

# Indian Institute of Technology, Kanpur

## Proposal for a new course

**Course Number:** ME 6XX

**Course Title:** Introduction to Tribology

**Credits:** 3L-0T-0P-0A: 9

**Course level:** Open elective (PG and 3rd & 4th year UG)

**Duration of Course:** Full Semester

**Proposing Department:** Mechanical Engineering

**Other departments which may be interested in the proposed course:** Materials Engineering, Chemical Engineering, Aerospace Engineering

**Proposing Instructor:** Manjesh K. Singh

**Other faculty who might be interested in teaching this course:** Dr. Tanmay Mathur, Dr. Ushasi Roy, Dr. Sudhansu Shekhar Singh, Dr. J. Ramkumar, Dr. Kantesh Balani, Dr. Ishan Sharma

### Course Description

- (a) **Objective:** To introduce the students to fundamentals and different components of tribology – friction, wear and lubrication.
- (b) **Contents** (assuming 50 minutes lectures, total 40 lectures):
- (i) **Introduction** [1 Lecture]  
Definition, history and economic cost
  - (ii) **Friction and Adhesion** [12 Lectures]
    - Surfaces: Roughness, real and apparent contact
    - Adhesion: Surface-forces, bonds and free surface energy theory of adhesion
    - Contact of spheres: The Hertz theory, the JKR theory and the DMT theory
    - Relative motion of surfaces: Sliding, rolling and spin
    - Origin and laws of friction
    - Friction in sliding/rolling contact
  - (iii) **Lubricants and Lubrication** [10 Lectures]
    - Properties of lubricants: Viscosity and thermal properties
    - Fluid film lubrication: Viscous flow and Reynolds equation, Stribeck curve, boundary, mixed and hydrodynamic regime
    - Hydrostatic, hydrodynamic and elastohydrodynamic lubrication
    - Boundary lubrication and lubricants
    - Solid lubrication and lubricants

(iv) **Wear** [8 Lectures]

- Wear and its causes
- Adhesive, abrasive, erosive, fatigue, corrosive and fretting wear
- Mathematical modelling of wear

(v) **Special topics:** Instructor's discretion to focus on some of the following topics. [9 Lectures]

- Friction and wear measurements: Laboratory experiments/demonstrations.
- Design of bearings and gears
- Tribology in Automobiles, Aircrafts and Electric Vehicales
- Biotribology: Natural and artificial hip joints
- The JKR-DMT transition
- Computational Tribology

(c) **Prerequisites:** None

## Books/References

1. Israelachvili, J. "Intermolecular and Surface Forces", 3<sup>rd</sup> Ed., Academic Press
2. Bhushan, B. "Introduction to Tribology", 2<sup>nd</sup> Ed., Wiley
3. Stachowiak, G. W. and Batchelor, A. W. "Engineering Tribology", 3<sup>rd</sup> Ed., Butterworth-Heinemann
4. Hutchings, I. and Shipway, P., "Tribology", 2<sup>nd</sup> Ed., Butterworth-Heinemann
5. Johnson, K. L., "Contact Mechanics" , Cambridge University Press
6. Goryacheva, I. G., "Contact Mechanics in Tribology", Kluwer Academic Publishers
7. Maugis, D., "Contact, Adhesion and Rupture of Elastic Solids", Springer

Dated: 19-10-2024

Proposer: Manjesh K. Singh

Dated: \_\_\_\_\_

DUGC/DPGC Convener: \_\_\_\_\_

**The course is approved/ not approved**

**Chairman, SUGC/SPGC**

**Dated:** \_\_\_\_\_