Lecture Hours

All lectures will be recorded and published on YouTube channel. There will be also synchronous recitation/Q&A sessions on Tuesday 10:40-11:30.

Course Assistant

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Grading:

- 1 Midterm: 20%
- Homeworks: 20% (+some bonus for good homeworks)
- Final: 30%
- Term Project: %25 (+some bonus for good projects)
- In Class Activities: 5% (active participation, attendance)

Important Note: Any of the following actions will result in NA grade:

- Not submitting two homeworks
- Not attending to the final exam
- Not submitting term project

Presentations:

Presentations will be added to keysan.me/ee464 weekly (but please also use the other sources given below:

- Week#1: Review (http://jblevins.org/presentations/ee464_review.html)
- Week#2: DC/DC cont. (http://jblevins.org/presentations/ee464_cuk_sepic.html)
- Week#3: Regulated Power Supplies (http://jblevins.org/presentations/ee464_power_supplies.html)
- Week#5: Magnetic Design for Power Electronics (http://jblevins.org/presentations/ee464_magnetic_design.html)
- Week#6: Half/Full Bridge Converters (http://jblevins.org/presentations/ee464_bridge_converters.html)
- Week#7: Controller Design (http://jblevins.org/presentations/ee464_controller_design.html)
- Week#8: Inverters (http://jblevins.org/presentations/ee464_pfc_inverters.html)
- Week#9: 3-Phase Inverters (http://jblevins.org/presentations/ee464_three_phase_inverters.html)
- Week#11: Other PWM Techniques-FOC (http://jblevins.org/presentations/ee464_svpwm.html)
- Week#13: 3Ph & Multi Level Inverters (http://jblevins.org/presentations/ee464_multi_level.html)

Upcoming lectures

- Week#10: Midterm Recitation (http://jblevins.org/presentations/ee464_recitation.html)
- Week#14: Resonant Converters (http://jblevins.org/presentations/ee464_resonant_converters.html)

Homeworks and Term Project:

Homeworks and Term Project will be announced from the ee464 GitHub Page of the course.

Brief Info:

EE463 and EE464 are the two core courses for power electronics and electric machines option. In these courses, you will learn about basics of power electronic topologies, components and control techniques. In the first semester we will focus on AC-DC converters (rectifiers), whereas in the second semester it will be mainly about DC-DC converters and inverters. You will find chance to design and implement fundamental circuit topologies and get understanding of other design factors such as selection of switches, passive components within electrical and thermal constraints. There will a hardware project to implement.

Important Notes:

In this course I will apply learning by doing, thus I expect (and encourage) you to actively participate to the lectures. Here are the important points:

- There are no stupid questions.
- Even if there is, asking a stupid question doesn't mean that you are stupid.
- Studying is an activity of students, not of lecturers.

Course Objectives:

At the end of course you will be able to:

- Understand the fundamental principles of power electronics topologies.
- Analyze and design controlled and uncontrolled DC/DC converters and inverters (1ph and 3ph)
- Understand the basics of motor design and grid connected systems Select commercial power switches and passive components for various applications.
- Evaluate and compare various options for power electronic topologies
- Use a few power electronic software (e.g. PSIM, Simulink etc.)
- Prepare design reports and use version control system (GitHub) to build your online portfolio.
- Design and implement a hardware project.

Required Background

EE463 is pre-requisite for this course, and I strongly advise you to review the topics covered in this course.

Assuming you are getting the core courses from the power electronics and electric machines option(EE462, EE463, EE464), you will need at least three more courses. If you are planning to continue your career in power engineering area I advise you the following courses (in the order of preference):

- EE498 Control System Design and Simulation
- EE406 Laboratory of Feedback Control Systems
- EE402 Discrete Time Systems
- EE471 Power Sytem Analysis-I
- EE447 Introduction to Microprocessors
- EE430 Digital Signal Processing

Textbooks & References:

- Power Electronics: Converters, Applications, and Design, N. Mohan, T. Undeland, W. Robbins, Wiley (Available in the bookstore)
- Cyril W. Lander, Power Electronics, McGraw-Hill, 1993, Third Edition.
- Modern Power Electronics and AC Drives, Bimal K.Bose, Prentice Hall

Useful Links:

- MIT Power Electronics Lecture Notes
- NPTEL Power Electronics Course
- University of Colorado Introduction to Power Electronics
- YouTube, Power Electronics by Ned Mohan
- YouTube, Fundamentals of Power Electronics by Katherine Kim
- YouTube, Power Electronics by Dr. Ferdowsi

Useful Software Tutorials

Here are some to get you started. If you think a link should be here, just let me know.

PSIM

- PSIM Book
- Tutorials
- Video Library

MATLAB/Simulink

- MathWorks
- MathWorks Examples
- Video Tutorials
- Video Tutorials-2
- MATLAB Power Electronics Basics

Notes on Projects

- In this course you will complete several software simulation projects (planned as 5), and one hardware project. Projects will be performed in groups (2-3 people). However, the groups will be assigned randomly, and will be shuffled for each project. You will be able to choose your group partners only for the hardware project.

- I would like you to use a version control system for your project. Please check keysan.me/okst/ for details.

- You will submit your projects using GitHub, so please open an account (preferably using your real name, as it will be your online portfolio when you graduated), and complete a few tutorials and learn the basics as soon as possible.

- You will not only submit the latest version of your projects, but I would like to see the intermediate stages, and you'll be also graded with number of commits, so please start working on the projects in the early days.

- In the course you will learn to use PSIM, Simulink. Please set up these software and start learning them as soon as possible.

Frequently Asked Questions

- **Why can't I choose my partner for the simulation projects?** Next year you will graduate and start working in companies or in research institutes. However, in your professional life you will not be able to choose your colleagues, and you will have to work with many people with different personal characters and backgrounds. Unfortunately, team working is a neglected aspect in our department and I hope in this course you will improve your competence to work with different people. Furthermore, once you begin your professional career you will see that your personal network is one of your valuable assets, so please consider these projects as a chance to have connection with 5-6 extra people, which all will be working in different companies in the following years.

- **But, there is my high school friend, whom I partnered with the all laboratories in the past so far...** Then, it is you that needs to meet with new people most.

- **But, I do all of the work, and my partner does not help at all. It is not fair!** That's why you have to use version control system. Each student will be graded separately based on their contributions and number of commits. If one of partners did not contribute at all, he/she will get zero.

- **What happens if I don't submit these projects?** If you don't submit three projects or more, you will get NA.

- **I already know how to use Simulink, why do I have to learn PSIM?** I think in the long run, it will be better for you to know more than one simulation software. At least, I am sure it will increase your chances of finding a job. Please note that, you will be free to use any software you like after the second project.

Projects Grading

Number of Commits (20%): The number of edits of your project files as seen from the contributors list. For example, if you start making your project in the last few days, you'll get no credit. If you start early and continue editing your files, you'll get full credit. The project topics are not easy, so this is a way to encourage you to start early and work regularly.

Level of Information (80%): The detail level of your designs (see requirements above), and the accuracy of your calculations.

Report Quality (Pass or Rejection): Text explaining your design decisions, quality of your figures, citing relevant studies and your conclusion section.