

B.E. MECHANICAL ENGINEERING EXAMINATION, 2022

(3rd Year, 2nd Semester)

PRINCIPLES OF ENGINEERING TRIBOLOGY

Time: Three hours

(Basic Professional Elective II)

Full Marks: 100

Missing data, if any, may be assumed.

Answer any five questions.

1.
 - a) Deduce the expression for ploughing component of friction using a spherical asperity model.
 - b) A hard conical slider of semi-apex angle 75° is slid across a soft metal surface and produces a groove of 2.5 mm width. For a measured coefficient of friction of 0.48 and considering friction due to adhesion and ploughing in additive mode, calculate the adhesive contribution to the coefficient of friction.
 - c) Explain how the friction of ceramics depends on normal load and sliding speed.
8+6+6

2.
 - a) Explain Archard's theory of adhesive wear.
 - b) Derive Hutching's equation for erosive wear.
 - c) A milling cutter is used to saw through a medium carbon steel bar ($H=2$ GPa) of 10 mm dia with a width of cut of 0.5 mm. It takes 10 min to saw and the energy expended was 50 watt. The coefficient of friction is 0.3. Calculate the wear coefficient during the cutting process.
6+6+8

3.
 - a) Explain the use of radiation detectors in measurement of surface temperature in sliding.
 - b) Explain the difference between chemical vapor deposition and physical vapor deposition.
 - c) Explain briefly the need for surface engineering.
8+6+6

[Turn over

- a) Explain CLA for a rough surface. State its values achieved in common manufacturing methods. State its demerits as a roughness parameter.
- b) Define skewness and kurtosis. State the range of these parameters and the physical significance of these values.
- 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

- a) State the assumptions of Greenwood-Williamson contact model.
- b) Explain how the load and contact area can be evaluated in elastic-plastic contact situation.
- c) Define plasticity index. Explain its physical significance. 4+10+6

- a) What is adhesion? Explain the factors influencing adhesion.
- b) Compare JKR, DMT and MD models of adhesion.
- c) Define elastic adhesion index and plastic adhesion index. State their physical significance. 4+10+6

Write short notes on (any four):

- a) Fractal dimension
- b) Surface treatments
- c) Delamination theory of wear
- d) Wear debris analysis
- e) Stick-slip
- f) Solid lubricants
- g) Atomic Force Microscope 5 x 4