# TRIBOLOGY
## (Elective-I)

**Subject Code: 13ME2205** **L P C**
**4 0 3**

**Pre requisites:** Design of machine members

**Course Educational Objectives:**
To make the student understand
1. technology of lubrication, control of friction and prevention of wear
2. the art of providing operational analysis to problems of great economic significance
3. the importance of nano-tribology

**Course Outcomes:**
The student will be able to explain
1. the fundamentals of fluid film lubrication bearings, rolling element bearings, friction and wear of metals
2. tribological parameters for the increase of service life of machine elements
3. the working of various microscopes used in nano-tribology
4. the fabrication techniques of MEMS/NEMS

**UNIT-I**
Properties and testing of lubricants: Viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers.
Friction: Introduction, Laws of friction, kinds of friction, causes of friction, friction measurement, theory of friction. Friction characteristics of metals, friction of Non metals, ceramics and polymers. Study of current concepts of boundary friction and dry friction.

**UNIT-II**
Wear of metals: Introduction, definition, scope, classification of wear, adhesive, delamination, fretting, abrasive, erosive and corrosive wear. Mechanism of wear, wear resistant materials, wear testing methods, wear reduction by surface improvement. Introduction to wear of polymers and ceramics.

**UNIT-III**

Hydrostatic lubrication: Hydrostatic step bearing, application to fixed and pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing. Hydrostatic thrust bearings, Hydrostatic bearing analysis including compressibility effects.

**UNIT-IV**

Hydrodynamic lubrication: Various theories of lubrication, Petroff's equation, Reynolds equation in two dimensions. Effects of side leakage - Reynolds equation in three dimensions, Somerfield number. Friction in slider bearing, hydro dynamic theory applied to journal bearing

Elastohydrodynamic lubrication: Theoretical considerations, Grubin type solutions, film thickness equations. Different regimes in EHL contact.

**UNIT-V**

Nano tribology: Introduction, measurement tools, Surface force operators, scanning tunneling microscope, friction force microscope, atomic force microscope, fabrication techniques for MEMS/NEMS.

**TEXT BOOK:**

1. B.C Majumdar, "*Tribology and Bearings*", C Publications, 2e, 2007

**REFERENCES:**

1. Basu Sen Gupta and Ahuja, "*Fundamentals of Tribology*", Prentice Hall, 1e, 2006.

2. Prasanth Sahoo, "*Engineering Tribology*", PHI Learning Publishing, 1e, 2005.

3. Kenneth C Ludema, "*Friction, Wear, Lubrication*", CRC Press, 1996.

4. Bharath Bhushan, "*Introduction to Tribology*", Wiley, 2002