

**1. Preamble**

The course explains the range of surface treatments and advanced coatings that are designed to minimize wear, friction and surface oxidation / corrosion in IC engines.

**2. Pre-requisite**

NIL

**3. Course Outcomes**

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
C01	Understand and perform basic design calculations of elastohydrodynamic lubrication and contact mechanics problems, including rolling bearing, gears and cams contacts	K2
C02	Calculate surface topographical parameters of Surface properties & Friction	K2
C03	Understand the wear theories, types of wear, mechanism, factors and selection of materials	K2
C04	Understand the basic design calculations of hydrodynamic lubrication problems, including thrust bearings and journal bearings	K2
C05	Understand Rheodynamics (Static) Lubrication characteristics, materials in extreme environments	K2

**4. Correlation with Programme Outcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	M	L	H							M	M
CO2	H	H	H	M	L	H							M	M
CO3	H	H	H	M	L	H							M	M
CO4	H	H	H	M	L	H							M	M
CO5	H	H	H	M	L	H							M	M

H- Strong; M-Medium; L-Low

**5. Course content****UNIT I INTRODUCTION**

L-9

Introduction of Tribology - General Tribological Considerations in the Design of Bearings, Gears, Cams, Reciprocating Components. Engine Tribology Basics - Tribological Aspects of Engine Components Such as Bearings, Piston Assembly, Valve Train and Drive Train Components.

**UNIT II SURFACE PROPERTIES & FRICTION**

L-9

**Surface Properties:** Surface Properties of Metals, Composites, Surface Texture Measurement and Assessment, Statistical Methods of Surface Texture Assessment. Friction: Theories of Friction, Sliding Friction – Rolling Friction Characteristics of Common Metals and Non-Metals – Friction under Different Environments. Engine Friction – Losses and Engine Design Parameters.

**UNIT III WEAR AND CRACKING**

**L-9**

Wear Theories - Types of Wear and Their Mechanism, Factors Affecting Wear, Selection Of Materials For Different Wear Situations, Measurement Of Wear, Tribometers And Tribometry. Engine Wears Mechanisms, Wear Resistant Materials, Coatings And Failure Mode Analysis.

**UNIT IV LUBRICATION & LUBRICANTS**

**L-9**

Lubrication: Hydrodynamics, basic concepts, generalized Reynolds equation, types of bearings, Hydrostatic bearing -basic concepts, bearing pads, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings. Lubricants: Type of lubricants, properties and testing, service, lubrication of tribological components, lubrication system, lubricant monitoring, SOAP, ferrography and other rapid testing methods for lubricants contamination.

**Unit V-Rheodynamics (Static) Lubrication**

**L-9**

Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotropic materials and Bingham solids, grease lubrication, tribology of components in extreme environments like vacuum, pressure and temperature

**TOTAL: 45 Periods**

**6. Text Books**

- 1 Bowden, F.P. & Tabor, D., "Friction and Lubrication of Solids", Oxford University Press 1986.
- 2 Ernest Rabinowicz z, " Friction and Wear of Materials" Inter science Publishers, 1995.
- 3 Neale, M.J., Tribology – Hand Book, Butterworth, 1995.
- 4 Fuller D.D., Theory and Practice of Lubrication of Engineers: John Wiley Sons, 1984.

**7. References**

1. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd. Uk, 1981.
2. Hulling, J. (Editor) --"Principles of Tribology", Macmillan, 1984.
3. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.
4. Neale M.J, "Tribology Hand Book ", Butterworth Heinemann, 1995.
5. Bhushan. B. Modern Tribology Handbook, Volumes 1 & 2. - Boca Raton A.O.: Crc Press, 2000. – 1760 P.
6. Stachowiak G., Batchelor A.W. Engineering Tribology. - New York A.O.: Butterworth-Heinemann; 2001. – 744.
7. Garkunov D.N. Scientific Discoveries in Tribo-Technologies. No-Wear Effect under Friction. Hydrogen Wears of Metals. - Moscow: Maa Publishing House; 2007.