

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

Fall 2024 EEL5930	Advanced Power Electronics	College of Engineering (CoE) A-223 Mon/Wed, 2:00 PM – 3:15 PM
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Instructor: Prof. Jinyeong Moon
CoE B-368
(850) 410-6584
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Schedule: Class
Mon/Wed 2:00 PM – 3:15 PM @ CoE A-223
Office Hours
Mon/Wed 1:00 PM – 2:00 PM @ CoE B-368

Course Topics

- (1) Energy Method for Loss Calculation
- (2) Switched Capacitor Converters
- (3) Duality
- (4) State Plane Analysis
- (5) Interleaving
- (6) Resonant Converters
- (7) 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
- (8) Topologies
 - a. Coupled Filters/ Parasitic Cancellation / Ripple Steering

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) **Principles of Power Electronics (2nd Ed.)**, By Kassakian, Perreault, Verghese, and Schlecht
- 2) Fundamentals of Power Electronics, Second Edition, By Erickson and Maksimovic
- 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. The due date will be specified in each assignment.

Final Project

As a project, students will design power electronic circuits. The topic can be chosen by students or can be developed with 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 simulation based. Students can also go beyond paper designs and do physical fabrication. The final presentation will take place in the Final Exam time slot for this course. Each team will get 20 minutes for the presentation and 10 minutes for questions and answers.

General Policy Statements

- First-day attendance is mandatory for FSU students, and first-week attendance is mandatory for FAMU students. Students not in class during the first day (FSU) or first week (FAMU) will be dropped from the course. This is a Title IV requirement involving federal financial aid. However, a student who was dropped from the course **may** re-register for it.
- **The detailed University attendance policy is presented in a separate section on the next page.**
- There is no makeup exam/quiz without a certified medical excuse or prior instructor approval. The corresponding exam/quiz score will be automatically zero.
- In the event of an excused absence for exams and quizzes, consult the instructor prior to the exam to discuss the proper procedure.
- Electronic devices, including **cell phones**, should not disrupt the lecture (**no sound, no vibration**).
- There will be no phone conversations or text messaging during class.
- Profanity, as well as ethnic, racial, or sexual remarks in my class, will not be tolerated and will result in a penalty for your grade.
- Grade disputes must be made within one week after the graded work has been returned to the student. The student will have the burden of proof to show why the student is correct.

Syllabus Change

Except for changes that substantially affect the implementation of the evaluation (grading) statement, the syllabus is a guide for the course and is subject to change with advance notice.

Class Lecture Recording

In this class, consistent with state law and university policy, students are permitted to make recordings of class lectures for personal use only. As noted, sharing, posting, or publishing classroom recordings may subject you to honor code violations and legal penalties associated with theft of intellectual property and violations of other state laws. Moreover, students and educators have expressed concern that recording classroom activities may negatively impact the learning experience for others, especially in classes that involve questions, discussion, or participation. To protect a learning environment in which everyone feels free to experiment with ideas, we ask you refrain from recording in ways that could make others feel reluctant to ask questions, explore new ideas, or otherwise participate in class. Students must monitor their recordings so that they do not include participation by other students without permission. Students with disabilities will continue to have appropriate accommodations for recordings as established by the Office of Accessibility Services.

Academic Success

Your academic success is a top priority for Dr. Moon, Florida A&M University, and Florida State University. University resources to help you succeed include tutoring centers, computer labs, counseling and health services, and services for designated groups such as veterans and students with disabilities.

University Attendance Policy

Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid written excuse. Consideration will also be given to students whose dependent children experience serious illness.

The College of Engineering has a restrictive interpretation of what is considered a valid excuse for an absence. See <https://www.eng.famu.fsu.edu/undergraduate/student-handbook>. Students may request an “Official Student Excuse” from Student Services and Undergraduate Affairs, B111. An excused absence does not necessarily excuse you from any missed course work. You must contact your course instructor to determine if you are eligible for any makeup assignments. Students should request an excused absence before it will occur if possible, or immediately upon their return to campus, and must bring verifiable documentation to justify the excuse. Excessive delay in requesting an excused absence or providing appropriate documentation may result in the request being denied. Deliberately providing false, forged, or misleading documentation may result in academic sanctions against the student.

Academic Honesty or Honor Policy

Academic Honesty or Honor Policy violations shall be reported, and appropriate actions will be taken by the Department Chair and Associate Dean, as appropriate for undergraduate or graduate students. Students are expected to uphold the University Student Code of Conduct and/or University Academic Honor Code for their home university, FAMU or FSU.

The **Florida A&M University** is committed to academic honesty and its core values which include scholarship, excellence, accountability, integrity, fairness, respect, and ethics. These core values are integrated into its academic honesty policy. Being unaware of the Academic Honesty Policy is not a defense to violations of academic honesty.

(Ref: <https://www.famu.edu/about-famu/leadership/board-of-trustees/policies.php>)

The **Florida State University** Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to "...be honest and truthful and...[to] strive for personal and institutional integrity at Florida State University."

(Ref: <http://fda.fsu.edu/Academics/Academic-Honor-Policy>)

University's Non-Discrimination Policy Statement

FAMU: <https://www.famu.edu/about-famu/leadership/division-of-legal-affairs/equal-opportunity-programs-and-labor-relations/policy-statement.php>

FSU: http://www.hr.fsu.edu/PDF/Publications/diversity/EEO_Statement.pdf

Americans with Disabilities Act

The universities value diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive, and welcoming. We are committed to providing reasonable accommodations for all persons with disabilities in a manner that is consistent with academic standards of the course while empowering the student to meet the integral requirements of the course.

Please note that instructors are not allowed to provide classroom accommodations to a student until appropriate verification from the FAMU Center for Disability Access and Resources (CeDAR) or FSU Office of Accessibility Services (OAS) has been provided. This syllabus and other class materials are available in alternative format upon request.

- **FAMU students** with disabilities needing academic accommodation should:
 - 1) register with and provide documentation to FAMU CeDAR; **and**
 - 2) ensure a letter from CeDAR is sent to the instructor indicating the need for accommodation and type.
 - For more information about services available to FAMU students with disabilities, contact:

Center for Disability Access and Resources (CeDAR)

Florida A&M University

CASS Building, 1735 Wahnish Way, Suite 102, Tallahassee, FL 32307

(850) 599-3180 (voice); (850) 561-2513 (fax)

cedar@famuedu.edu;

<https://www.famuedu.edu/students/student-resources/center-for-disability-access-and-resources/index.php>

- **FSU students** with disabilities needing academic accommodation should:
 - 1) register with and provide documentation to the Office of Accessibility Services (OAS);
 - 2) request a letter from OAS to the instructor to be sent to the instructor indicating the need for accommodation and what type; **and**
 - 3) meet (in person, via phone, email, skype, zoom, etc.) with each instructor to whom a letter of accommodation was sent to review approved accommodations.
 - For more information about services available to FSU students with disabilities, contact the **Office of Accessibility Services (OAS)**:

Florida State University
Tallahassee Campus
874 Traditions Way
108 Student Services Building
Tallahassee, FL 32306-4167
(850) 644-9566 (voice)
(850) 644-8504 (TDD)
oas@fsu.edu
<https://dsst.fsu.edu/oas>

Florida State University
Panama City Campus
Office of Student Affairs
2nd floor Barron Building, Room 215
Panama City, FL. 32405
(850) 770-2172 (voice)
(866) 693-7872 (toll-free)
sds@pc.fsu.edu
<http://pc.fsu.edu/students/student-affairs/sas>

Confidential Campus Resources

Various centers and programs are available to assist students with navigating stressors that might impact academic success. These include the following:

FAMU students

Victim Advocate Program
1676 S Martin Luther King Jr Blvd
302 C.C. Cunningham Building
victimadvocate@famuedu.edu
(850) 599-8785

<https://www.famuedu/students/student-resources/victim-advocate-program/index.php>

Office of Counseling Services*
1735 Wahnish Way, Suite 304 (CASS Building)
(850) 599-3145 (voice)
(850) 599-8481 (fax)
counseling@famuedu.edu
<https://www.famuedu/students/student-resources/health-and-wellbeing/counseling-services/index.php>

Student Health Services
1735 Wahnish Way, Suite 104 (CASS Building)
(850) 599-3777 (voice)
(850) 412-5643 (fax)
<https://www.famuedu/students/student-resources/health-and-wellbeing/health-services/index.php>

FSU students

Victim Advocate Program
University Center A, Rm. 4100
(850) 644-7161
Available 24/7/365
Office Hours: M-F 8-5
<https://dsst.fsu.edu/vap>

Counseling and Psychological Services*
250 Askew Student Life Center
942 Learning Way
(850) 644-TALK (8255)
Walk-in and Appointment Hours:
M-F 8 am – 4 pm
<https://counseling.fsu.edu/>

University Health Services
Health and Wellness Center
960 Learning Way
(850) 644-6230
<https://uhs.fsu.edu/>

* The counseling offices' primary mission is to address psychological needs and personal concerns, which may interfere with students' academic progress, social development, and emotional well-being. Services may include in-person and virtual individual therapy, group therapy, crisis intervention, psychoeducational and outreach programming, after hours crisis hotline, and access to community providers for specialized treatment.

Additional Resources

The FAMU-FSU College of Engineering website provides several resources, links, and deadlines that students should know about. These include:

Important Deadlines , including late drop/withdrawal, retroactive drop/withdrawal, and graduation application	https://www.eng.famu.fsu.edu/students/academic-deadlines
Student Resources	https://www.eng.famu.fsu.edu/student-resources
Undergraduate Student Handbook	https://www.eng.famu.fsu.edu/undergraduate/student-handbook
Graduate Student Resources links	https://www.eng.famu.fsu.edu/student-resources
Program Outcomes/Student Learning Outcomes for engineering programs	https://eng.famu.fsu.edu/about/accreditation
Academic Learning Compacts (ALC) for degree programs	
COE	https://eng.famu.fsu.edu/about/accreditation/outcomes-alc-sacs
FAMU	https://www.famu.edu/administration/strategic-planning-analysis-and-institutional-effectiveness/university-assessment/academic-learning/current-alcs.php
FSU	https://provost.fsu.edu/outcomes/smalcs-report/
Sexual Misconduct	https://www.eng.famu.fsu.edu/sexual-misconduct

Tentative Lecture Schedule: EEL5930 - Advanced Power Electronics (Fall 2024)				
Date	Day	Lecture	Topics	Homework
08/26	Mon	1	Energy Method	HW #1 out
08/28	Wed	2	Energy Method	
09/02	Mon		Labor Day - No Class	
09/04	Wed	3	Switched Capacitor Converter	HW #1 due / HW #2 out
09/09	Mon	4	Switched Capacitor Converter	
09/11	Wed	5	Switched Capacitor Converter	
09/16	Mon	6	Switched Capacitor Converter	
09/18	Wed	7	Switched Capacitor Converter	
09/23	Mon	8	Duality	HW #2 due / HW #3 out
09/25	Wed	9	Duality	
09/30	Mon	10	State Plane Analysis	HW #3 due / HW #4 out
10/02	Wed	11	State Plane Analysis	
10/07	Mon	12	Interleaving	
10/09	Wed	13	Resonant Converters	
10/14	Mon	14	Core Factor and Core Area Product	HW #4 due / HW #5 out
10/16	Wed	15	Magnetic Diffusion	
10/21	Mon		Review for Midterm Exam	
10/23	Wed		Midterm Exam (75 Minutes, Classroom)	
10/28	Mon	16	Magnetic Winding Loss	HW #5 due
10/30	Wed	17	Magnetic Winding Loss	
11/04	Mon	18	Magnetic Core Loss	
11/06	Wed	19	Magnetic Core Loss	
11/11	Mon		Veteran's Day - No Class	
11/13	Wed	20	Transformer Modeling	
11/18	Mon	21	Transformer Modeling	
11/20	Wed	22	Magnetic Circuit	
11/25	Mon	23	Magnetic Circuit	
11/27	Wed		Thanksgiving - No Class	
12/02	Mon	24	Magnetic Saturation	
12/04	Wed	25	Coupled Filters / Parasitic Cancellation	
12/11 Wed, 12:30 PM			Final Presentation (2 Hours, CAPS 3rd Floor)	Syllabus Version: August 19, 2024
12/17 Tue			Letter Grade Available on Registrar	