SYLLABUS TEMPLATE PART ONE

INFORMATION ABOUT THE COURSE

COURSE TITLE AND COURSE NUMBER: ECE 8930: Advanced Power Electronics

TERM: Start date: January 12, 2022

End date: April 29, 2022

Last day to register or add a class or declare Audit: January 19, 2022

Last day to drop a class or withdraw from the University without a W grade: January 26, 2022

Last day to drop a class or withdraw from the University without final grades: March 18, 2022

Spring break: March 21, 2022 – March 25, 2022

CLASS MEETING TIME AND PLACE:

Tuesday and Thursday, 5:00 pm to 6:15 pm

106 ZGEC, CURI & 223 Riggs, Main campus

TIME TO WAIT:

Students are expected to wait 15 minutes if an instructor is late

INFORMATION ON MODALITY:

In-person

INSTRUCTOR NAME:

Zheyu Zhang

INSTRUCTOR EMAIL:

E-mail: zheyuz@clemson.edu

Email questions will be answered within 36 hours (Excluding weekends and university holidays)
Please use [ECE8930] in the subject line

UNIVERSITY OFFICE PHONE:

843-730-5067

OFFICE ADDRESS/OFFICE NUMBER:

309 Zucker Family Graduate Education Center

1240 Supply St., N. Charleston, SC 29405, USA

OFFICE HOURS:

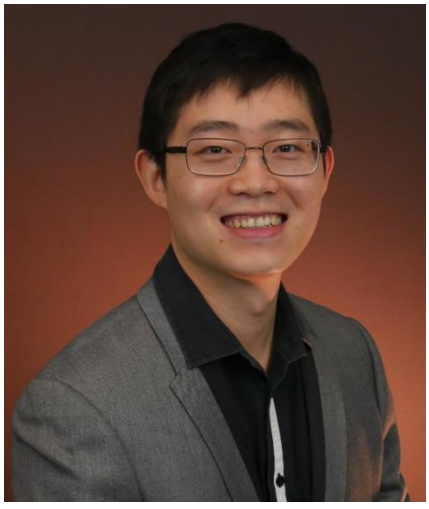
Tuesday/Thursday 1:00 pm – 2:00 pm primarily through Zoom Personal Meeting Room and in the office by appointment
https://zoom.us/j/2947747574?pwd=UTBkeklUL09tbVhEczRHdmp1UG9lZz09

Meeting ID: 294 774 7574; Passcode: dh1G9W

During cancelled lectures

Individually scheduled

INSTRUCTOR PHOTO:



COURSE DESCRIPTION

Multi-phase (esp. three-phase) AC PWM converters are one of the most popular and important types of power electronics converters. Many emerging applications require the use of three-

and multiphase PWM converters: electrified transportation, electronic power distribution systems, and renewable energy systems. They are used in industrial automation, vehicles, wind power generator, appliances in the form of electric motor drives; and used in power systems as electronic transformer, power flow controller, and compensator. There is a real need to have a course focusing on the design of the multi-phase PWM converters, not only their control, but also power stage, system interface, and integration. This course starts from an introduction to AC three-phase PWM converters. Then the detailed power stage design of three-phase PWM converters will be presented, including power semiconductor device selection and loss calculation, passive component selection and design, thermal design, gate drive, protection, auxiliary circuits, sensors, and controller hardware. Afterward, the power converter interface with load and source will be discussed, including dv/dt filter for motor drives, LCL filter for grid-tied applications, and EMI filter for industrial and emerging applications (e.g. aviation). Finally, a high-density converter design methodology will be overviewed with several examples highlighted. The course targets for graduate students with fundamental power electronics knowledge.

Learning Outcomes

After completing this course, students will be able to:

- Understand the operation of three-phase PWM converters
- Design a three-phase converter, including component selection, power stage design, filter design, and auxiliary circuit design
- Consider the important source and load interface issues, including harmonics, EMI noise, *dv/dt* noise
- Use simulation in design and validation
- Understand the basic principle for achieving high power density converter design
- Give a technical presentation

Prerequisites

ECE4930/6930 – Fundamentals of Power Electronics

Required Materials

Simulation software — PLECS, MATLAB, and SABER (license will be provided in the class)

Textbook (optional) — 1) Analysis of Electric Machinery and Drive Systems –Krause, Wasynczuk, Sudhoff, 2) Power Electronics: Converters, Applications and Design –Mohan, Undeland, Robbins; 3) Vector Control and Dynamics of AC Drives –Novotny and Lipo; 4) Power Electronics and Motor Drives: Advances and Trends –Bose; 5) High Power Converters and AC Drives –Wu; 6) Electric Motor Drives: Modeling, Analysis, and Control –Krishnan

In case a remote participation is needed, student is required to have a laptop computer, internet connectivity capable of transmitting and receiving video, a video camera, a microphone, and a cell phone

Required Technical Skills

MATLAB/SIMULINK

Basic knowledge of power electronics circuits

Solid knowledge of circuit theory

Major Assessment/Grading Activities *[REQUIRED]*

Grading Type	Weighting
Homework (three)	30 %
Participation and discussion	5 %
Project (one)	20 %
Student presentation (two)	20 %
Final project (one)	25 %
Total	100 %

Procedures for turning in homework – online submission through canvas.

Grading System

Letter	Points
A	90 - 100
B	80 – 89.99
C	70 – 79.99
D	60 – 69.99
F	< 60

Grading Policies

Late work:

- Except in cases of documented emergencies, late work will lead to 10 points penalties (note that each assignment/project has the full score of 100 points)
- Late work after one week of the deadline will not be counted except in cases of documented emergencies

Absences:

- Should you miss a class (including online), it is YOUR RESPONSIBILITY to contact with your instructor within one week to deliver the written excuse by email. Missing class WILL AFFECT your final grade. See grading policy below.
- A student will be marked absent if not in class/online within 5 minutes of starting time. This can be changed into a tardy. The student is responsible for contacting the instructor after class.
- The student is responsible for asking the professor to change an absence into a tardy if the student arrived more than 5 minutes late immediately after the class in which the tardy occurs. (No changes will be made on a later day.) The third tardy will result in a loss of 2 participation points, the fourth 2 more points, etc.
- Exception — for part-time graduate students, absence is exempt if it is due to the full-time job (e.g. scheduled meeting, biz travel, etc.). Please send an email to your instructor before the class, in the meantime, make sure you will spend equivalent time to review the lecture slides and learn by yourselves.

Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. 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

1. Basics of three-phase PWM converters
2. Component design
    a. Power semiconductors
    b. Thermal management
    c. Capacitor
    d. Inductor
3. Subsystem design
    a. Topology and modulation
    b. Power stage design
    c. Filter design, including EMI filter, *dv/dt* filter, LCL filter
    d. Control and auxiliary hardware, including gate drive, protection, dead-time effect
4. Converter design and optimization

FOR STANDARD ACADEMIC POLICY LANGUAGE AND STUDENT RESOURCES, SEE THE UNIVERSITY POLICY AND STUDENT SUPPORT SYLLABUS PART 2

In part two, you will find these required items:

- An accessibility statement is required in the syllabus.
- The Title IX statement is required in the syllabus.
- The Academic Integrity statement is required in the syllabus.
- The emergency preparedness statement is required in the syllabus.

MODIFICATION STATEMENT:

The instructor reserves the right to modify any aspect of the syllabus at any time during the semester for reasons including but not limited to COVID-related situations. The date of this version of the syllabus is January 20, 2022.