

B.E. Mechanical Engineering - Third Year - Second Semester Examination – 2025

Time: Three hours

Subject: **PRINCIPLES OF ENGINEERING TRIBOLOGY**

Full Marks: 100

All parts of the same question must be answered together

CO1 [40]	Q. 1	Answer any four from (a) to (f) in this block 10 x 4 (a) Explain any four statistical roughness parameters for a rough surface. (b) Explain Abbott Bearing Area Curve. Explain the working of a surface profilometer with diagram. (c) Explain G-W contact model stating the assumptions. (d) Briefly explain JKR and DMT models of adhesion. State their domains of applicability. (e) Explain the use of radiation detectors in measurement of surface temperature. (f) Explain solid erosion. Derive Hutchings equation for erosion wear.
CO2 [20]	Q. 2	Answer any two from (a) to (c) in this block 10 x 2 (a) A sphere of 100 mm diameter is pressed into the plane surface of a solid block. Assume that both the sphere and the block are made of steel ($E=210$ GPa, Poissons's ratio= 0.3), but the block is softer than the sphere and has a tensile yield stress of 200 MPa. Find the maximum pressing load that can be applied to the sphere before the yielding of the block sets in. (b) In a pin-on-disk wear test, a bronze pin of radius 12 mm is placed with its flat face resting on a steel plate under a normal load of 120 N and at a distance of 250 mm from the centre of the steel plate which rotates about its axis at 10 Hz for 15 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 180 mg and 12 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 g/cc and 8.4 g/cc, respectively. (c) A micro-scale friction measurement uses 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.
CO3 [20]	Q. 3	Answer any two from (a) to (c) in this block 10 x 2 (a) What is surface engineering? Explain briefly any three techniques of microstructural treatments. (b) Explain friction variation of ceramics with fracture toughness, normal load, sliding speed and temperature. (c) Explain: i) Adhesion theory of friction, ii) Ploughing component of friction for conical asperity model.
CO4 [20]	Q. 4	Answer any two from (a) to (c) in this block 10 x 2 (a) Derive Archard equation of wear. How can it be used in selection of materials for dry contact? (b) Explain the working of (i) AFM and (ii) Tribometer. (c) Explain (i) Wear Debris Analysis (ii) Hertz Contact theory.