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Bhartiya Vidya Bhavan's

Sardar Patel College of Engineering

(An Autonomous Institution affiliated to University of Mumbai)

KT Exam. M.E.(Mech) with Mle Design term I

Class/Sem.: **M.E. (Machine Design)/I** Date: **19.06.2014**

Duration: **4 Hrs.** Subject: **Tribology**

Total Marks: **100**

N.B.:1. Answer any **five** questions.
2. Use of PSG Design Data book and certified charts is permitted.
3. Assume suitable data, if necessary, giving reasons.
4. Draw neat sketches to illustrate your answers.
5. Figures to the right indicate full marks.

MASTER

1. (a) Explain the use of various dimensionless parameters in the design of hydrodynamically lubricated journal bearings. **06**

(b) Design a hydrodynamically lubricated journal bearing to support a radial load of 10 kN for a turbine shaft operating at 700 rpm. Select a suitable lubricating oil, show thermal balance and analyse the operating parameters such as oil temperature, viscosity, flow rate, minimum film thickness, coefficient of friction, friction power loss, maximum pressure, etc. **14**

2. (a) Define static and dynamic load capacities of rolling contact bearings giving explanations of the conditions under which they are defined. **06**

(b) Select suitable type and size of the rolling contact bearing subjected to the following load cycle which is repeated. **14**

Sr. No.	Radial Load (kN)	Axial Load (kN)	Speed (rpm)	Percent Time	Type of Load
1	2.0	1.6	300	30	Uniform
2	4.0	2.0	260	45	With Mild Shock
3	1.5	1.0	240	25	With Mod. Shock

The expected life is 15000 hrs., a probability of survival of 91 percent and an operating temperature of 125° C.

3. (a) Describe the principles of operations and construction of a hydrostatically lubricated thrust bearing. **06**

(b) Design a circular pad hydrostatically lubricated thrust bearing to support a load of 40 kN for a shaft operating at 500 rpm. The bearing is fed from a manifold pressure of 45 bar through a capillary restrictor, the film thickness is 60 microns, oil SAE 40 at 45°C, density 0.86 gm/cc and specific heat 1.75 kJ/kg °C. Assume recess to pad radii ratio of 0.5 and restrictor to bearing resistance ratio for maximum bearing stiffness condition. Calculate bearing inlet pressure, oil flow rate, pump power, friction power, bearing stiffness, oil temperature rise and capillary size etc. **14**

4. (a) Define wear and explain briefly different types of wear. Describe in detail adhesive wear and its estimation. **10**

(b) Explain briefly different lubrication regimes. Describe theory of elastohydrodynamic lubrication. **10**

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5. (a) Describe the constructional features and operating principles of fixed and tilting pad hydrodynamically lubricated thrust bearings. Compare fixed and tilting pad bearings. 06

(b) Design a hydrodynamic rectangular plane-slider bearing, length in direction of motion B, 0.8 times the length in direction perpendicular to motion L, slider velocity u = 2.5 m/s, load W =12 kN, lubricating oil used SAE 30 at 65°C. Assume maximum load condition for which, $C_P = 0.16024$, $C_F = 0.753191$, $C_f = 4.7000$, and $C_C = 0.5779$. Find the inclination of the surfaces, coefficient of friction, power loss, heat generated, oil flow rate, oil temperature rise, etc. Use minimum film thickness 40 microns. 14

6. (a) Enumerate the essential bearing material characteristics. State the common bearing materials with their compositions. 06

(b) Explain the role played by additives. 06

(c) Two smooth circular discs, each 200 mm in diameter, are separated by a film of SAE 40 oil at 25° C. Find the time required for the oil film to change its thickness from 0.04 mm to 0.006 mm if, the load applied is 500 N. Derive the equations used, if any. 08

7. Write notes on any four of the following: 20

(a) Theories of friction

(b) Failures in rolling contact bearings.

(c) Solid lubricants.

(d) Friction materials for Brakes and clutches and their properties.

(e) Surface finish.

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