ME (mech) Sem III. mic Design

2/1/08

Tribology.

master

Con. 5914–07. BB–8772

(4 Hours) [Total Marks : 100

N.B. : (1) Question No. 1 is compulsory.
(2) Attempt any four questions out of remaining six questions.
(3) Assume necessary data, if required, with proper justifications.
(4) Figures to the right indicate full marks.
(5) Use of standard databooks and certified charts is permissible.

1. Write short notes on any four of the following :– 20
   (a) Viscosity and its measurement.
   (b) Generalised, three dimensional Reynold's equation, significance of each term and applications of Reynold's equation.
   (c) Stick slip phenomenon.
   (d) Preloading of rolling contact bearings.
   (e) Ploughing theory of friction.
   (f) Solid lubricants.

2. (a) Define static and dynamic load capacities of a rolling contact bearing and explain their significe in the selection of bearings. 11
   A single row ball bearing has to be selected for a 45 mm shaft subjected to a radial load 3 kN, and a thrust load 2 kN at shaft speed of 600 RPM. Bearing is subjected to mild shock, inner race only rotates and the life required is 12000 hrs. Select a suitable bearing.
   (b) A cylindrical roller bearing is subjected to following loading cycle repeated continuously.

Sr. No.	Radial load (kN)	Speed (RPM)	Running time secs.
1.	5	1200	6
2.	10	1500	3
3.	12	700	4
4.	15	600	2

   Find the expected life of the bearing in hours and in millions of revolutions, if the dynamic capacity is 56 kN.

3. (a) Describe the kings bury's electrical analogy method for measurement of pressures developed in a hydrodynamically lubricated bearing. 8
   (b) Design a hydrodynamically lubricated journal bearing to support a radial load of 25 kN for a steam turbine shaft operating at 12000 RPM. Show the thermal balance of the bearing and determine operating parameters like oil temperature, viscosity, flow rate, coefficient of friction, friction power loss, maximum pressure etc. assuming it to be self contained bearing. 12

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4. (a) Describe the constructional features and principle of operation of a hydrostatic thrust bearing. Explain the use of compensators and their functions. State and compare different types of compensators used. 8

(b) Making suitable assumptions design an externally pressurised thrust bearing to support a thrust load of 45 kN with shaft rotating at 360 RPM. The bearing is fed from a manifold pressure of 50 bar through a capillary compensator, film thickness is 140 microns, oil viscosity 32 CP, density 0-86 and specific heat 1·76 kJ/kg °C. Calculate bearing inlet pressure, oil flow rate, friction power loss, pump power and bearing stiffness. Also calculate the rise in temperature of oil from manifold temperature to the temperature of oil at the outlet of the bearing. 12

5. (a) Describe oil lift in hydrostatic bearing. 20

(b) The following data is given for a hydrostatic thrust bearing (hydrostatic thrust bearing) :

(i)	Shaft speed of hydrostatic thrust bearing	= 1000 RPM
(ii)	Supply pressure	= 6 MPA
(iii)	Film thickness	= 0·2 mm
(iv)	Specific heat of lubricant	= 1·75 kJ/kg. °C
(v)	Shaft diameter	= 500 mm
(vi)	Recess diameter	= 250 mW
(vii)	Viscosity of lubricant	= 30 CP
(viii)	Specific gravity of lubricant	= 0·8

Calculate its load capacity, flow requirements in mm^3/sec, frictional power loss, pumping power loss, total power loss and temperature rise. Assume the total power loss is converted into frictional loss.

6. (a) Discuss the various theories of friction. 20

(b) Define wear. Describe adhesive wear in brief.

7. (a) Write the merits and demerits of hydrostatic bearing. 20

(b) Discuss the role played by additives in enhancing the properties of lubricants.