

ME 462 - Lubrication in Machine Design

Fall 2017

www.mne.psu.edu/chang/me462

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Office hours: 4:00-5:00pm daily or by appointment

Text: Various handouts

Topics of study:

1. *Introduction* –Engineering tribology. Interdisciplinary aspects. Contact failure modes.
2. *Surfaces* – Surface physico-chemical, topographical and mechanical properties and characterizations. Regimes of lubrication.
3. *Lubricants* – Types of lubricants. Properties of lubricating oils: compositions, viscosity, additives, synthetics. Engine oils.
4. *Theory of fluid-film lubrication* – Mechanisms of hydrodynamic pressure generation. Reynolds equation.
5. *Hydrodynamic lubrication* – Machine components with hydrodynamic lubrication. Thrust bearings, journal bearings. Design calculations.
6. *Elastohydrodynamic lubrication (EHL)* – Machine components with concentrated contacts. Basic contact mechanics. EHL film thickness formulas. Thermal EHL and traction. Design calculations for gear, cam and rolling-bearing lubrication.

Grading: Homework 70% (may be done two students in a group, one report)
Final 30%

Grading by exam alone: 60=D, 65=C, 70=C+, 75=B-, 80=B, 85=B+, 90=A-, 95=A

Related books:

Friction and Lubrication of Solids I & II, by Bowden and Tabor, Oxford, 1955 & 1964
Principles of Tribology, by Halling, MacMillan, 1978.
Lubrication Fundamentals, by Wills, Marcel Dekker, 1980.
Basic Lubrication Theory, by Cameron, Ellis Horwood, 1981.
Contact Mechanics, by Johnson, Cambridge Press, 1985.
Friction, Wear, Lubrication, by Ludema, CRC Press, 1996.
Engineering Tribology, by Stachowiak and Batchelow, Butterworth & Heinemann, 2001.
Applied Tribology: Bearing Design and Lubrication, by Khonsari and Booser, John Wiley, 2008.

Course Objectives:

1. Understand engineering significance of tribology and lubrication.
2. Understand surface physico-chemical, topographical and mechanical properties.
3. Understand physical and chemical properties of lubricants and rheology of lubricating oils.
4. Understand various mechanisms of lubrication and the basic theory of fluid-film lubrication.
5. Perform basic design calculations of hydrodynamic lubrication.
6. Perform basic design calculations of elastohydrodynamic lubrication and contact mechanics.

Course Outcomes: After completing this course, students should be able to

1. Describe engineering significance of tribology and lubrication.
2. Describe the tribological significance of surface physico-chemical, topographical and mechanical properties.
3. Calculate surface topographical parameters from measurement data.
4. Describe the tribological significance of the physical and chemical properties of lubricants and rheology of lubricating oils.
5. Calculate viscosity of lubricating oil from laboratory data.
6. Define various mechanisms of lubrication and regime of lubrication.
7. Simplify and solve the Reynolds equation for a number of basic problems.
8. Perform basic design calculations of hydrodynamic lubrication problems, including thrust bearings and journal bearings.
9. Calculate the hydrodynamic film thickness, friction loss and film temperature.
10. Perform basic design calculations of elastohydrodynamic lubrication and contact mechanics problems, including rolling bearing, gears and cams contacts.
11. Calculate EHL film thickness and maximum contact stresses.