ECE 534

Fundamentals of Power Electronics and Utility Applications

Instructor: Dr. Subhashish Bhattacharya  sbhatta4@ncsu.edu  Ph: 919-513-7972

Course Objectives: This first level graduate level course is intended to develop an understanding of Power Electronics and switching mode power converters for DC-DC applications. This course is intended to teach the fundamentals of power conversion and will cover the design, analysis, modeling and control of all types of mainly DC-DC power converters – and also introduce the concepts of dc-ac inverters, ac-dc rectifiers / converters. This course will also include interface of power converters to single-phase and three-phase ac systems, and discuss utility interface of power electronic converters – including power quality.

The students will develop skills in complete design of these power converters through a project – focused on design of dc-dc converters.

This will be an important course for understanding of renewable energy interface to the grid, power converters for ac- and dc motor drives and power converter controls.

Teaching material:


References: (strongly recommended) “Power Electronics: Converters, Applications and Design” – Mohan, Undeland, Robbins, Second Edition

Course Locker: http://courses.ncsu.edu/ece534/lec/601/wrap/

Computing Tools

(You can also use Saber software if you are more familiar with Saber)
MATLAB: http://www.eos.ncsu.edu/software/matlab/

Grading policy

Homework (5-6): 40 %
Mid-term exam: 15 %
Final exam: 25 %
Final Project 20 % (Design project)

TA: Misha Kumar  email:mkumar2@ncsu.edu TA Hours: M,W: 3:30pm-5:00pm (tentative)

REG02.20.1: “Reasonable accommodations will be made for students with verifiable disabilities.”


Course Syllabus (weekly topics):

1. Introduction Chap. 1 – Power Conversion Principles
2. Steady-State Converter Analysis – Principles 2.1, 2.2
3. Steady-State Converter Analysis – Basic Circuits 2.3, 2.5, 2.6
4. Steady-State Converter Modeling Chap. 3
5-6. Power Semiconductor Switches; Average and Small-Signal Models of PWM Converters Chapters 7.1, 7.2, 7.4, 7.6

7. Non-isolated and isolated DC-DC Converter Topologies 6.1 - 6.5
8-9. Converter Transfer Functions Chap. 8
10-12. Output Feedback Control Design Chap. 9, Current Programmed Control – Chap 12
13. Line Frequency Diode Rectifiers – single-phase and 3-phase, PWM Rectifiers
14. PWM Inverters – single-phase and 3-phase; Utility interface issues – e.g. PV (solar)

Project: Focus on design, analysis, modeling and control of dc-dc converters.