

B E MECH ENGG EXAMINATION, 2017

(3rd Year, 2nd Semester)

PRINCIPLES OF ENGINEERING TRIBOLOGY

Time: Three hours

(Elective I)

Full Marks: 100

Missing data, if any, may be assumed.

Answer any five questions.

1.
 - a) Explain Skewness, Kurtosis and Power Spectral Density Function for a rough surface.
 - b) For a Gaussian distribution, evaluate the ratio of RMS to CLA roughness.
 - c) Explain Auto Correlation Function. How does it distinguish between open and closed texture.
 - d) Explain the working of a surface profilometer. 5 x 4

2.
 - a) Explain Greenwood-Williamson contact model with assumptions.
 - b) Define plasticity index. Explain its physical significance.
 - c) A rubber sphere of diameter 20 mm is brought in contact with a flat smooth glass plate with an initial joining load of 4 g. Now if external load is gradually reduced, explain the contact radius vs. load behavior with the help of graphs for the following two situations:
 - a) the experiment is carried out in normal atmospheric condition
 - b) the experiment is carried out in vacuum. Mention the respective theories to explain the behavior.8+4+8

3.
 - a) State and explain Reynolds equation in fluid film lubrication.
 - b) Explain the physical significance of different terms in Reynolds equation.
 - c) Explain the mechanism of pressure development in hydrodynamic bearings. 8+6+6

4.
 - a) Explain how does friction behaviour of ceramics depend on fracture toughness, normal load and sliding speed.
 - b) Consider a micro-scale friction measurement using a hard ball of radius 2.83 mm sliding against a soft and flat surface. The overall friction coefficient is measured as 0.25, and the groove produced during sliding has a width of 1 mm. The interfacial shear strength at the contact is found to be one-tenth of the bulk value. Assuming friction due to multiple mechanisms acting in additive mode, calculate the contribution from different mechanisms towards friction. P.T.O.

- c) Deduce the expression for ploughing component of friction using a conical asperity model. 6+8+6
5. a) Explain Archard's theory of adhesive wear.
b) Explain Delamination theory of wear.
c) In a pin-on-disk wear test, a bronze pin of radius 10 mm is placed with its flat face resting on a steel plate under a normal load of 100 N and at a distance of 200 mm from the centre of the steel plate which rotates about its axis at 5 Hz for 20 hours. At the end of the test, the specimens are separated and weighed and it is found that the mass losses of the bronze and steel are 250 mg and 10 mg respectively. Calculate the wear coefficients for bronze and steel if hardness and density of steel and bronze are 2.4 GPa, 0.8 GPa, 7.8 Mg/m³ and 8.4 Mg/m³, respectively. 5+5+10
6. a) Explain the use of thermocouples in measurement of surface temperature in sliding.
b) Explain the difference between CVD and PVD.
c) Explain briefly the applications of atomic force microscopy. 8+6+6
7. Write short notes on:
a) Stiction
b) Ferrography
c) Fatigue wear
d) Scanning Tunnelling Microscopy 5 x 4