MASTER OF MECHANICAL ENGG. EXAMINATION, 2019

(2nd Semester)

LUBRICATION ENGINEERING

Time: Three hours Full Marks: 100

Missing data, if any, may be assumed.

Answer any **five** questions.

1. a) Explain five important properties of lubricant.
   b) How does viscosity vs. temperature relation of gas lubricants differ from that of oils?
   c) Explain the working of an efflux viscometer. 10+4+6

2. a) State the basic assumptions of the theory of lubrication. Use these assumptions to derive Reynolds equation from Navier-Stokes equations.
   c) Explain the need for continuity equation in solving lubrication problems.
   c) Explain the physical significance of different terms in Reynolds equation. 12+4+4

3. a) Explain the mechanism of pressure development in a hydrodynamic bearing.
   b) Starting from the integrated form of the Reynolds equation, derive the expression for load capacity of a parallel step slider bearing.
   c) A fixed inclination slider bearing of length 100 mm and width 600 mm operates at a sliding velocity of 1m/s. Select a mineral oil such that the bearing operates with a minimum film thickness of $40\,\mu$m at maximum load capacity of 20 kN. Also calculate the coefficient of friction. 5+8+7

4. a) Explain Half Sommerfeld boundary conditions for analyzing hydrodynamic journal bearing. Use these to derive the pressure distribution and load capacity of an infinitely long journal bearing.
   b) Explain the design procedure of a finite length journal bearing. 14+6

5. a) Explain the merits and demerits of hydrostatic bearings.

   b) For a circular step thrust bearing, write down the appropriate Reynolds equation. Hence deduce the expression for load capacity and total power loss for such a bearing.

   c) For a circular step thrust bearing, deduce the condition fore minimum pumping power loss. 4+10+6

6. a) Starting with the generalized Reynolds equation, derive the fundamental principles of self-acting gas lubrication.

   b) Explain slip flow and surface roughness effects in gas bearings. 12+8

7. a) For a infinitely long squeeze journal bearing, deduce the squeeze load capacity.

   b) A normal load of 20 kN is applied to a parallel – plate squeeze film bearing with plates 10 mm long and 1 m wide and a film thickness of 20 μm. The oil has viscosity of 0.04 Pa-s. Calculate the time required to reduce the film thickness to 2 μm and the film thickness after 1.5 sec.

   c) Derive Stribeck's equation for the static load capacity of ball bearings. 8+6+6

8. Write short notes on

   a) Reduced Reynolds equation for a piezoviscous fluid.

   b) Metal working lubrication.

   c) Hydrodynamic instability

   d) Selection of rolling contact bearings 5 x 4