

ME454: INDUSTRIAL TRIBOLOGY

CREDITS = 5 (L=3, T=0, P=2)

Course Objective:

To analyze the concept of friction, wear and lubrication in the context of life of relatively moving elements

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				
L	T	P		Theory		Practical		Total Marks
			ESE	CE	ESE	CE		
3	0	2	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	<u>Introduction:</u> Tribology in design, industry, economic considerations, Flow of fluids, Viscosity and temperature variation, Viscosity index, determination of viscosity and different viscometers, Lubrication, lubricants, types of lubricants and properties of lubricants, SAE classification, recycling, disposal of oils, lubricant additives, and selection.	06
2	<u>Surface Topography:</u> Terminological considerations nature of surfaces and their contact, Physio-mechanical properties of surface layer, geometrical properties of surfaces, Methods of studying surfaces, study of contact of smoothly and rough surfaces, Thermal effects on surface, Statistical analysis of surface. <u>Friction and Wear:</u> Friction - Laws of friction - Friction classification - Causes of friction, Theories of Dry Friction, Friction Measurement, Stick-Slip Motion and Friction Instabilities, Wear - Wear classification - Wear between solids - Wear between solid and liquid - Factors affecting wear - Measurement of wear, Theories of Wear, Approaches to Friction Control and Wear Prevention, Boundary Lubrication Bearing Materials and Bearing Construction.	06
3	<u>Hydrodynamic Lubrication:</u> Principle of hydrodynamic lubrication, Mechanism of pressure development in oil film and lubrication regimes, Reynolds's equation for hydrodynamic bearing, hydrodynamic journal bearing and its analysis, hydrodynamic thrust bearing. <u>Elasto-Hydrodynamic Lubrication:</u> Principles and Applications, Pressure viscosity term in Reynolds's equation, Hertz's Theory, Ertel-Grubin equation, Lubrication of spheres, Gear teeth bearings, Rolling element bearings.	08

Unit No.	Topics	Teaching Hours
4	<p><u>Hydrostatic Lubrication:</u> Principle of hydrostatic lubrication, Arrangement of hydrostatic lubrication systems , Advantages , limitation and applications of hydrostatic lubrication, Viscous flow through rectangle and circular slot , Hydrostatic step bearings, Energy losses in hydrostatic step bearing, Optimum design of hydrostatic step bearing, Temperature rise in hydrostatic step bearing. Hydrostatic squeeze- film bearings, Squeeze Film Lubrication - Basic concept - Squeeze action between circular and rectangular plates - Squeeze action under variable and alternating loads, Application to journal bearings , Piston Pin Lubrications.</p>	08
5	<p><u>Air/Gas Lubrication:</u> Introduction to Gas lubrication and requirements of gas lubrication, Advantages, limitations and applications of gas lubrication, Reynolds's equation for Gas lubrication, Principle, advantages, limitations and applications of Air bearings.</p>	05
6	<p><u>Industrial Case Studies on Tribology with recent trends in research:</u> Tribology in Design - Mechanical design of oil seals and gasket - tribological design of oil seals and gasket, Tribology in Industry Maintenance, Nano tribology, <u>Tribological Aspects of Rolling Motion:</u> The mechanics of tire-road interactions, Road grip and rolling resistance, Tribological aspects of wheel on rail contact, Magneto-Rheological (MR) Fluids.</p>	05
TOTAL		44

List of References:

1. H.G. Phakatkar, R.R. Ghorpade , “*Tribology* ”, 4th edition, Nirali Prakashan
2. S.K. Basu, S. N. Sengupta, “*Fundamental of Tribology*”, PHI Learning Private Ltd.
3. Sushil Kumar Srivatsava, “*Tribology in Industry*”, S. Chand & Co
4. Bharat Bhushan, “*Introduction to Tribology*”, WILEY publication
5. I.V. Kragelsky and V.V. Alisin, “*Friction Wear Lubrication: Tribology Handbook*” Vol. I, II and III - MIR Publishers.
6. A. Cameron and C.M. Mc. Ettles, “*Basic Lubrication Theory*”, Wiley Eastern.
7. Theo Mang, Kirsten Bobzin and Thorsten Bartels, “*Industrial Tribology: Tribo systems, Friction, Wear and Surface Engineering*”, Wykeham Publications Ltd.
8. Arun kumar “*A text book of Tribology*” ,S.K.Kataria & Sons

Course Outcomes (COs):

At the end of this course students will be able to ...

1. Recognize the properties of lubricants used in different bearings and industrial process.
2. Explain laws of friction , topology of surfaces , modes of wear and the wear-mechanism maps
3. Apply mathematical models of hydrodynamic and Elasto-Hydrodynamic bearings.
4. Apply mathematical model of Hydrostatic bearings.
5. Identify the application of Air/Gas lubrication bearing
6. Apply the condition monitoring techniques