EE 270 Modeling & Control Power Electronic Converters

Spring, 2025

Instructor: Haoyu Wang

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Class Hours: Tuesdays and Thursdays 8:15am-9:55am; Rm. 1A-106, SIST BLDG

Office Hours: Fridays 3:00pm-4:30pm; the other times are fine, but by appointment only

Course Website: http://pearl.shanghaitech.edu.cn/teaching/2025spring/EE270/

Homework: https://www.gradescope.com/courses/934819

TA: Chenxi Li; lichx2023@shanghaitech.edu.cn; (021)2068-5097

TA Office Hours: Wednesdays 3:00 pm-5:00 pm, 3-503 SIST BLDG;

Course Description: An introduction course to switched-mode power converters. The first part of the course treats basic circuit operation, including steady-state converter modeling and analysis, switch realization, discontinuous conduction mode, and transformer-isolated converters. Next, converter dynamics and control are covered, including ac modeling of converters using averaged methods, small-signal transfer functions, and classical feedback loop design. Finally, advanced modeling, analysis, and control techniques are covered, including Feedback Theorem; circuit averaging, averaged switch modeling, and simulation; DCM modeling, extra element theorems; and current-programmed control.

Prerequisite(s): Circuits Theory

Credit Hours: 4

Required Text:

R. W. Erickson, and D. Maksimovic, *Fundamentals of Power Electronics*, 3rd Edition, Springer Science & Business Media, 2020. ISBN: 978-3-030-43879-1

Recommended Texts:

The following recommended texts will provide background for the course.

N. Mohan, and T. M. Undeland, *Power Electronics: Converters, Applications, and Design*, 3rd Edition, John Wiley & Sons, 2007. ISBN: 978-0-47-122693-2

M. H. Rashid, *Power Electronics: Circuits, Devices and Applications*, 4th Edition, Prentice Hall, 2013. ISBN: 978-0-13-312590-0

Course Contents:

1. Introduction
2. Steady-state converter analysis
3. DC equivalent circuit modeling
4. Switch realization
5. Discontinuous conduction mode
6. Converter circuits
7. AC equivalent circuit modeling
8. Converter transfer functions
9. System Stability

10. Negative Feedback & Network Transfer Functions
11. Regulator Design
12. Feedback Theorem
13. Averaged Switch Modeling
14. Modeling of DCM
15. Extra element theorems
16. Current programmed control
17. High f Dynamics & DCM Modeling

Course Material: Most course material will be delivered within the lecture. Supplementary material, such as course notes, homework, and project announcements, will be updated on the class website at http://pearl.shanghaitech.edu.cn/teaching/2025spring/EE270/.

Homework: There will be roughly 6 homework. Homework will typically be due in class one week after it is posted and will be collected and graded on Gradescope.

Late Policy: Late homework is allowed 4 days maximum after its due date, but its weight will be deducted by 20% per day.

Exams: Your exam score in the class will be based on two exams. The midterm exam is scheduled for 3/20/2025; the final exam is scheduled for 5/15/2025. Exam questions will be based on the lecture notes and homework.

Project: Students are also responsible for a research-oriented project. You will work individually to design, analyze, and simulate a novel power electronic converter/control method/modeling method that improves the performance of the existing converter/control method from the literature.

Grading: Grading will be based on: homework (20%), mid-term exam (25%), final exam (25%), final project (30%).

Academic Dishonesty: Although I sincerely wish that I will not have to cope with this issue, I would like to make it very clear that academic dishonesty will not be tolerated. The following acts of academic dishonesty are prohibited: cheating, fabrication, facilitating academic dishonesty, and plagiarism. Academic dishonesty in this course includes copying homework or deliberately taking unfair advantage of the other students in the course. Once found, it can lead one to an F grade in this class and will be referred to the academic committee in the School of Information Science and Technology.