T.E. (Mechanical) (Semester – II) Examination, 2010
TRIBOLOGY
(2003 Course)

Time : 3 Hours   Max. Marks : 100

Instructions :
1) *Answers to the **two** Sections should be written in **separate** books.*
2) ***Neat** diagrams must be drawn **wherever** necessary.*
3) *Black figures to the **right** indicate **full** marks.*
4) ***Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
5) *Assume suitable data, if **necessary**.*

SECTION – I

1. a) Explain with the help of suitable examples the importance of 'Tribology' in the design of machine elements.   8

   b) Explain different types of additives used to improve the properties of lubricating oils.   6

   c) What do you understand by 10W/30 motor oil ?   2

                              OR

2. a) Write short notes on   (4+4)

      1) Types and Use of Greases.

      2) Factors influencing the selection of lubricants.

   b) Discuss in short the effect of temperature and pressure on viscosity of lubricating oil.   6

   c) What is the relation between Absolute viscosity and Kinematic viscosity ? Write S.I. units of both.   2

3. a) What is meant by Abrasive wear ? Deduce the equation for volume of abrasive wear per unit sliding distance with conical abrasive particles.   6

   b) Explain the theory of friction "Junction growth theory".   4

   c) What are the factors affecting wear rate ?   4

    d) What do you understand by Conformal Geometry tests in relation to friction measurement ?   2

<div align="center">OR</div>

4. a) Name any four different experimental methods of wear measurement. Explain any one of them.   6

    b) Explain in short :

      i) Stick slip phenomenon   4

      ii) Fretting.   4

    c) List the causes of friction.   2

5. a) Explain the mechanism of pressure development in Hydrodynamic Lubrication.   6

    b) Derive Reynolds Equation for two dimensional flow. Also state the assumptions in the derivation. What is the difference between Infinitely long and Infinitely short journal bearings ?   (8+2+2)

<div align="center">OR</div>

6. a) The following data is given for full hydrodynamic bearing : (Use table 1)   8

    l/d ratio = 1

    Bearing length = 50 mm

    Eccentricity = 15 microns

    Radial clearance = 20 microns

    Journal Speed = 1450 rpm

    Radial Load = 10 kN

    Sp. Gravity of lubricant = 0.86

    Calculate

      i) Minimum oil film thickness

      ii) Coefficient of friction

      iii) Viscosity of the lubricant

      iv) Total flow rate of the lubricant in lit/min.

    b) Discuss different regimes of lubrication with the help of Stribeck curve.   6

c) Write Petroff Equation. State its usefulness. 4

Table 4 : Dimensionless Parameters for Full Journal bearings

$\frac{l}{d}$	$\frac{h_o}{c}$	$\in$	$S = \left(\frac{r}{c}\right)^2 \frac{\mu n_s}{P}$	$\left(\frac{r}{c}\right)f$	$\frac{Q}{r c n_s l}$	$\frac{Q_s}{Q}$	$\frac{p_{max}}{p}$
1.	0.0	1.0	0	0	–	1.0	–
	0.03	0.97	0.00474	0.514	4.82	0.973	6.579
	0.1	0.9	0.0188	1.05	4.74	0.919	4.048
	0.2	0.8	0.0446	1.70	4.62	0.842	3.195
	0.4	0.6	0.121	3.22	4.33	0.680	2.409
	0.6	0.4	0.264	5.79	3.99	0.497	2.066
	0.8	0.2	0.631	12.8	3.59	0.280	1.890
	0.9	0.1	1.33	26.4	3.37	0.150	1.852
	1.0	0.0	∞	∞	3.142	0	–

SECTION – II

7. a) Discuss the advantages, limitations and applications of Hydrostatic Lubrication.

   (3+3+2=8)

   b) Show that in case of hydrostatic step bearing with shaft rotating at exceptionally low speed, for a given load carrying capacity and a shaft diameter, the power loss is minimum when :

   Recess diameter = 0.53×shaft diameter. 8

                OR

8. a) The following data refers to the hydrostatic step bearing used for vertical shaft.

   Thrust load 1 kN

   Inlet pressure 8 MPa

   Ratio of recess diameter to shaft diameter 0.5

   Oil film thickness 20 μm

   Viscosity of lubricant 35 cP

   Shaft speed 100 rpm

   Specific heat of lubricant 2.1 kJ/Kg °C

Specific gravity of lubricant 0.86

Calculate :

  i) Shaft and recess diameter

  ii) Flow rate of lubricant

  iii) Frictional power loss

  iv) Pumping power loss   **8**

  b) Derive the equation of flow rate of viscous fluid through rectangular slot. Also state the assumptions while deriving the equation.   **8**

9. Derive the expressions for load carrying capacity and time of approach in case of two parallel rectangular plates of infinite width and separated by a fluid film. Two parallel rectangular plates with width to length ratio of 4 are separated by an oil film of thickness 0.1 mm at the beginning of load cycle. The load of 12 kN is applied on the upper plate for 5 seconds, the lower plate being stationary. If the viscosity of oil and the permissible minimum oil film thickness are 30 cP and 0.02 mm respectively, calculate the length and width of plates.   **(12+4)**

<div align="center">OR</div>

10. a) Explain the phenomenon of Squeeze film lubrication ? State two examples where this type of lubrication is observed.   **4**

  b) Write notes on   **12**

    i) Lubrication in metal working

    ii) Gas lubricated bearing.

11. a) Derive the equation for pressure distribution and load carrying capacity of infinite width tapered pad bearing.

  b) Explain the phenomenon of Elastohydrodynamic lubrication. How does it differ from Hydrodynamic lubrication ?   **(4+2)**

<div align="center">OR</div>

12. a) What are the desirable properties of bearing materials ? List few suitable materials for bearing.   **6**

  b) Write notes on   **12**

    i) Gaskets

    ii) Oil seals

    iii) Types of hydrodynamic thrust bearing.

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