[Total No. of Questions - 8] [Total No. of Printed Pages - 2]
(2066)

16422(J)

M. Tech 2nd Semester Examination

Industrial Tribology

PE-E12

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt any five questions. All questions carry equal marks.

1. (a) What do you mean by conformal and non-conformal contacts? Explain with neat sketches. (10)

   (b) What do you understand by the real area of contact? Describe in brief the different measurement techniques to measure real area of contact. (10)

2. (a) What do you mean by friction? Explain in brief classification of frictional contacts. (10)

   (b) Explain the following terms: (i) wear and their classification (ii) stress state in materials (iii) Generation of defects (iv) Degrees of wear. (10)

3. (a) Explain Tabor's model of friction. (10)

   (b) Describe the various methods of monitoring wear. Explain the principle of working of a pin-on-disc tribometer. (10)

4. (a) What is the principle of lubrication? Explain lubricated wear classification and the types of lubricant. (10)

   (b) What are the equations governing viscosity variation of liquid lubricant with temperature and pressure? What are various grades of lubricants (Engine Oils) as per SAE? (10)

5. (a) What is the reason for temperature rise in lubricant film of a journal bearing? What is the effect of various operating parameters on temperature rise? (10)

[P.T.O.]

   (b) A normal load of 10kN is applied to a parallel-plate squeeze film bearing with plates 10 mm long and 1 m wide and a film thickness of 10μm. The bearing is lubricated with an oil film of viscosity of 40cP. Calculate (i) the time required to reduce the film thickness to 1μm, and (ii) the film thickness after 1 second. (10)

6. (a) Differentiate between hydrodynamic and elasto-hydrodynamic lubrication. (8)

   (b) Two cylindrical gears with 50 mm radius, made of steel and separated by an incompressible film of mineral oil, roll together at surface velocities of 10 m/s each under normal load per unit width of 1×10^6 N/m. The effective modulus of elasticity of the gear is 456 GPa and absolute viscosity and α for the mineral oil are 50 mPa s and 0.022 MPa^{-1}, respectively. Calculate the film thickness for the case of rigid teeth and constant viscosity and film thickness for elastic teeth lubricated with variable viscosity using Grubin's analysis. (12)

7. (a) Using Reynold's boundary condition derive the equation for pressure distribution and load carrying capacity of a journal bearing. (10)

   (b) A machine tool bearing has a length of 50 mm and its journal diameter is also 50 mm. The r/c ratio is 1000 and the operating viscosity of the lubricant (SAE 30) is 50 MPa sec. If the journal speed is 950 rpm, and the eccentricity ratio, ε=0.5, calculate: (i) The load carrying capacity, (ii) The maximum/minimum pressure and their locations, if the oil inlet pressure at $\theta = 185°$ is 200 kPa, (iii) The coefficient of friction and the power lost in friction. Use the long bearing approximation. (10)

8. Write short notes on:
   (a) Surface Energy theory
   (b) Mechanism of Rolling Friction
   (c) Solid lubricant
   (d) Factors governing the selection of anti-friction bearings (5×4=20)