Ex/ME(M2)/PE/B/T/325C/2023

B.E. Mechanical Engineering - Third Year - Second Semester Examination – 2023

Time: Three hours Subject: **PRINCIPLES OF ENGINEERING TRIBOLOGY** Full Marks: 100

Different parts of the same question should be answered together.

CO1 [40]	Q. 1	**Answer any four from (a) to (f) in this block** 10 x 4 **(a)** Explain CLA for a rough surface. State its values achieved in common manufacturing methods. State its demerits as a roughness parameter. Define skewness and kurtosis. State the range of these parameters and the physical significance of these values. **(b)** Explain Auto Correlation Function. How does it distinguish between open and closed texture. Explain the working of a surface profilometer. **(c)** State the assumptions of Greenwood-Williamson contact model. Explain how the load and contact area can be evaluated in elastic-plastic contact situation. Define plasticity index. Explain its physical significance. **(d)** What is adhesion? Explain the factors influencing adhesion. Compare JKR, DMT and MD models of adhesion. Define elastic adhesion index and plastic adhesion index. State their physical significance. **(e)** What is flash temperature? Explain the use of radiation detectors in measurement of flash temperature. **(f)** Explain Archard's theory of adhesive wear. Derive Hutching's equation for erosive wear.
CO2 [20]	Q. 2	**Answer any two from (a) to (c) in this block** 10 x 2 **(a)** A hard conical slider of semi-apex angle 75^0 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, calculate the adhesive contribution to the coefficient of friction. **(b)** 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. **(c)** A ceramic ball of radius 5mm is pressed into a hemispherical recess of 10mm radius in a steel plate. Elastic modulus, Poisson's ratio and hardness of ceramic material and steel are 450 GPa and 200 GPa, 0.3, 0.3, 20 GPa and 5 GPa respectively. Find the normal load necessary to initiate yielding in steel plate. Calculate the radius of contact and the depth at which yield first occurs.
CO3 [20]	Q. 3	**Answer any two from (a) to (c) in this block** 10 x 2 **(a)** Explain the need for surface engineering. Explain the difference between CVD and PVD. Explain the different techniques of hard facing. **(b)** Explain solid film lubrication. Explain the variation of coefficient of friction with pressure for graphite and molybdenum disulphide. **(c)** Describe briefly: i) Pin-on-Disc, ii) stick-slip, iii) wear debris analysis.
CO4 [20]	Q. 4	**Answer any two from (a) to (c) in this block** 10 x 2 **(a)** Explain the working of a scanning tunneling microscope with schematic diagram. **(b)** Explain the working of an atomic force microscope with schematic diagram. **(c)** Explain the wear behavior of ceramic and polymer materials.