EE 462L / EE 394-7, Fall 2019, Power Electronics

TTH 12:30-2, ETC 2.114, Unique Numbers: 16515, 16520, 16790, 16795

Professor: Mark Flynn, Office Hrs: TTH 11-12:10pm, 2-3pm in EER 4.804. Email: mmflynn@utexas.edu

Prerequisites: Credit with a grade of at least C- for EE 313; Credit with a grade of at least C- or registration for ASE 333T, BME 333T, CHE 333T, CE 333T, EE 333T, ME 333T, or PGE 333T.

Course Web Site: https://canvas.utexas.edu

Textbook: None required, however highly recommended references are on course website if you desire one for further study.

Description: Analysis, design, and operation of power electronic circuits. Emphasis on single-phase power conversion from AC to DC, DC to DC, DC to AC, and maximizing the power from photovoltaics (PV). Design and construction of 150 W power electronic circuits in the power laboratory, and comparison of their performance to theory. A working circuit model will be available for observation, study, and improvement.

Lab Safety Practices: Downloadable from course website.

Class, Lab Sessions, and Work Schedules:

- Lectures on TTH 12:30-2p, in ETC 2.114.
- Lab sessions in the power lab, EER 1.808:
  Sections 16520 and 16795: Thursday from 3:30-6:30p
  Sections 16515 and 16790: Friday from 1:00-4:00p
- **Our laboratory is shared space with other courses.** Be sure you have read the lab material and are prepared when you arrive in lab as access to the lab at other times may be very limited.
- **Students perform labs in teams of 2.** The teams are requested/assigned in the first lab and are fixed for the entire semester. Partners must be in the same lab session. Solo teams will only be granted in extremely rare exceptions with well-justified reasons. Teams of 3 students are not allowed. A random graduate student will be asked to work solo in a section with an odd number of students.
- **Reports are due at the beginning of your lab period.** Provide hardcopy and electronic version (docx format, no PDF) to TA's. Failure to follow the rules will result in a zero for the lab.
- **Conduct yourselves professionally**. 1. Be on time. 2. Refrain from eating and drinking.
- **Keep cell phones, tablets, and laptops off in class** (unless cleared with Dr. Flynn). Students not complying with this rule will be assigned an "absent" for the week's lab. Such devices activated during a test will be interpreted as scholastic dishonesty and result in appropriate consequences. In lab, laptops are OK. *Please do not take photographs, video, or voice recordings in class.*
- **Modifications may occur due to unforeseen changes.** Teams, project formats, schedule may be modified due to unforeseen issues. Any such changes will be posted online and announced in class.
- **Lab circuits and reports (40 %):** See detailed course description file on course website for details.
- **Lab/Lecture Quizzes (8 %):** Quizzes assess how well you have been keeping up with the coursework and converting new concepts into permanent knowledge. As such your ability to complete the quiz in the allotted time is a factor of your success. Each quiz will be started at the beginning of lab/class; students are expected to be in their seats by the time the lab/class begins. Students entering late will not be allowed extra time on the quiz. The lowest in-lab quiz grade and the lowest in-lecture quiz grade will be dropped and therefore no makeup quizzes will be given. Quizzes will be closed book, closed notes. No calculator or other aid will be allowed unless specifically stated at quiz time.
  - **In-Lab Quizzes (4 %):** Usually given weekly during lab, covers material from lab and lecture notes.
  - **In-Lecture Quizzes (4 %):** Usually given weekly, on Tuesdays. Covers practice problems from previous week. The quiz will be conducted using UT Instapoll, see the link on the course website for how to set it up on your device. Failure to set up UT Instapoll or to bring your device to class will result in a quiz score of zero.

- **Prerequisite Review Quiz (3 %):** Conducted during the solar lab (see schedule on last page). Covers relevant material from EE302, EE411, and EE313. See course website for prerequisite material you are expected to be proficient with and suggested review problems. The quiz problems will be very similar to the review problems on the course website. Note the lab work for the solar lab is rather minimal. During your lab time you will first take the prerequisite review quiz, next you will take your normal weekly in-lab quiz, lastly you will proceed with the solar lab work.
- **Two tests (13 % each):** During a test, one 8.5 x 11" sheet of notes (both sides) may be used. Your lowest test grade (including a *pre-excused* missed test) will be replaced with your final exam grade if it works to your advantage. See **Makeup Exam** section below.
- **Final Exam (13 %):** The final is comprehensive and given during the official UT-scheduled time period (see http://registrar.utexas.edu/students/exams/). One 8.5 x 11" sheet of notes (both sides) may be used. Please do not ask to take the final exam at any other time.
- **Lab Attendance (5 %):** Taken at all lab sessions. There are no makeup labs. The attendance grade is scaled linearly according to the following two points: 100 % attendance gets full credit, and 50 % attendance record gets no credit. Each late arrival beginning with the third equals one absence.
- **Class Participation and Attendance (5 %):** On-time attendance is expected, late arrivals are disruptive to all.
- **Course Grade:** Numerical course grades are converted to fractional letter grades using the scale below.

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
100	90	87	84	80	77	74	70	67	64	60	57	0

- **Makeup Exams:** There are no makeup tests. To account for any contingency, your lowest test grade (including a pre-excused missed test) will be replaced with your final exam grade if it works to your advantage. An unexcused exam absence will result in an irreplaceable score of zero. Excused absences will only be given for a documented serious illness or family emergency; in such an event the final exam score will replace that of the missed exam. You are advised to not schedule other activities in your professional or personal life during class/exam times, such conflicts will not result in an excused absence.
- **Questions Regarding Test Grading:** Write your concerns on a clean sheet of paper, staple it to your test, highlight on your test with a colored pen as needed to support your case, and return the stapled pack to Dr. Flynn within one week. I reserve the right to re-grade the entire exam, your overall result may go up or down.
- **Questions regarding lecture/lab absences:** You are expected to attend the lectures and the lab section you signed up for. Absences due to interviews or extra-curricular activities will generally not be excused. There are no makeup labs or makeup exams for such reasons. If you have anything you'd like me to consider when computing your final course grade at the end of the semester regarding your absences, please write such information on a clean sheet of paper and present it to me in person before class or during office hours.

Students with Disabilities: Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities at 471-6259 (voice), 232-2937 (Video Phone), or http://www.utexas.edu/diversity/ddce/ssd as soon as possible to request an official letter outlining authorized accommodations.

Integrity: The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Academic misconduct including, but not limited to, plagiarism and/or copying previous years' reports will be treated according to the university policy detailed in http://deanofstudents.utexas.edu/sjs/. I keep copies of previous years reports. So be wise!! Besides the moral issues, a few more points added to your grade does not worth the risk and consequences of being caught cheating.

Drops: University policy on course drop dates states: "A student may not drop a course after the twelfth class day in the long session except for good cause (e.g., health or serious personal problems, or a demonstrated need to

work more hours). A graduate student seeking to drop a class after the twelfth class day should go to the department offering the course." For this course, the department offering the course is ECE. Additional information can be found at: http://www.engr.utexas.edu/undergraduate/forms/adddrop

Religious Holy Days: By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, I will give you an opportunity to complete the missed work within a reasonable time after the absence.

Evaluation: The MEC common evaluation form will be used.

Online Privacy: Web-based, password-protected class sites are associated with all academic courses taught at The University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1. For information on restricting directory information see: http://www.utexas.edu/student/registrar/catalogs/gi06-07/app/appc09.html

Emergency Preparedness: Review the Emergency Preparedness and Emergency Terms documents on Canvas. All occupants of university buildings are required to evacuate a building when a fire alarm and/ or an official announcement is made indicating a potentially dangerous situation within the building. Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building. If you require assistance in evacuation, inform your instructor in writing during the first week of class. For evacuation in your classroom or building:

1. Follow the instructions of faculty and teaching staff.
2. Exit in an orderly fashion and assemble outside.
3. Do not re-enter a building unless given instructions by emergency personnel.

See SCHEDULE on NEXT PAGE

Week	Day	Lecture Topic	Lab Assigned	Lab Due
27-Aug	Th	Course introduction; Solar power.	Orientation, safety, soldering demonstration and construction tips	None
3-Sep	T Th	Solar continued. RMS waveforms and definitions. Fourier Series.	Solar	Finalize teams, assign tools
10-Sep	T Th	Filters and periodic steady state. Thyristors and ac-ac power conversion.	Light dimmer	None
17-Sep	T Th	Diode bridge rectifiers. MOSFETs and MOSFET gate drive circuit Part 1.	Diode bridge rectifier (DBR)	Light dimmer circuit and report
24-Sep	T Th	MOSFETs and MOSFET gate drive circuit Part 2. DC-DC buck converter.	MOSFET gate drive circuit	DBR circuit and report
1-Oct	T Th	DC-DC buck converter continued. Boost converter. DC-DC SEPIC converter.	Buck converter	MOSFET gate drive circuit and report
8-Oct	T Th	Transformers and dc-dc flyback converter. Review.	Boost and SEPIC converters	Buck converter circuit and report
15-Oct	T Th	**Test 1 (10/15).** H-bridge inverter - basics Part 1.	None	Boost and SEPIC converter circuit and report
22-Oct	T Th	H-bridge inverter - basics Part 2. H-bridge inverter - unipolar PWM controller.	H-Bridge Inverter - PWM controller	Solar report
29-Oct	T Th	H-bridge inverter - gate drive circuit. H-bridge inverter - power stage and output filtering.	H-bridge Inverter - Power Stage	PWM controller circuit and report
5-Nov	T Th	H-bridge inverter - blanking. H-bridge - audio amplifier.	H-Bridge Inverter - Audio amplifier	Power Stage circuit and report
12-Nov	T Th	H-bridge inverter - renewable power to grid. Nonlinear power electronic circuit solving.	H-Bridge Inverter - Power to grid	None
19-Nov	T Th	Review. **Test 2 (11/21).**	None	Audio amplifier, Power to grid Equipment check-in during usual lab periods.
26-Nov	T Th	H-bridge applications. Thanksgiving Holiday.	None (Thanksgiving)	None (Thanksgiving)
3-Dec	T Th	Power electronics applications. Case study	None	None

14-Dec **Final, Saturday 2-5pm (double check this yourself)**