

FLORIDA A&M UNIVERSITY – FLORIDA STATE UNIVERSITY College of Engineering
Department of Electrical and Computer Engineering

Fall 2022
EEL5930

Advanced Power Electronics

College of Engineering (CoE) B-214
Mon/Wed, 3:30 PM – 4:45 PM

Instructor: Prof. Jinyeong Moon
CoE B-368
(850) 410-6584
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Schedule: Class
Mon/Wed 3:30 PM – 4:45 PM @ CoE B-214
Office Hours
Mon/Wed 2:30 PM – 3:30 PM @ CoE B-368

Course Topics

- (1) Energy Method for Loss Calculation
- (2) Switched Capacitor Converters
- (3) Duality
- (4) Magnetics Design
 - a. Core Factor & Core Area Product
 - b. Magnetic Diffusion
 - c. Winding Loss
 - d. Core Loss
 - e. Transformer Modeling
 - f. Magnetic Circuit
 - g. Magnetic Saturation
- (5) Topologies
 - a. Coupled Filters
 - b. Parasitic Cancellation / Ripple Steering
 - c. Interleaving
 - d. State Plane Analysis / Integrated Magnetics

Prerequisite

Strong circuit background is required. Undergraduate students must consult with Prof. Moon prior to registration. Graduate students must have previously taken the following (or equivalent) course:

EEL4243/EEE5317 Power Electronics

Subject Reading

The principal sources for this course will be lecture notes and classic and recent papers on power electronics and related areas. The following textbooks might prove helpful:

- 1) Fundamentals of Power Electronics, Second Edition, By Erickson and Maksimovic
- 2) Principles of Power Electronics, By Kassakian, Schlecht, and Verghese
- 3) Elements of Power Electronics, By Krein
- 4) Modern DC-to-DC Switchmode Power Converter Circuits, By Severns and Bloom
- 5) Basic Circuit Theory, By Desoer and Kuh
- 6) Electromagnetic Fields and Energy, By Haus and Melcher

Grading

Homework (20%), Midterm (40%), Project (40%)

A = 90 ~ 100; B = 80 ~ 89; C = 70 ~ 79; D = 60 ~ 69; F = < 60

Homework assignments will be issued periodically, and due dates will be specified in each assignment.

Final Project

As a project, students will design a power electronic circuit. The topic can be freely chosen by students, or can be developed with a consultation with Prof. Moon. To reduce the workload toward the end of the course, it is recommended to arrange a meeting with Prof. Moon as early as possible. If desired, individual meetings will be scheduled to facilitate the development of a topic and to check the progress of the project. Up to two students can pair up to work as a team for the same project. The examples for project topics are:

- Parasitic-aware high frequency power converter
- Switching capacitor topology for better load regulation
- MHz inverter with low magnetic loss/small magnetic components
- High frequency power amplifiers
- Power converter for photovoltaic without passive RLC

A design can be purely theoretical and simulation-based. However, students can also go beyond paper designs, and fabricate and implement designs physically.

Policy Statements

- Late homework is not accepted.
- The general policy is no makeup exam. In the event of an excused absence, you must notify the instructor prior to the exam to discuss proper procedure.
- Grade dispute must be made within one week after the graded work has been returned to the student.

Academic Honor Code

Students are bound by their university's Academic Honor Code and are subject to sanctions if they are found in violation of the Code. Possible sanctions include but are not limited to: (1) a failing grade on an exam or assignment; (2) a failing grade in the course; (3) dismissal from the academic program; or (4) dismissal from the university.

Americans with Disabilities Act

Students with disabilities needing academic accommodation should:

- (1) Register with and provide documentation to the appropriate university office.
For FAMU students, this is the Learning Development and Evaluation Center (LEDC).
For FSU students this is the Student Disability Resource Center (SDRC); and
- (2) Bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

Syllabus Change

Except for changes that substantially affect implementation of the grading policy or grading scale, the syllabus is a guide for the course and is subject to change with advance notice.

Tentative Lecture Schedule: EEL5930 - Advanced Power Electronics (Fall 2022)				
Date	Day	Lecture	Topics	Homework
08/22	Mon	1	Energy Method	HW #1 out
08/24	Wed	2	Energy Method	
08/29	Mon	3	Switched Capacitor Converter	
08/31	Wed	4	Switched Capacitor Converter	
09/05	Mon		No class - Labor Day	
09/07	Wed	5	Switched Capacitor Converter	
09/12	Mon	6	Switched Capacitor Converter	HW #1 due / HW #2 out
09/14	Wed	7	Switched Capacitor Converter	
09/19	Mon	8	Duality	
09/21	Wed	9	Duality	HW #2 due / HW #3 out
09/26	Mon		Midterm Review	
09/28	Wed		Midterm	
10/03	Mon	10	Core Factor and Core Area Product	HW #3 due / HW #4 out
10/05	Wed	11	Magnetic Diffusion	
10/10	Mon	12	Magnetic Winding Loss	HW #4 due / HW #5 out
10/12	Wed	13	Magnetic Winding Loss	
10/17	Mon	14	Magnetic Core Loss	
10/19	Wed	15	Magnetic Core Loss	
10/24	Mon	16	Transformer Modeling	
10/26	Wed	17	Transformer Modeling	
10/31	Mon	18	Magnetic Circuit	
11/02	Wed	19	Magnetic Circuit	HW #5 due / HW #6 out
11/07	Mon	20	Magnetic Saturation	
11/09	Wed	21	Magnetic Saturation	
11/14	Mon	22	Coupled Filters	
11/16	Wed	23	Resonant Converters	HW #6 due
11/21	Mon	24	Parasitic Cancellation / Ripple Steering	
11/23	Wed		No class - Thanksgiving	
11/28	Mon	25	Interleaving	Project Report Due
11/30	Wed	26	State Plane Analysis	
12/14		Wed	Letter Grade Available on Registrar	Syllabus Version: August 04, 2022