

**BE/B.Tech Degree End Semester Examinations, April / May 2013**  
**Fifth Semester Material Science and Engineering**  
**ME 9030 INDUSTRIAL TRIBOLOGY**

**Time: 3 Hrs**

**Max.Marks:100**

**Answer All Questions**  
**PART-A (10 x2=20)**

(26)

1. Metals exhibit very high sliding friction in vacuum.-Justify
2. Define apparent and real area of contact in sliding systems
3. What are the laws of adhesive wear?
4. What is fretting wear? Give an example for the same.
5. What is meant by viscosity index of a liquid lubricant?
6. What are the advantages and limitations of hydrostatic lubrication?
7. Bring out the principle of wedge action in hydrodynamic lubrication
8. Write the Reynolds equation for an infinitely long squeeze film bearing.
9. What are the main properties required for materials of sliding element bearings?
10. Name any two materials used as ingredients of hard surface coatings

**Part- B ( 5x 16 = 80 mark)**

11. (i) Explain the role of the following in sliding friction

1. Surface roughness
  2. Adhesion
- ( 8 marks)

(ii) Discuss the friction characteristics of the following materials

1. MoS<sub>2</sub>
  2. PTFE
- ( 8 marks)

12 (a) . Explain the significance of following in sliding friction .with appropriate examples

- a. adhesion
- b. hardness of the surfaces
- c. surface energy

**OR**

12 (b) i. Explain the difference between two body and three body abrasive wear ( 8 mark)

ii. Explain ferrographic technique of wear analysis. (8mark)

13 (a) i. Specify suitable grade of lubricant for the following application highlighting the role of additives used in each case

1. Bearings of propeller shaft of Marine engines
  2. Main spindle bearing of a CNC machining centre
  3. Aircraft turbine bearing
- ( 8mark)

13 (a) ii. Explain the mechanism of boundary lubrication? What are the types of boundary lubricants? ( 8 marks)

OR

(b) i Distinguish elastohydrodynamic and hydrodynamic lubrication ( 6mark)

ii. Under what operating conditions solid lubrication is preferable over liquid lubrication.

Discuss important solid lubricants. (10 mark)

14(a) i Explain with sketch the working principle of hydrodynamic journal bearings. ( 8mark)

ii. Derive Petroff's equation for friction power loss in concentrically rotating hydrodynamic journal bearing. ( 8mark)

OR

14 (b) i. A journal bearing of 60 mm diameter 15 mm long , and 10 micron clearance operating at 1000 rpm supports a load of 10 k N . Assuming isothermal conditions and eccentricity ratio of 0.7 find the required viscosity for lubricating the bearing. ( 8 mark)

ii. Starting from first principle, show that the pressure gradient and velocity are related by

$dp / dx = \eta \delta^2 u / \delta y^2$  for viscous fluid flowing between two parallel stationary plates

( 8 mark)

15(a) Explain with schematic sketch the following coating methods :

1. PVD process
2. Ion plating process.
3. Flame spraying process.

OR

15(b) i. What are the situations in which the rolling bearings are preferable over journal bearings? ( 6 mark)

ii. Explain the composition and characteristics of any two sliding and rolling bearing materials .( 10mark)

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