is 6 m/min. Also find the efficiency of the screw. **[8]**

OR

Q2) a) 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 100 mm 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. **[8]**

b) Define core diameter, minor diameter, left hand screw, and Multiple thread screw in terms of power screw. **[4]**

c) What is meant by power screw? Give its advantages, disadvantages and applications. **[6]**

P.T.O.

Q3) a) What is meant by springs? Explain different types of springs. **[6]**

b) A compression coil spring made of an alloy steel is having the following specifications :

Mean diameter of coil = 50mm; Wire diameter = 5mm; Number of active coils = 20. If this spring is subjected to an axial load of 500N; calculate the maximum shear stress (neglect the curvature effect) to which the spring material is subjected. **[4]**

c) c) A 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 Surge in Springs. **[6]**

b) Give any 2 applications of springs and any 2 material required for manufacturing of springs. **[4]**

c) 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]**

Q5) a) What is spur gear? Enlist any 2 applications of spur gear and Give its detail classification. **[9]**

b) 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. **[8]**

OR

Q6) a) Define the terms in respective of spur gears: Module, Addendum, Pitch circle diameter, and Backlash **[4]**

b) Discuss the Causes of Gear Tooth Failure. **[5]**

c) The following particulars of a single reduction spur gear are given :

Gear ratio = 10:1; Distance between centres = 660 mm approximately; Pinion transmits 500 kW at 1800 r.p.m.: Involute teeth of standard proportions (addendum = m) with pressure angle of 22.5°; Permissible normal pressure between teeth = 175 N per mm of width, Find: **[8]**

i) The nearest standard module if no interference is to occur;

ii) The number of teeth on each wheel;

iii) The necessary width of the pinion; and

iv) The load on the bearings of the wheels due to power transmitted.

Q7) a) What are rolling contact bearings? Discuss their advantages over sliding contact bearings. **[4]**

b) Write short note on classifications and different types of antifriction bearings. **[5]**

c) 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 percent of time, 2 kN for 20 percent of time, 1 kN for 30 percent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95 percent reliability, calculate dynamic load rating of the ball bearing. **[8]**

OR

Q8) a) Where are the angular contact and self-aligning ball bearings used? Draw neat sketches of these bearings. **[7]**

b) How do you express the life of a bearing? What is an average or median life? **[6]**

c) Explain how the following factors influence the life of a bearing: **[4]**

i) Load

ii) Speed

iii) Temperature

iv) Reliability