MASTER OF MECHANICAL ENGG. EXAMINATION, 2018

(1st Semester)

PRINCIPLES OF TRIBOLOGY

Time: Three hours

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) Consider a smooth surface brought into contact with a surface having a random roughness. Outline the steps in the argument, which explains that the real area of contact is approximately proportional to the load, independent of the deformation mode of individual asperities.

    10+4+6

3. a) What is adhesion? Explain the factors influencing adhesion.

    b) Compare JKR, DMT and MD models of adhesion.

    c) Deduce the expression for ploughing component of friction using a conical asperity model.

    6+6+8

    P.T.O.

4.   a) Explain how does friction behaviour of ceramics depend on fracture toughness, normal load and sliding speed.

b) A hard metal ball of 10 mm diameter is slid across a soft metal surface and produces a groove of 3 mm width. For a measured coefficient of friction of 0.45, calculate the adhesive contribution to the coefficient of friction.

c) Explain stick-slip process. How can it be prevented?   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/m^3 and 8.4 Mg/m^3, respectively.   5+5+10

6.   a) Explain the use of radiation detectors 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) Solid lubricants

b) Wear debris analysis

c) Hutching's equation for erosive wear

d) Fractal dimension   5 x 4

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