

Clemson University
Department of Electrical and Computer Engineering

ECE 419/619
Electric Machines and Drives

Spring Semester, 2008

Professor: Dr. Randy Collins
201 Riggs Hall
656-5920, *emergencies only* at 888-1307
randy.collins@ces.clemson.edu

Text: Power Electronics, 3rd edition, M. Rashid.

Office Hours (tentative): MWF: 10:30 am – 1:45 pm; T-Th: 9:30 am– 10:30 am.
Please make an appointment if you can't make these scheduled hours. I will do my best to be available during these times. *These office hours may change. I will let you know if they do.* Please don't come by the office just between 12:00 and 12:30 pm since I will probably be in final class preparation panic.

Attendance: Attendance is *required* for all classes and tests. You are responsible for being in each class and the material covered in class, whether it is in the textbook or not. There will not be any make-up classes or tests, nor will homework assignments be accepted if you are not in class to hand it in personally *at the beginning of class*. You can be dropped from the class for unexcused absences; if this occurs during the last 5 weeks of the semester, you will receive a grade of F instead.

There will be approximately 5 laboratory assignments in the new Rockwell Automation Lab in 203 Riggs. These labs will be mandatory and will *not* occur during regular class times. I will announce the lab assignments and available times about two weeks in advance. I will compensate for this extra time by giving “time off” from regular lecture periods. If you miss these labs, you will receive a grade of zero. You must see the instructor immediately (in advance) if you have a problem attending and participating in the lab experiments.

Grading: Two tests worth 40% (20% each) and a final exam worth 20%. These will be scheduled in advance. Homework will be assigned regularly and may be graded on a selective basis. The final homework grade will be worth 20%. Laboratory assignments are planned which will require participation and a lab report. The participation and reports will be worth 20%. The ECE 619 students will have an additional project worth an additional 15%. So, the final overall grade will be

divided by 1.15 to scale it to 100%. Any missed test, exam, or homework will result in a grade of zero.

Prerequisites: ECE 360 and 321, senior or graduate standing.

Tests: The tests and final exam will be closed book and notes. Formula sheets will probably be allowed. The specifics will be announced prior to the tests. If you miss class and don't hear about an upcoming test, that is your fault. Test attendance is required; there will be no makeup tests. The only excusable absences from a test will be in the event of true, documentable personal emergencies (i.e. hospitalization, death in the family, etc.). If such a circumstance arises, you must let me know immediately. Otherwise, a grade of zero will result from a missed test.

Academic Honesty: The University has a published statement concerning academic honesty. Please see your *Undergraduate Announcements* for more details. I am very sensitive to this subject. Don't even attempt to cheat in my class (or in any of your other classes for that matter). I will fully pursue any evidence of dishonesty.

Course Coverage: The book contains much more material than we can possibly cover. We will be covering the following: Portions of chapter 2 (diodes), chapter 3 (rectifier circuits), chapter 7 (thyristors), chapter 10 (thyristor circuits), chapter 15 (dc drives), chapter 4 (transistors), chapter 5 (dc/dc converters), chapter 6 (inverters), chapter 14 (ac drives). I supplement your textbook with additional material provided in class (through handouts and lecture), especially related to mechanical systems. Your class notes will be a very important source of information; the tests and homework will be based primarily on material covered in class. If you skip a class, you will probably find that you will have missed some very important material. I will not allow copying of my personal class notes, nor will I "repeat" a lecture during my office hours. The bottom line is that you should attend every class and take good notes.

Goals of the course:

The field of power electronics has experienced rapid growth during the last decade in response to an increased demand for compact, efficient, and highly controllable power supplies. These supplies are used in all types of applications ranging from aerospace electronics all the way to utility-level power conversion. As a result, rapid advances have occurred in circuit topologies, magnetics, and semiconductor devices for use in power electronic applications. One of the major applications of power electronic-based power supplies are for the control of electric motors. By manipulating the output of the power supply (voltage, frequency, etc.), the mechanical output behavior (torque, speed, etc.) can be controlled, often with great precision. ECE 419/619 will provide you with a sufficient background for the serious study, analysis, and design of power electronic circuits and systems, especially as applies to electric motor control. A knowledge of power electronics and motor drives will be invaluable for your future career since the demand for

engineers with a power electronics background is so high and the number of engineers having a power electronics and drives background is so small.

Rockwell Automation, the parent company of Reliance Electric, Allen-Bradley, and others, has generously donated both equipment and scholarship money to the ECE and ME departments. Fortunately for us, the type of equipment that Rockwell is primarily involved with is industrial automation, which heavily involves electric motors, motor drives, and controllers (PLCs). We have been working with Rockwell to develop lab stations with real-life industrial control products: AC and DC motors, AC and DC motor drives, tachometers and encoders, gear boxes, data acquisition and control, etc. Furthermore, we have been fortunate to receive lab equipment monies that have enabled us to equip the workstations with state-of-the-art digital oscilloscopes, data acquisition, etc. These workstations are essentially complete and we are presently developing meaningful lab exercises with the workstations. This equipment contains the circuits and components we will be studying this semester. I plan to be able to give you exposure to real automation equipment much like many of you will see in industry after graduation.

General notes:

Please try to adhere to the scheduled office hours. If you can't make them, please make an appointment to see me. I travel a good bit and often have meetings both on and off campus and will occasionally be unable to meet my scheduled office hours. In such a case, I will try to let you know in advance or I will place a note on my door to let you know when I might be available at an alternate time.

In the event that I am unable to attend class on time, you are required only to wait 15 minutes after the scheduled class time. After this time period passes, you may leave unless told otherwise.

I check my e-mail on a regular basis. If you have homework or other questions, you might want to use e-mail. Feel free to contact me this way anytime. I may occasionally post a homework correction or other clarification and will send these to your email address. So, you might want to get in the habit of checking your email regularly.

We will be using the Blackboard course management system primarily as a repository of handouts, homework and test solutions, etc. You should check the announcements frequently.

I encourage you to work together in solving problems (homework and self-study). I think there is a lot of value in working together as long as it is productive. However, please do not copy other student's work (or an old solution) and turn it in as your own. If I find that you are doing this, you will get a grade of zero on the assignment and be subject to academic dishonesty proceedings. The homework

solutions must be your own work. (In the long run, relying on others and copying will result in a failure to learn the material adequately and will lower your understanding and performance in this and future classes.)

Please recognize that the homework is worth 20%, i.e. two letter grades. Obviously I value your working on problems outside of class. If you simply copy someone else's paper, then you might wind up with an ok score on homework (unless you get caught), but you will suffer greatly on the tests. If you don't put effort in the homework, you will seriously compromise your final grade for the class. You could have a B or C average in the class and get a D or F if you fail to put forth a good effort on the homework. This has happened before -- more than once. Do not let it happen to you.

If you have a true, documentable personal emergency (i.e., hospitalization, death in the family, etc.), please contact myself or a member of the ECE staff immediately if this emergency places you in peril with a class assignment. If you are out of town and do not have the phone number, call 1-864-555-1212 (information) and ask for the Clemson University Electrical and Computer Engineering department's phone number.

I welcome questions in class. Please feel free to stop me at any time during the lecture if you have a question or if you would like for me to clarify something. If you don't understand something, chances are that many others don't either. I look forward to getting to know those of you that I don't know already. Feel free to drop by and introduce yourself sometime.

I also realize that many of you are job interviewing and might miss classes. Be sure to let me know if that is going to happen and arrange with one of your classmates to get the class notes. Be sure you get notes from someone you trust! Good luck to you in your job search, school and in ECE 496!

Approximate Schedule

Only portions of these chapters may be covered. It will be obvious what is going on if you come to class. You should read all sections of the chapter even if it is not covered in class.

Chapter 2 (Diodes)
Chapter 3 (Rectifier Circuits)
Chapter 7 (Thyristors)
Chapter 10 (Controlled rectifier circuits)

Test 1

Chapter 15 (DC Drives)
Chapter 4 (Power Transistors)
Chapter 5 (DC/DC Converters)
Chapter 15 again (application of DC/DC Converters for DC Drives)

Test 2

Chapter 6 (Inverter Circuits)
Chapter 14 (AC Drives)
Mechanical systems and Energy Issues=
Other inverter applications (time permitting)

Final Exam