MECH 5230 – Friction, Wear and Lubrication

**Summary:** Theory and techniques for considering friction, wear, and lubrication, in the design of machine components, and other surface interactions. Includes a group design project on optimizing the tribological performance of a component.

**Class Schedule:** Three 50-minute lectures per week or two 75-minute lectures per week.

**Prerequisites:** MECH 3230, MECH 3030 or INSY 3800 and instructor permission.


**Supplemental Texts and References:**

**Journals (for graduate students):**
- *Journal of Tribology*, American Society of Mechanical Engineers.
- *Tribology Transactions*, Society of Tribologists and Lubrication Engineers.

**Course Coordinator:** Robert L. Jackson, Assistant Professor of Mechanical Engineering

**Course Objectives:**
This course will present and demonstrate to the students the following:

1. Manipulation and identification of the parameters which govern performance of tribological systems that are found in engineering practice. (Program Outcomes 1, 2, 7)
2. Applied lubrication theory for hydrostatic and hydrodynamic bearing applications. (Program Outcomes 1, 2, 4, 7, 12)
3. Application of asperity contact, friction and wear theories to real contact situations found in engineering. (Program Outcomes 1, 2, 4, 7, 12)
4. The fundamental solid mechanics, fluid mechanics, chemistry and physics which govern tribological systems. (Program Outcomes 1, 2, 4, 7, 12)
Course Outcomes:
Upon completion of the course students will be able to:

1. Identify critical parameters in a tribological system. (Course Objective 1)
2. Make predictions of the performance and behavior of a tribological system based on these critical parameters. (Course Objectives 1, 2, 3, 4)
3. Design or choose efficient and robust tribological systems such as rolling element bearings, hydrodynamic bearings, and dry sliding bearings, for the needs of a specific application. (Course Objectives 1, 2, 3)
4. Improve the tribological properties of a machine component surface to improve reliability. (Course Objectives 1, 4)
5. Optimize existing and new systems to improve performance. (Course Objectives 1, 2, 3)

Representative Lecture Topics and Coverage (50 Minute Lecture Periods)

1. Background and Motivation [2 Lectures]
2. Fluid and Material Properties [2 Lectures]
3. Surface Characterization [3 Lectures]
4. Normal Single Asperity Contact [2 Lectures]
5. Contact Between Rough Surfaces [3 Lectures]
6. Asperity Sliding Contact [2 Lectures]
7. Abrasive Wear [2 Lectures]
8. Adhesive Wear [3 Lectures]
9. Metal Working [2 Lectures]
9. Coatings and Solid Lubricants [2 Lectures]
10. Rolling Element Bearing Design [3 Lectures]
11. Hydrodynamic Lubrication Theory [3 Lectures]
12. Thrust Bearing Design and Modeling [3 Lectures]
14. Gas Bearing Design [3 Lectures]
16. Boundary Lubrication [2 Lectures]
17. Exams [3 Lectures]

Course Grading: The course will graded through homework, exams and a group design project that will be due at the end of the semester. The design project will be simple enough to be completed in one semester.

Grading:

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<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
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<tr>
<td>Exam #1</td>
<td>20%</td>
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<tr>
<td>Exam #2</td>
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<td>Exam #3</td>
<td>20%</td>
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<tr>
<td>Project</td>
<td>30%</td>
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Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
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<tr>
<td>A</td>
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<td>F</td>
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**Homework:** Homework will be checked for satisfactory completion on a ten point scale. Late homework will be deducted three points. Students may work in groups, but are strongly encouraged to work individual problems themselves.

**Exams:** All exams will be open book and notes. Exams and final will be open to all material covered in class and homework up to that point. The projects will be presented during the regularly scheduled final exam period.

**Project:** A project will be assigned to the entire class. The project will use techniques in the course to design and optimize a tribological system. The projects will also be presented at the end of the semester using a 10-15 minute presentation format during the final exam period. The project grades will consist of 70% for report and 30% for presentation.

**Course Policies:**

**Cheating:** Cheating or academic misconduct on Exams will not be tolerated and will be reported to the Academic Honesty Committee as outlined in the Tiger Cub student handbook. This includes sharing answers and information during exams.

**Student Accommodations:** Students who need accommodations are asked to arrange a meeting during office hours the first week of classes, or as soon as possible if accommodations are needed immediately. If you have a conflict with my office hours, an alternate time can be arranged. To set up this meeting, please contact me by E-mail. Bring a copy of your Accommodation Memo and an Instructor Verification Form to the meeting. If you do not have an Accommodation Memo but need accommodations, make an appointment with The Program for Students with Disabilities, 1244 Haley Center, 844-2096 (V/TT).

**Contribution to ME Curriculum:** Undergraduate Technical Elective

**Professional Component Contribution:** Engineering Science and Design 3 Hours

**Prepared by:** Robert L. Jackson, January, 2005 Edited September, 2006, April, 2008