EE 453 Electric Drives

Winter 2017

Course Information

Times/Locations: Lectures 4:30-6:30 MTh Sieg 230  Labs TuF 9:30-12:20 EEB 053

Credits: 5

Professor: Rich Christie
Office: EEB 222  Hours: Tue 9:30-11:30, W 1:00-3:00
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Teaching Assistants: Nam Song  Hours: TBA
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Grader: TBD  Email: NA


Slemon, *Electric Machines and Drives*, Addison-Wesley 1992

Syllabus:

Week  Topic                                                                                       Read Chapters
1  Intro to Class, Project, Drives  
   Holiday M 1/2  
   No Lab TF 1/3, 1/6                         1
2  Power Electronics Review, Brushless DC Motors                                           2,3,5,1
   Lab 1 (First set) DC Speed Control  
   Th 1/12 Quiz, HW1 handed out
3  Brushless DC Drives, Motoring, Braking                                              6,8,9
   Holiday M 1/16  
   Lab 1 (Second set) DC Speed Control  
   Th 1/19 Quiz, HW1 due, HW2 handed out
4  Induction Machines                                                                  5.2, 7
   Lab 2 (First set) DC Braking  
   Th 1/26 Quiz, HW2 due  
   F 1/27 5:00 PM Commutation Design due
5  Synchronous Machines, Switched Reluctance Machines, AC Drives                       5.3
   Lab 2 (Second set) DC Braking  
   Th 2/2 Quiz  
   F 2/3 5:00 PM Inverter Hardware Design Due
6  Project Work                                                                     
   Th 2/9 PDR Presentations
7  Project Work                                                                     
   M 2/10 PDR Presentations
8  Project Work                                                                     
   Holiday M 2/20
Prerequisites (by course): EE 452

Grading

The grading in this course is primarily based on the project. Homework, quizzes and labs also contribute to the grade. The homework, labs and project are performed by assigned groups. The written examinations (quizzes) are individual.

The final grade is computed as follows:

- Homework: 5%
- Laboratory Grade: 10%
- Exams: 10%
- Design Project: 80% (Sums to 105%)

The final percentage will be divided by 25, and rounded to one decimal place. No curve will be used. Grades over 4.0 will be rounded down to 4.0.

Grade Inflation Adjustment: In the event of a class average grade under 3.0, I may shift everybody's grade up the same amount to obtain a 3.0 (or lower) average. In the event of a class average over 3.5, I may shift everybody's grade down the same amount to obtain a 3.5 (or higher) average. (Shift applied before rounding.)

Homework

Homework will be assigned on Thursdays of Weeks 2 and 3. It will typically be due one week after it is assigned. Homework will be done by assigned groups. See the section on group assignments.

Homework is due to the class drop box on the preset date and time. This will usually be the start of class on the due date. Late homework will be accepted up to the start of the next class, or when solutions have been published, whichever comes first, with a 25% penalty. A group member may volunteer in writing (e.g. email) to accept the entire penalty.

Homework will be graded and returned as soon as possible, usually a week after submission. Because homework is a group product, a high standard of achievement is expected.

Laboratory Work

There are two laboratories. Due to limitations on equipment, the students assigned to a lab section may be divided into two sets, one to do the lab the first week it is scheduled and the other to do the lab the second week. All students should go to the first scheduled offering of the first lab for assignment to groups and sets.

Safety: The laboratory equipment has been designed to maximize safety under student use. Nevertheless potentially hazardous voltages (similar to those in household wiring) are in use. Students should be aware of rotating machinery hazards. In particular, wearing of rings around rotating machinery is discouraged, and long hair should be worn in a way that minimizes the chances of wrapping it around a shaft.

Accessibility: Because of the hazards of rotating machinery and the voltages employed in the lab, work on Labs 1 and 2 must be done while the lab is attended by the instructor, TA and/or lab technician.
Lab Reports: Lab reports are to be electronic documents including cut-and-paste simulation results, submitted to the class drop box by the date set by the TA, with contents and format as directed by the TA.

Lab Grading: 0-100 on quality of laboratory work as reported in the lab report.

Examinations

There is a 10 to 15 minute quiz every Thursday at the start of class, during weeks 2-5. The quizzes are closed book, closed notes, no calculator, and will focus on material covered since the last quiz. However, the skills you need for problem solving tend to be cumulative from the start of class.

See the Group Assignments section regarding group bonuses for exams. See also the grading section on class average grades and grade inflation.

I expect you to make a good faith effort to attend every examination as scheduled. Makeup examinations are extremely inconvenient for both of us. The commonly accepted reasons for missing an examination are your personal illness, or a death in your immediate family (parents, spouse or child). Other reasons will be judged on a case by case basis. I am generally supportive of job interviews and conference attendance. Please make every effort to let me know as soon as possible when you cannot attend an examination, before the examination if at all possible, so we can arrange a make up.

Design Project

Each group will design, build, test and demonstrate a brushless DC drive using the provided motor and DC power source. See the separate document for design requirements and specifications. Project schedule:

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Th 1/5</td>
<td>Project start</td>
</tr>
<tr>
<td>F 1/27 5:00 PM</td>
<td>Commutation Design Due</td>
</tr>
<tr>
<td>F 2/3 5:00 PM</td>
<td>Inverter Hardware Design Due</td>
</tr>
<tr>
<td>Th 2/9 M 2/13</td>
<td>Preliminary Design Review Presentations (with video of open loop bidirectional control)</td>
</tr>
<tr>
<td>M 2/27 Th 3/2</td>
<td>Final Report Presentation and Business Plan</td>
</tr>
<tr>
<td>M 3/6</td>
<td>Demo and Poster</td>
</tr>
<tr>
<td>Th 3/9 6:30 PM</td>
<td>Final Report Submission</td>
</tr>
</tbody>
</table>

Project Grading:

- 60% Meets Requirements
- 25% Quality of Design
- 5% Quality of Business Plan
- 5% Presentation Style
- 5% Writing Style

Groups will have an opportunity to report percentage contribution to the project of each group member.

Group Assignments

You will be formed into groups of three or four to do the homework, labs and design project. Groups will be assigned at the first laboratory and will stay together for the duration of the class. Each group will hand in ONE set of answers or report, and each participating group member will receive the same grade (except see percentage contribution for projects).

The following approach is strongly suggested for doing the homework (and lab reports) in groups:

1. Each individual member independently sketches out the method of solving the problem, e.g. "First find possible device states..." Focus on the sequence of calculations, the equations to use, and the source of values for the variables in the equations.
2. At the group meeting, compare solution approaches and agree on one approach.
3. One individual does the complete solution.
4. Another individual (or, both other individuals) reviews the solution for correctness.

There are two important group roles for homework and labs. The group **supervisor** has real authority - the supervisor lists which group members get credit for the HW assignment. If a group member has not contributed, the supervisor can omit their name from the HW cover page. If it should subsequently be established that a named group member did not participate in the assignment, the group supervisor as well as the group member will receive a zero on the assignment. The group supervisor (only) should sign the cover page near the list of names of contributing group members, e.g.

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John Smith
Pham Nguyen
Supervised by: Ellen Johnson  <signature>
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The signature indicates that the group supervisor certifies that the other group members have done sufficient work to receive credit for the assignment.

The group **recorder** is responsible for assembling the finished assignment and getting it handed in. Rotate these positions on a weekly basis. Groups are responsible for rotation of assignments.

In lab preparations, design and simulation tend to go hand in hand. I suggest that one person in the group be hands on at the keyboard, another be specifically concerned to ensure that the design specifications are met, and the third concerned with recording design information and simulation results. It’s important for group learning to rotate the roles from lab to lab, or even from part to part of one lab.

In the physical lab itself, one person can be the "hands on" technician, actually building the circuit. One can be the advisor, deciding what to do next, and the third the recorder, operating instrumentation and collecting data. These roles should also rotate from lab to lab, within a lab, and from preparation to lab.

In general, students are expected to work with their assigned groups for the duration of the course. Assignments will only be accepted from designated groups. In extraordinary circumstances, and with my consent, a student may quit a group. In extraordinary circumstances, with a unanimous request from the rest of the group, and with my consent, a student may be fired from a group. Students who have quit or been fired may join another group with the unanimous consent of that group and my consent.

Special deal on exams: If the group exam average is over 16 (out of 20) on an exam, each member of the group gets an extra 1 point on that exam.

**Disabled Students**

If you have a documented disability and wish to discuss academic accommodations, please contact me as soon as possible. I am happy to make every reasonable accommodation.

**Academic Integrity**

I expect every member of the class to conform to the highest standards of academic integrity. The following statements set forth these standards as I understand them to apply to the EE 453 class:

Because your homework, labs and design project have a bearing on your grade, they must be your group's original work. You may compare homework answers and discuss problem solving methods with other groups in the class, but the final result - the work you hand in - must consist of work that your group, and your group only, has performed. For homework, when writing out the answers to be handed in, if they are being copied from anything the group itself has not generated, then that is cheating. For lab reports and project reports, material copied from other sources must
be clearly marked to indicate its origin, usually with a citation to the reference material. Copied material that is not so attributed is considered plagiarism.

**Examinations must be your individual original work.** No discussion of any kind is allowed among students while taking an examination.

Copying homework done by someone outside the group, or copying old homework or the answer key, copying the work of anyone else on examinations, the use of unauthorized notes or other unauthorized aids during examinations, and knowingly permitting your work to be copied for the purpose of cheating are all examples of cheating. During an examination, you may ask the instructor questions if you do not understand some aspect of a problem statement, or if you are unclear about what is required. Please try not to ask questions about your answer, such as “Am I doing this the right way?”

If you cheat, you cheat yourself of the opportunity to learn the material, and you cheat your classmates - all of your classmates - out of grades they have earned. If you let someone else copy your work, you are allowing them to devalue your grade and that of your fellow students. Cheating is a bad way to embark on a career in engineering. Cheaters make bad engineers, and I want you to be good ones. You can help by not tolerating cheating by your fellow students. The TAs and I will monitor for cheating and will write up all suspected cases. About the worst thing I can imagine is writing up someone who is not actually cheating. Please help us avoid this by avoiding even the appearance of possible cheating. Cheating can result in failure of the course and even eventual expulsion from the University.

(rdcl 12/17)