BENGAL ENGINEERING & SCIENCE UNIVERSITY, SHIBPUR
B.E. (ME) Part –IV 8th Semester Final Examination, 2012
Subject :Fundamentals of Tribology (EL – II)
(ME – 804 / 1)

Time : 3 hours **Full Marks : 70**

Answer **SIX** questions taking any **THREE** from each half.
Use separate answer script for each half.
The questions are of equal value.

FIRST HALF

1. (a) Explain briefly the mechanism of hydrodynamic instability due to whirling of journal.
   (b) Establish the expressions for squeeze film pressure and load capacity of an infinitely long journal bearing.

2.(a) Establish the expressions for the load capacity and frictional power loss of a circular step thrust bearing.
   (b) The following data is provided for a circular step thrust bearing of a vertical turbo generator:
   Inner diameter of thrust bearing = 80 mm
   Outer diameter = 260 mm
   Film thickness = 0.05 mm
   Viscosity of oil = 0.05 Pa-S
   Speed of runner = 1200 rpm
   Recess pressure = 3.5 MPa
   Determine –
   (i) load capacity (ii) frictional power loss

3. (a) Explain the following elastohydrodynamic lubrication regimes.
   (i) isoiscous-elastic * (ii) piezoviscous-elastic
   (b) Explain Hertzian contact pressure. With the help of this pressure, derive the load capacity of EHL point contact.
   (c) Discuss various dimensionless parameters involved in EHL line contact.

4. (a) Explain the piezoviscous effect in EHL contact.
   (b) What is viscosity – index of lubricants? How do you quantify it?.
   (c) Explain SAE classifications of lubricants.

5. (a) Discuss the various temperature-viscosity relations for lubricants.
   (b) Write short notes on the followings:
   (i) acidity and alkalinity of lubricants
   (ii) viscosity index improvers
   (iii) pour-point depressants

* isoviscous - elastic

6 (a) Describe and represent diagrammatically the structures of a typical polished metal surface and subsurface.

(b) Describe briefly **SEM** and **TEM** used for qualitative examination of surface texture.

(c) Stating all the assumptions of Greenwood & Williamson's model and describing all the relevant surface rough parameters and mechanical properties, derive the expressions of expected **total number of asperity contacts**, expected **area of contact** and **Plasticity Index** of contact of two nominally flat rough surfaces.

7. (a) State Amontons and Coulomb laws of friction. Explain Simple **Adhesion Theory of Friction** and find coefficient of friction.

(b) Why a durable thin oxide layer on the surface due to humid environment helps in reducing coefficient of friction? Prove that the coefficient of friction between two perfectly cleaned dry sliding surfaces under vacuum approaches towards infinity.

(c) What do you understand by **Adhesion** & **E. Rabinowicz's Compatibility Chart**?

8. (a) Define **Tribology & Tribometer**. Classify **Wear Mechanisms**, citing example of each mechanism.

(b) Derive the Archard's Adhesive Wear Equation, stating clearly the assumptions made.

(c) An experiment was carried out on a Pin-on-Disc machine for sliding contact of mild steel pin of 8 mm diameter with EN31 disc. The Disc was rotating at 1000 r.p.m. and the pin was located at a distance of 100 mm from the centre of the disc. If after 7 hours of running in dry condition with a normal load of 3 kg, 0.55 mg of material is removed from the pin, find out the Archard's Wear Coefficient and Archard's Wear Equation for mild steel pin. Given that

	Mild Steel	EN31
Density (kg/m^3)	7800	8500
Hardness (GPa)	1.8	7.8
Modulus of elasticity (GPa)	196	202

9. (a) Discuss the mechanism of wear involved in the blades of induced draft fan & impellers of slurry pump, handling fly ash in thermal power plant.

(b) Explain the mechanism of cavitational wear. How this mechanism helps in removal of kidney stone?

(c) Define Corrosive Wear and explain its model of repeated removal of **Passivating Oxide Film**.

(d) Explain the transition between **Corrosive and Adhesive Wear**.

10. Write short notes on the followings:

(i) Talysyuf
(ii) Surface & subsurface stress distribution of hertzian point contact
(iii) 2-body and 3-body abrasive wear
(iv) Skewness & Kurtosis of surface roughness
(v) Spalling failure in rolling contact bearing and pitting failure of gear
(vi) Scuffing