

M. TECH. DEGREE EXAMINATION, MODEL QUESTION PAPER – I

First Semester

Branch: Mechanical Engineering

Specialisation: Machine Design

MMEMD 105-4 Industrial Tribology (Elective – I)

(Regular – 2013 Admissions)

Time: Three Hours

Maximum: 100 Marks

Answer all questions. Only approved design-data handbook permitted.

1. a. What are the prominent theories of friction? (3 marks)
- b. State the laws of friction. (3 marks)
- c. Briefly explain any 3 theories of wear. (3 marks)
- d. Derive Reynolds equation in Cartesian co-ordinates. (16 marks)

Or

2. a. Define viscosity and briefly explain viscosity Index. (5 marks)
- b. Explain the mechanism of Pressure development in an oil film. (5 marks)
- c. Explain the relevance of Reynolds equation and its components. (5marks)
- d. Derive the Hagen- Poiseuille Equation for flow through horizontal and inclined capillary tubes (10 marks)

3. a. The following data is given for a journal bearing :
Radial load of 3.2 kN, Journal speed of 1490 r.p.m, journal diameter of 50 mm, bearing length of 50 mm, radial clearance of 0.05 mm, viscosity of 25 cP. Calculate for the given conditions:
 - a. Coefficient of friction.
 - b. Power loss owing to friction.
 - c. Minimal film thickness
 - d. Flow requirement of oil in litres /minute
 - e. Temperature rise in the bearing. (18 marks)
- b. Briefly describe the mechanism of pressure build-up in a hydrodynamic bearing with relevant figures. (7 marks)

Or

4. a. Explain: i. Sommerfeld number with reference to Reynolds equation.
ii. Bearing Characteristic number
iii. Pressure distribution in Journal bearing, with relevant figure. (12 marks)

b. The following data is given for 360° hydrodynamic journal bearing.

l/d	1
n	1350 r.p.m
Journal diameter	100 mm
Diametral clearance	100 μm
External load	9 kN

The value of minimum film thickness variable is 0.3. Find the viscosity of oil that needs to be used. (13marks)

5. a. Derive the equation for the load bearing capacity, frictional power loss, energy losses of a hydrostatic step bearing. (15marks)
- b. What is the role of restrictors in such bearings? (5 marks)
- c. What is air film lubrication? Compare it with oil lubrication. (5marks)

Or

6. a. Explain the working principle of hydrostatic thrust bearing with figures. (12 marks)
- b. Derive the equation for pressure acting on hydrostatic annular thrust bearing. (13 marks)

7. a. Derive the equations for static load bearing capacity of a rolling element bearing. (10 marks)
- b. A ball bearing is operating on work cycle of 3 hours consisting of:
 - i. a radial load of 3 kN at 1440 r.p.m for one quarter cycle.
 - ii. a radial load of 5 kN at 720 r.p.m for half cycle.
 - iii. a radial load of 2.5 kN at 1440 r.p.m for the remaining cycle.

The expected life of the bearing is 10000 hours. Calculate the load carrying capacity of the bearing. (15 marks)

Or

8. a. Explain the possible causes of bearing failure, and remedies. (5marks)
- b. Explain briefly the construction of a typical ball bearing with figure and specify the materials used for construction of different parts. (5marks)
- c. Explain i. Static Load Carrying capacity ii. Dynamic Load carrying capacity iii. Equivalent load carrying capacity of an anti-friction bearing (10marks)
- d. Derive the expression for predicting the L_{50} life of a bearing. (5 marks)