SYLLABUS PART ONE

INFORMATION ABOUT THE COURSE

COURSE TITLE AND COURSE NUMBER:

ECE 4980: Research in Electrification of Transportation

TERM: Fall 2021

State date and end date: August 18, 2021 – December 3, 2021

Last day to register or add a class or declare Audit: August 24, 2021

Last day to drop a class or withdraw from the University without a W grade: August 31, 2021

Fall break: October 11 – October 12, 2021

CLASS MEETING TIME AND PLACE:

Monday, TBD

Zoom meeting to be scheduled

TIME TO WAIT:

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

INFORMATION ON MODALITY:

Online

INSTRUCTOR NAME:

Zheyu Zhang

INSTRUCTOR EMAIL:

E-mail: zheyuz@clemson.edu
Email questions will be answered within 24 hours (Excluding weekends and university holidays)
Please use [ECE4980] in the subject line

UNIVERSITY OFFICE PHONE:

843-730-5067

OFFICE ADDRESS/OFFICE NUMBER:

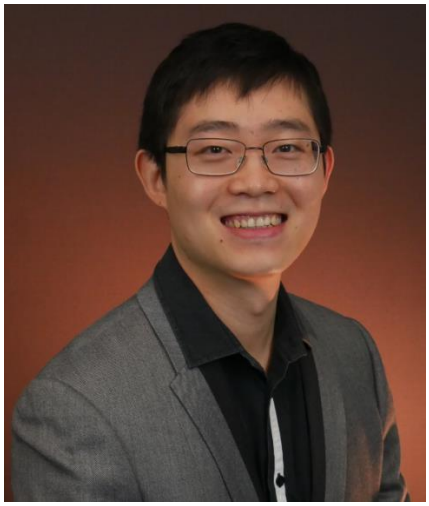
309 Zucker Family Graduate Education Center

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

OFFICE HOURS:

Individually scheduled

INSTRUCTOR PHOTO:



COURSE DESCRIPTION

Electrification of transportation and grid modernization are key solutions towards “net-zero” greenhouse gas emissions to cope with climate changes. Also, the recent Texas Power Crisis re-emphasizes the significance of energy resiliency under extreme weather events. Therefore, a self-mobile energy storage system could be a potential enabling technology to 1) offer resilient vehicle-to-building (V2B) support, 2) provide universal vehicle-to-grid (V2G) solution, 3) allow efficient vehicle-to-vehicle (V2V) fleet offline energy management, and 4) deliver flexible, scalable microgrid infrastructure for a connected community. Electric bus with hundreds-kilowatt/-kilowatt-hour capacities, such as school bus, is the target transportation. This independent research course focuses on the integrated power electronics system study for the electric bus. It starts with an introduction to power conversion principles. Then the detailed power stage design of power electronics converters will be presented, including the power semiconductor device, modulation, thermal management. Afterward, the power converter interface with load and source will be discussed, including

dv/dt filter for motor drives and LCL filter for grid-tied applications. Finally, an integrated power electronics converter will be designed for the electric bus.

Learning Outcomes

After completing this course, students will be able to:

- Understand the operation of three-phase power electronics converters
- Design a three-phase power electronics converter, including component selection, power stage design, and filter design
- Use PLECS simulation in design and validation
- Give a technical presentation

Prerequisites

ECE4930/6930 - Introduction of Power Electronics Technology and Applications

Required Materials

Simulation software — PLECS and MATLAB (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

Required Technical Skills

MATLAB

Basic power electronics knowledge

Major Assessment/Grading Activities

Grading Type	**Weighting**
Homework (six)	60 %
Participation and discussion	5 %
Student presentation (one)	10 %
Final report (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.

Topical Outline

Week	Date	Topic
W1	08/19	Power conversion principles in three-phase converters & installing PLECS
W2	08/23	Understanding of power electronics design – power devices basics & learn PLECS simulation example
W3	08/30	Understanding of power electronics design – modulation & build PLECS simulation based on new specs
W4	09/06	Understanding of power electronics design – power devices behavior models
W5	09/13	Understanding of power electronics design – thermal management
W6	09/20	Understanding of power electronics design – power stage

W7	09/27	Establish PLECS simulation model with thermal management model
W8	10/04	Understanding of power electronics design – space vector modulation
W9	10/11	Establish PLECS simulation model with SVM modulation
W10	10/18	Understanding of power electronics design – dv/dt filtering & Establish PLECS simulation model with dv/dt filter
W11	10/25	Understanding of power electronics design – dv/dt filtering & Establish PLECS simulation model with LCL filter
W12	11/01	Understanding of power electronics design – passives and physically select capacitor based on the previous simulation model
W13	11/08	Understanding of power electronics design – passives
W14	11/15	Physically design inductors based on the previous simulation model
W15	11/22	Summary of design results
W16	11/29	Final report and presentation

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 August 17, 2021.