ME 4232: Fluid Power Control Lab
Syllabus – 2015 Spring

Instructor: Perry Y. Li
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Meeting Times & Places:

<table>
<thead>
<tr>
<th>Event</th>
<th>Section</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
<th>Instructor/TA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>All</td>
<td>Friday</td>
<td>11:15am – 1:10pm</td>
<td>AkerH 221</td>
<td>Li</td>
</tr>
<tr>
<td>Labs</td>
<td>-002</td>
<td>Tues, Thurs</td>
<td>9:05am – 11:00am</td>
<td>Phys 250</td>
<td>Lee</td>
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<tr>
<td></td>
<td>-003</td>
<td>Tues, Thurs</td>
<td>11:15am – 1:10pm</td>
<td>Phys 250</td>
<td>Lee</td>
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<tr>
<td></td>
<td>-004</td>
<td>Mon, Wed</td>
<td>12:20pm – 2:15pm</td>
<td>Phys 250</td>
<td>Dekarski</td>
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<tr>
<td></td>
<td>-005</td>
<td>Mon, Wed</td>
<td>2:30pm – 4:25pm</td>
<td>Phys 250</td>
<td>Tian</td>
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<td></td>
<td>-006</td>
<td>Mon, Wed</td>
<td>10:10am – 12:05pm</td>
<td>Phys 250</td>
<td>Saadat</td>
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<td></td>
<td>-007</td>
<td>Mon, Wed</td>
<td>8:00 am – 10:00am</td>
<td>Phys 250</td>
<td>Saadat</td>
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Prerequisites:
Thorough understanding of System Dynamics and Controls (ME 3281 or equivalent).

Course Description:
Fluid power plays an important role in industry. Uses of fluid power include machine tools, off-highway vehicles, aviation control, material testing systems etc. In this course, students will be introduced to this exciting field through hands on exercises of building fluid power circuits and observing how they operate. In addition, students will obtain hands-on experience in designing and implementing control systems for real systems. Throughout the course, students will be encouraged to derive and use mathematical models to make predictions and to answer queries.

This course can be used to satisfy the senior lab requirement.

Course Objective:
- Introduce fluid power components, circuits, and systems
- Provide hands-on experience in designing, analyzing and implementing control systems for real and physical systems.
- Provide first hand experience in modeling, control and other dynamical systems concepts introduced in Systems Dynamics and Control (ME 3281).

Expected outcomes:
- Familiarity with common hydraulic components, their use, symbols, and mathematical models
- Ability to formulate and analyze simple mathematical models of hydraulic circuits
- Ability to identify single input single output (SISO) dynamical systems
- Ability to design, analyze and implement simple control systems
- Appreciation of advantages and disadvantages of various types of controllers
- Ability to relate control systems analysis with actual performance
• Intuitive and mathematical appreciation of dynamical system concepts (e.g. stability, instability, resonance)
• Appreciation of un-modeled real world effects
• Become very familiar with using Matlab for analysis and plotting.
• Comfortable with commercial hydraulic catalogs

Required References:

Additional References:
**System Dynamics and Controls Texts:**

**Fluid Power Texts:**
Merritt is an excellent (although old and expensive) book on modeling of hydraulics components and systems that is still being heavily used by researchers. Sullivan is written more in a regular text book style and discusses components, circuits and analysis. Cundiff is a good introductory book written for practicing engineers.

Course Outline (Major Topics):
1. Fluid Power Components and Circuits 7 weeks
2. Control of Fluid Power Systems 7 weeks

*Please see course web page for a more detailed schedule.

Course Structure:
This course will consist of one two-hour lecture per week and two two-hour lab sessions per week. Lab exercises will be the primary learning tool in this course. During lab sessions, your first objective is to learn about the system, component, or controller you are working on. The exercises described in the lab handouts are baseline exercises. You are encouraged to formulate additional questions to test using the lab setup. How much you learn depends on how willing you are to ask and answer additional questions. Lectures will primarily supply background information needed to understand the lab activities and will occasionally include guest lectures by fluid power experts.

Because a great deal of the value you will gain from this course will revolve around lab and classroom activities, active attendance during all meeting sections is expected. The class participation component of your grade reflects your attendance and participation in all activities.
Lab Reports:
All lab reports must follow the Mechanical Engineering Lab Report Guidelines, available at: http://me.umn.edu/education/undergraduate/writing.shtml. Most labs include a pre-lab activity that must be completed prior your lab session and initialed by your lab TA at the start of lab. Lab reports, with attached pre-lab assignments are due at the start of your lab section one week after completing the lab, unless otherwise directed. At the middle of the semester there will be a system dynamics review homework; this homework will be graded and the points will be counted as a lab report. Any late lab reports will receive a 20% grade reduction per week late (or portion thereof).

Final Exam:
The cumulative final exam will be held Saturday, May 16, 1:30pm – 3:30pm. If you are unable to take the final exam at the scheduled time, please see the instructor to arrange for an alternative time. Except for emergency situations, any arrangement must be made 2 weeks prior to the exam.

Re-grades:
Any grade disputes must be made within 1 week of returning the assignment. T.A. who graded the assignment should be contacted first. Only in the case of continued disagreement on grading, should Dr. Stelson be contacted.

Grade Computation:
Grade point ranges will be determined at the end of the term. In general, 90-100 is an “A”, 80-90 is a “B”, and 70-80 is a “C.” The weighting of evaluation criterion is a follows:

- Lab Reports 60%
- Active Participation 10%
- Final Exam 30%

Course Policies:
1. Accommodations for Students with Disabilities: Students with special needs must talk to the instructor as soon as possible; all conversations will be kept confidential. As per University policy, reasonable accommodations will be made on an individual student basis.
2. Student Conduct: The classroom environment is very important to promoting learning. Disruptive behavior that might interfere with the learning process of other students will not be tolerated.
3. Sexual Harassment: Sexual harassment is prohibited as defined by the University policy which can be found at: http://www1.umn.edu/usenate/policies/sexualharassmentcp.html
4. Academic Dishonesty: All submitted work must be your own. Any form of academic dishonesty will be treated very seriously. If you have any concerns about the authenticity of your work, or when group work is appropriate, please contact the professor. For further information about the University policy on academic dishonesty, refer to http://www.umn.edu/regents/policies/academic/StudentConduct.pdf

We look forward to working and learning with all of you throughout the semester. Feel free to contact us by e-mail with any questions. We look forward to doing our best to make this class a pleasant and successful learning experience.