Tribology - Video course

COURSE OUTLINE

Tribology deals with design of fluid containment systems like seals and gasket, Lubrication of surfaces in relative motion to achieve reduced friction and wear. The structure of the bearing and the nature of fluid flow determine the loads that can be supported.

Modeling systems as hydrostatic, squeeze film and elasto-hydrodynamic lubrication will be studied as infinite and later finite structures. Gas (air) lubricated and rolling contact type motions with deformation at contact will be studied as special systems.

COURSE DETAIL

Sl. No	Topic
1.	**INTRODUCTION** 1. Defining Tribology 2. Tribology in Design - Mechanical design of oil seals and gasket - Tribological design of oil seals and gasket 3. Tribology in Industry (Maintenance) 4. Defining Lubrication 5. Basic Modes of Lubrication 6. Properties of Lubricants 7. Lubricant Additives 8. Defining Bearing Terminology - Sliding contact bearings - Rolling contact bearings 9. Comparison between Sliding and Rolling Contact Bearings • Examples • Exercise
2.	**FRICTION and WEAR** 1. Friction - Laws of friction - Friction classification - Causes of friction 2. Theories of Dry Friction 3. Friction Measurement 4. Stick-Slip Motion and Friction Instabilities 5. Wear - Wear classification - Wear between solids - Wear between solid and liquid - Factors affecting wear - Measurement of wear. 6. Theories of Wear 7. Approaches to Friction Control and Wear Prevention

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Mechanical Engineering

Pre-requisites:

- Fluid mechanics

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	8. Boundary Lubrication 9. Bearing Materials and Bearing Construction • Examples • Exercise
3.	**LUBRICATION of BEARINGS** 1. Mechanics of Fluid Flow - Theory of hydrodynamic lubrication - Mechanism of pressure development in oil film. 2. Two Dimensional Reynolds's Equation and its Limitations. 3. Idealized Bearings 4. Infinitely Long Plane Fixed Sliders 5. Infinitely Long Plane Pivoted Sliders 6. Infinitely Long Journal Bearings 7. Infinitely Short Journal Bearings 8. Designing Journal Bearing - Sommerfeld number - Raimondi and Boyd method - Petroff's Solution - Parameters of bearing design - Unit pressure - Temperature rise - Length to diameter ratio - Radial clearance - Minimum oil-film thickness • Examples • Exercise
4.	**HYDRODYNAMIC THRUST BEARING** 1. Introduction - Flat plate thrust bearing - Tilting pad thrust bearing 2. Pressure Equation - Flat plate thrust bearing - Tilting pad thrust bearing 3. Load - Flat plate thrust bearing - Tilting pad thrust bearing 4. Center of Pressure - Flat plate thrust bearing - Tilting pad thrust bearing 5. Friction - Flat plate thrust bearing - Tilting pad thrust bearing • Examples • Exercise
5.	**HYDROSTATIC and SQUEEZE FILM LUBRICATION** 1. Hydrostatic Lubrication - Basic concept - Advantages and limitations - Viscous flow through rectangular slot - Load carrying capacity and flow requirement - Energy losses - Optimum design. 2. Squeeze Film Lubrication - Basic concept - Squeeze action between circular and rectangular plates - Squeeze action under variable and alternating loads. 3. Application to journal bearings 4. Piston Pin Lubrications • Examples • Exercise

6.	**ELASTO-HYDRODYNAMIC LUBRICATION** 1. Principles and Applications 2. Pressure viscosity term in Reynolds's equation 3. Hertz's Theory 4. Ertel-Grubin equation 5. Lubrication of spheres 6. Gear teeth bearings 7. Rolling element bearings. • Examples
7.	**GAS (AIR-) LUBRICATED BEARINGS** 1. Introduction 2. Merits, Demerits and Applications 3. Tilting pad bearings 4. Magnetic recording discs with flying head 5. Hydrostatic bearings with air lubrication 6. Hydrodynamic bearings with air lubrication 7. Thrust bearings with air lubrication • Examples • Exercise
8.	**TRIBOLOGICAL ASPECTS of ROLLING MOTION** 1. The mechanics of tyre-road interactions 2. Road grip and rolling resistance 3. Tribological aspects of wheel on rail contact • Examples • Exercise
9.	**FINITE BEARINGS** 1. Hydrostatic bearings 2. Hydrodynamic bearings 3. Thrust oil bearings 4. Porous Bearings 5. Foil bearings 6. Heat in bearings • Examples • Exercise