

ENGINEERING TRIBOLOGY (ME - 911)

Time: 3 Hours

Full Marks: 70

**Answer any FIVE questions.
All questions carry equal marks.**

1. (a) How roughness parameters are measured? Define Abbott Firestone Bearing Area Curve

(b) Explain magnification and resolution of Optical Microscope and Electron Microscope for qualitative examination of surface texture.

(c) Define Skewness and Kurtosis of surface roughness

2. (a) Define nominal contact area and real area of contact of two interacting surfaces.

(b) From Greenwood & Williamson's model, derive the expressions of expected number of asperity contacts, area of contact and plasticity index for a given contact of two rough flat surfaces under normal load.

3. (a) State Amontons and Coulomb laws of friction.

(b) State the simple adhesion theory and find the coefficient of friction.

(c) Why a durable thin oxide layer on the surface due to humid environment helps in reducing coefficient of friction? Prove that the coefficient of friction between two perfectly cleaned dry sliding surfaces under vacuum approaches towards infinity.

4. (a) Explain that Tribology addresses interdisciplinary areas of research.

(b) Derive the Archard's Adhesive Wear Equation stating clearly all the assumptions made.

(c) An experiment was carried out on a Pin-on-Disc machine for sliding contact of mild steel pin of 10 mm diameter with EN31 disc. The Disc was rotating at 1000 r.p.m. and the pin was located at a distance of 150 mm from the centre of the disc. If after 7 hours of running in dry condition with a normal load of 5 kg, 0.85

mg of material is removed from the pin, find out the Archard's Wear Coefficient and Archard's Wear Equation for mild steel pin.

Given that

	Mild Steel	EN31
Density (kg/m^3)	7800	8500
Hardness (GPa)	1.8	7.8
Modulus of elasticity (GPa)	196	202

5. (a) A spherical ball (made of EN31 steel) of diameter 5 cm makes contact inside a cylindrical surface (mild steel) of diameter 20 cm under a normal load of 50N. Find out maximum Hertzian contact stress, maximum tensile stress and shear stress developed and also show the distribution of stresses on the surface and subsurface. Mechanical properties of EN31 and Mild Steel are as given in Q.No.4.
- (b) Discuss the lubrication regimes in terms of ratio of film thickness to composite roughness of surfaces called " λ " ratio. Show schematically the lubrication regimes versus coefficient of friction and wear resistance in the same diagram.
- (c) Discuss on the influence of microstructures, present in various kind of heat-treated steels, on resistance to adhesion and surface fatigue.
6. (a) Discuss the mechanism of wear involved in the blades of induced draft fan & impellers of slurry pump, handling fly ash in thermal power plant.
- (b) Explain the mechanism of cavitation wear. How this mechanism helps in removal of kidney stone?
- (c) Define Corrosive Wear and explain its model of repeated removal of Passivating Oxide Film.
- (d) Explain the transition between Corrosive and Adhesive Wear.