



ECE 4190/6190: Electrical Machines and Drives  
Section 001 and 843  
Spring 2021

**MEETING TIME:** Tuesday and Thursday 3:30pm to 4:45pm

**MEETING LOCATION:** Online

**INSTRUCTOR:** Dr. Christopher S. Edrington, Riggs 213, cedring@clemson.edu

**OFFICE HOURS AND PROCEDURES:** Office hours will be established after the first class meeting to best accommodate both students and instructor. All office hours will be VOH (Virtual Office Hours) to be held via Zoom.

**COURSE MODALITY:** Online

**COURSE DESCRIPTION:** (referring to 3<sup>rd</sup> edition of Krause text,). Note, most of the semester will be spent on Chapter 1,2, 6, 4 and 5(if time allows).

1. Basic principles for electric machine analysis (Chapter 1 and Chapter 2)
2. Reference frame theory (Chapter 3)
3. Symmetrical induction machines (Chapter 6)
4. Theory of brushless dc machines (Chapter 4)
5. Synchronous machines (Chapter 5)

**COURSE PREREQUISITES:** Students are expected to have completed courses comparable to ECE 3210 and ECE 3600 and ECE 3800 before enrolling in this course. Additionally, students are expected to have completed, or be concurrently enrolled in, a course comparable to MATH 4340 when enrolling in this course.

This 4000-level course has a 6000-level counterpart.

**STUDENT LEARNING OUTCOMES:**

- Be able to illustrate an in-depth knowledge of the energy conversion process
- Be able to illustrate an in-depth knowledge of how to apply the energy conversion process for any type of machine
- Be able to illustrate an in-depth knowledge of reference frame theory and how it is relevant to modeling of machines and how it links to control/drive objectives
- Be able to illustrate an in-depth knowledge of the operation and performance of induction machines
- Be able to illustrate an in-depth knowledge of the operation of permanent magnet machines
- Be able to illustrate an in-depth knowledge of the operation of synchronous machines

**REQUIRED MATERIALS:** Although this course does not require any specific text book, it is encouraged that you obtain a copy of either the 1<sup>st</sup>, 2<sup>nd</sup>, or 3<sup>rd</sup> edition of the text Analysis of Electrical Machines and Drive Systems, P. Krause, O. Wasynczuk, and S. Sudhoff, Wiley Interscience, with the caveat that some material may be slightly different in arrangement and/or notation. Any homework required for this course will come from the 3<sup>rd</sup> edition of the aforementioned text.

ALSO the student is required to have a laptop/desktop computer, internet connectivity capable of transmitting and receiving video, a video camera, a microphone, and a cell phone (please refrain from accepting or making calls while in a class session).

**TOPICAL OUTLINE:** 3 credit hours

- Energy conversion process
- MMF and winding inductances
- Reference frame theory
- Induction machines
- Permanent magnet machines
- Synchronous machine

**CLASS CANCELLATION POLICY:** Class is cancelled if the instructor is more than 15 minutes late to class.

**GRADING POLICY:** The grade scale is 90-100 A, 80-89.9 B, 70-79.9 C, 60 – 69.9 D, 0-59.9 F for undergraduates and 90-100 A, 80-89.9 B, 70-79.9 C, 0-69.9 F for graduate students.

**WEIGHTING:**

Quizzes/Homework 20%

Projects 80%

**COURSE WORK:**

- All projects will be submitted online via Canvas. Projects will have a defined template provided by the instructor. All projects will be done individually, though is certainly acceptable to consult with each other. 25% of the grade of the project will be regarding the ability to correctly follow the format and to be grammatically correct. It is encouraged that non-native English speaking students use a tool such as Grammarly (now provided by Clemson University) to check their work. 75% of a project will be on the technical competency illustrated in the project writeup.
- All quizzes will be online through Canvas. Typically quizzes will occur about every 3 weeks. The quizzes are always going to be over the lecture material that has been presented.
- All homework will be submitted through Canvas. Typically homework will be sparse but focused. Homework is due 1 week after it is assigned. Homework is likely to be heavier at the beginning of the semester and taper off as we get enough material covered so that you can address the work in the projects.
- No late work will be accepted. You will have plenty of time to address the project oriented work (typically 2 – 4 weeks) and homework (typically 1 week).

- Do not procrastinate on a project. Attack the work early so that I can help you address questions. Waiting until the last week to attempt to get it done is not going to work in a course such as this.

### **Homework:**

- Homework will be due approximately 1 week after it is assigned.
- No late homework will be accepted.
- Simulations that support homework should be uploaded in CANVAS.
- All graphs, schematics, and tables should be attached to your homework writeup. You should NEVER “hand-draw” a graph for which you have the data.
- Typically, since problems can be challenging, there will be no more than 2 or 3 each assignment for undergraduates. Graduate students can expect a couple more than what I will assign the undergraduates or I may ask for additional information from graduate students for the same problems I assign the undergraduates.
- The total number of homework points (each problem is 50 points) will be scaled to 100 points.

### **Quizzes:**

- Quizzes will cover theoretical as well as simulation type material that has been addressed during previous lectures. These are typically topical questions and not calculation type questions where you have to work something out. They typically take about 10-15 minutes. Each quiz will be worth 10pts/problem.

### **Projects:**

- The primary source of evaluation is projects.
- There will be 3 projects during the semester for undergraduates.
- There will be 4 projects during the semester for graduate students.
- Project topics will range from purely theoretical/analysis to open-ended design.
- Each project will be worth 100 pts.
- Each project will strictly follow the IEEE Transactions style format.
- Projects will be graded as follows:
  - 25% : format; grammar; spelling; legibility of graphs, plots, charts etc.
  - 75% : theoretical justification, explanation of engineering judgment, solution rationale, and conclusions
  - An upper page limit of 8 pages and lower page limit of 6 pages will be established.
  - All project reports must be accompanied by a working simulation. I should be able to run your simulation and get the same exact results that you obtained in your paper.

### **Regular Exams:**

This class will have no regular exams.

### **Final Exam:**

The final project will serve as the final exam.

### **Make-up Policy:**

- There will be no make-up work. If for some reason you will not be present on the day that either a project, homework, or quiz is due, then you must make an arrangement to complete the assignment before the due date. In general, unless under extremely mitigating circumstances (death, extreme illness, etc.), this policy will be adhered to. Travel to conferences and other university related events will not fall under this category.

**Consulting with Faculty:**

- It is strongly encouraged that you discuss any academic questions, in relation to this course, with me.

**Miscellaneous Items:**

- Out of courtesy to me and your fellow classmates cell phones are to be either muted or in vibration mode during class. There will be no answering of cell phone, conversations on cell phones, or text messaging during class.
- Use of profanity, ethnic, racial, or sexual remarks in my class will not be tolerated and will result in a reduction in your grade.

**ATTENDANCE POLICY:**

1. This class is completely online.
2. Online attendance is optional; however to get the most out of the class it is highly encouraged to attend unless circumstances prevent.
3. Please email me if you are going to be unable to attend online.

**ACCESSIBILITY STATEMENT:** Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing [studentaccess@lists.clemson.edu](mailto:studentaccess@lists.clemson.edu). Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: <http://www.clemson.edu/campus-life/campus-services/sds/>.

**TITLE IX STATEMENT:** Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

**SAFE CAMPUS:** Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- a. Ensure you are signed up for emergency alerts (<https://www.getrave.com/login/clemson>)
- b. Download the Rave Guardian app to your phone (<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)
- c. Learn what you can do to prepare yourself in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)

**ACADEMIC INTEGRITY:** As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.'

Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the *Undergraduate Announcements* and in the *Graduate School Policy Handbook*.

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**MODIFICATION STATEMENT:** This syllabus is a living document and is subject to change depending on an assessment of the circumstances. The current modification date is:

12/31/2020