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P.E.S. College of Engineering, Mandya - 571401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, M.Tech. - Mechanical Engineering (MMDN)

Semester End Examination; Jan. - 2020

Tribology and Bearing Design

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Explain:

i) Simple adhesion theory of friction

ii) Abrasive theory of friction — 12

b. With a neat sketch, explain the following types of wear mechanism:

i) Corrosives wear

ii) Fatigue wear — 8

2 a. Explain with sketches, the regimes of lubrication. — 8

b. Explain the effect of temperature and pressure on viscosity of lubricating oils. — 6

c. State and explain Newton's law of viscous flow. — 6

UNIT - II

3 a. Derive Hagen-Poiseuille's law. State the assumptions made in the derivation. — 10

b. With a neat sketch, indicate the pressure induced flow and velocity induced flow in a converging oil film. — 4

c. The diameter of a capillary tube connecting two reservoirs is 0.025 cm and its length is 160 cm. The viscosity of oil filling the system is 24.1 cp. Determine the difference between pressure in reservoirs A and B, if maximum velocity of flow at the center line of capillary is equal to 8 m/min. — 6

4 a. In a hydrodynamic lubrication, show that velocity distribution across a converging oil film is in the form of, — 10

$$U = \frac{1}{2\eta}\frac{dp}{dx}(y^2 - hy) + U\left(\frac{(h-y)}{h}\right)$$

b. A pivoted shoe of a slider bearing has a square shape. The load carrying on the bearing is 15 kN. Velocity of the moving member is 5 m/s. Viscosity of lubricating oil is 24 cp. The permissible minimum oil film thickness is 0.02 mm Determine;

i) The dimensions of the shoe

ii) Coefficient of friction — 10

Assume that the inclination of bearing surface corresponds to the maximum load carrying capacity of the bearing.

Contd…2

UNIT - III

5 a. Derive an expression for load carrying capacity of idealized full Journal bearing. 10

b. An idealized full journal bearing has the following specifications:
Diameters of journal = 50 mm, length of bearing = 60 mm, speed of journal = 1200 rpm, radial clearance = 0.025 mm, average viscosity of oil under operating conditions is 0.0115 pas, Altitude = 0.8. Find; 10
i) Coefficient of friction
ii) Load carrying capacity
iii) Power loss in the bearing

6 a. Explain clearly the significance of Sommerfeld number in idealized full journal bearing. 8

b. List the factors to be considered when selecting the bearing length to diameter ratio. 6

c. A journal bearing of width 1 m operates with a shaft of 200 mm diameter which rotates at 1200 rpm. The diametral clearance is 200 μm and absolute viscosity of the lubricating oil at an inlet temperature of 20°C is 40 cp. For an eccentricity ratio of 0.7, calculate the minimum film thickness and maximum film pressure. 6

UNIT - IV

7 a. Explain different types of hydrostatic lubrication systems. 8

b. Derive an expression for discharge and load carrying capacity of hydrostatic step bearing. 12

8 a. A hydro static circular pad bearing operating under minimum oil film thickness of 50 μm supports a vertical load of 50 kN at a shaft of 2000 rpm. The lubricant viscosity at operating temperature of 8.5 cp. The recess pressure is 2 MPa and the external pressure outside the bearing is = 0. Assuming $d_2/d_1 = 3$, calculate; 10
i) Bearing dimensions ii) Ratio of oil flow
iii) Power loss iv) Coefficient of friction

b. Explain the meaning of EHL. Give a detailed account of different regimes in EHL contacts. 10

UNIT - V

9 a. Explain the governing differential equation for gas bearing. 10

b. What is porous bearing? How does the Reynolds equation is modified for porous bearing? 10

10 a. Explain the role of following components in an active magnetic bearing construction: 8
i) Position sensor
ii) Controller
iii) Power amplifier

b. Explain the advantages of magnetic bearings and mention their industrial applications. 8

c. Distinguish clearly between passive magnetic bearing and active magnetic bearing. 4

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