ECE 4190/6190 SYLLABUS PART ONE

INFORMATION ABOUT THE COURSE

COURSE TITLE AND COURSE NUMBER

ECE 4190/6190

TERM

Fall 2023 (see Clemson University Academic calendar for specific observed holidays and breaks)

CLASS MEETING TIME AND PLACE

8am - 9:15am Tuesday and Thursday

Riggs Hall 223

TIME TO WAIT

Students should wait at least 15 minutes for the professor. It is extremely rare that I would be late for a class; however, there may always be some circumstance that is beyond my control. As such the 15 minutes is a courtesy to me for such instances.

INFORMATION ON MODALITY

"in - person" unless the modality changes due to mandates from the university.

INSTRUCTOR NAME

Dr. Christopher S. Edrington

DEPARTMENT AND COLLEGE OF INSTRUCTOR

College of Engineering, Computing and Applied Sciences

Department of Electrical and Computer Engineering

INSTRUCTOR EMAIL

cedring@clemson.edu You can expect a response from me within 24 hours excluding weekends, holidays, and breaks. I do not answer emails after 5pm or before 8am.

Additionally, there may be other times when I may be away on either personal or professional travel and might not have access to my communications systems; however, I will inform the class ahead of time in such instances.

University Office Phone

864.656.5925

Office Address/Office Number

213 Riggs Hall

Office Hours

Office hours will be established after the first class meeting to best accommodate both students and instructor. All office hours will be in-person except for special cases in which they are by appointment, which in this case may be either via Zoom or in person.

Course Description

The purpose of this course is to educate students in the area of electrical machines and prepare them for analysis of those machines under various loading conditions. Additionally, the purpose of this course is to aid the student in understanding how to develop simulations of any machine based off of fundamental principles. Furthermore, the course will educate students in how to model machines using reference frame theory which is necessary when considering drives applications and associated control. Finally, this course aids in helping students in understanding how to technically communicate results of simulations and analysis.

Course Overview

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

Learning Outcomes

After completing this course, students will:

- 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

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.

REQUIRED MATERIALS

Although this course does not require any specific text book, it is encouraged that you obtain a copy of either the 1st, 2nd, or 3rd 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 3rd 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).

REQUIRED TECHNICAL SKILLS

To be successful in this course a student should have a good to excellent working knowledge of Matlab/Simulink; without such skills the student will be at a serious disadvantage. Additionally, the student should have an excellent working knowledge of differential equations, linear algebra and calculus of multi-variables, since such skills are essential in composing simulations of the machines.

MAJOR ASSESSMENT/GRADING ACTIVITIES

- 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 it 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 2 weeks. The quizzes are always going to be over the lecture material that has been presented.
- No late work will be accepted. You will have plenty of time to address the project oriented work (typically 2 – 4 weeks).
- 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.

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. Quizzes will be done via Canvas online. I will open a window of time that should be sufficient for you to complete them in.

Projects:

- The primary source of evaluation for this course is projects.
- All projects will be team oriented. There will be no exceptions. The size of the team will be determined based on the size of the class. Teaming will occur as a random draw and the instructor will attempt to make sure that for the next project the team does not have the same composition.
- There will be 2 projects during the semester for undergraduates.
- There will be 3 projects during the semester for graduate students. The 3rd project will actually be a mini-project that is an extension of the 2nd project.
- 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 imposed.
    - 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.

- All projects will be submitted via Canvas. Each team member should submit the exact same project as their teammate(s).

Regular Exams:

This class will have no regular exams.

Final Exam:

The final project will serve as the final exam.

GRADING SYSTEM

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

90-100 A, 80-89.9 B, 70-79.9 C, 0-69.9 F for graduate students.

- Quizzes 25%
- Projects 75%

GRADING POLICIES:

I do not round any grades during the semester. However, I do look at the overall performance at the end of the semester and make a decision individually or as an aggregate as to whether I will provide any curving of the grades. All decisions are at the discretion of the professor and are applied individually as is deemed appropriate.

Quiz grades I typically have a turn-around time of 1 day. Project grades typically have a turn-around time of approximately 1 - 1.5 weeks.

There will be no make-up work. If for some reason you will not be present on the day that either a project 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.

NOTIFICATION OF ABSENCE:

The **Notification of Absence module in Canvas** allows students to quickly notify instructors (via an email) of an absence from class and provides for the following categories: court attendance, death of immediate family member, illness, illness of family member, injury, military duty, religious observance, scheduled surgery, university function, unscheduled hospitalization, other anticipated absence, or other unanticipated absence. The notification form requires a brief explanation, dates and times. Based on the dates and times indicated, instructors are automatically selected, but students may decide which instructors will receive

the notification. This does not serve as an "excuse" from class. It is a request for an excused absence and students are encouraged to discuss the absence with instructors, as the instructor is the only person who can excuse an absence. If students are unable to report the absence by computer, they may reach the Office of Advocacy and Success via 864.656.0935. Students with excessive absences who need academic or medical assistance can also contact the Office of Advocacy and Success.

Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather-related cancellation.

TOPICAL OUTLINE

(referring to 3rd edition of the 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. Symmetrical induction machines (Chapter 6)
3. Reference frame theory (Chapter 3)
4. Theory of brushless dc machines (Chapter 4)

HOW TO BE SUCCESSFUL IN THIS COURSE

- Student's Responsibility
  - Be prepared for all classes
  - Be respectful of others
  - Actively contribute to the learning activities in class
  - Abide by the University Academic Integrity Policy
- Instructor's Responsibility
  - Be prepared for all classes
  - Evaluate all fairly and equally
  - Be respectful of all students
  - Create and facilitate meaningful learning activities
  - Behave according to University codes of conduct

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.

All infractions of academic dishonesty by undergraduates must be reported to Undergraduate Studies for resolution through that office. In cases of plagiarism instructors may use the Plagiarism Resolution Form.

Additionally, for undergraduate classes:

Plagiarism, which includes the intentional or unintentional copying of language, structure, or ideas of another and attributing the work to one's own efforts. Graded works generated by artificial intelligence or ghostwritten (either paid or free) are expressly forbidden.

See the Undergraduate Academic Integrity Policy website for additional information and the current catalogue for the policy.

For graduate students, see the current Graduate School Handbook for all policies and procedures.

Accessibility

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 this class should let the instructor know and are encouraged to request accommodations through SAS (Student Accessibility Services) as soon as possible. To request accommodations through SAS, please see this link: (https://www.clemson.edu/academics/studentaccess/register.html). You can also reach out to SAS with questions by calling 864-656-6848, visiting SAS at the ASC Suite 239, or stopping by the office as a drop-in appointment.

The Clemson University Title IX Statement Regarding Non-Discrimination

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. This Title IX policy is located on the Access and Equity website. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Assistant Vice President of Equity Compliance. Her office is located at 223 Brackett Hall, 864-656-3181 and her email address is alesias@clemson.edu. Remember, email is not a fully secured method of communication and should not be used to discuss Title IX issues.

Clemson University aspires to create a diverse community that welcomes people of different races, cultures, ages, genders, sexual orientation, religions, socioeconomic levels, political perspectives, abilities, opinions, values and experiences.

Emergency Preparation

Emergency procedures have been posted in all buildings and on all elevators. Students should be reminded to review these procedures for their own safety. All students and employees should be familiar with guidelines from Clemson University Public Safety.

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:

1. Familiarize yourself with all possible exits, safer locations, and other key information on the emergency evacuation maps in this building, and those that you visit regularly.
2. Make a plan for how you would Run, Hide, and Fight in case of an active threat in this building, and those that you visit regularly. For example:
    a. Run – what are all the possible exits in this building, and the routes to them?
    b. Hide – what are the potential hiding locations in this room and building that are out of sight of doors and windows, how do you lock the door(s), how would you barricade the door(s) and windows, where do you turn off the lights?
    c. Fight – What tools are available in this room and building, should you have to fight?
3. Ensure you are signed up for emergency alerts. Alerts are only sent when there is a potential threat to safety, a major disruption to campus services, and once-monthly tests.
4. Download the Rave Guardian app to your phone. (https://www.clemson.edu/cusafety/cupd/rave-guardian/)
5. Learn what you can do to prepare yourself for the hazards that affect our locations. (http://www.clemson.edu/cusafety/EmergencyManagement/)

***Note this syllabus is a living document and is subject to revision. Revisions will never negatively impact a student and will only be done in cases of clarity or grammar.**