

ECE 6234: Design and Process Integration for Wide Band Gap Power Devices

Course Description

Design and processing of wide band gap power devices (including SiC, GaN and ultra wide band gap semiconductors) and reliability considerations. 2D device simulations, layout considerations for power chip design, optimization of performance and reliability/qualification for various voltage ranges from 600 V to 15 kV.

Prior Course Number: 6194.08

Transcript Abbreviation: Des & Proc WBG Dev

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Graduate

Student Ranks: Masters, Doctoral

Course Offerings: Spring

Flex Scheduled Course: Never

Course Frequency: Every Year

Course Length: 14 Week

Credits: 3.0

Repeatable: No

Time Distribution: 3.0 hr Lec

Expected out-of-class hours per week: 6.0

Graded Component: Lecture

Credit by Examination: No

Admission Condition: No

Off Campus: Never

Campus Locations: Columbus

Prerequisites and Co-requisites: Grad standing in engineering or physics.

Exclusions:

Cross-Listings:

Course Rationale: Update and expand curriculum to include design of modern power devices.

The course is required for this unit's degrees, majors, and/or minors: No

The course is a GEC: No

The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001

Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Provide an introduction to basic operation of WBG power devices
Students master design principles and 2D simulations of power devices

Students become competent with layout of power device chips
Students are exposed to the processing details of power devices
Students become familiar with reliability and qualification of power devices

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Review of semiconductor basics	4.0							
Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT	4.0							
2D simulations of 1700 V SiC Schottky Barrier Diode, DMOSFETS and 600 V GaN HEMT and design considerations for edge termination, dv/dt, short circuit time, avalanche ruggedness, design for HTRB, optimization of on-resistance etc.	9.0							
Process Integration: Overall process sequence for SiC Schottky Diode, SiC MOSFET and GaN HEMT and unit processes	9.0							
Layout of the 1700 V SiC Schottky Barrier Diode, DMOSFET and 600 V GaN HEMT	9.0							
Misc. Topics: Thermal and yield considerations, qualification and reliability, cost of manufacturing, availability of substrates and epilayers, worldwide manufacturing of SiC and GaN devices and supply chain	5.0							

Representative Assignments

Homework problems are assigned

Grades

Aspect	Percent
Homework	50%
Final Take Home Project	50%

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
*	a	An ability to apply knowledge of mathematics, science, and engineering.
*	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
***	c	An ability to design a system, component, or process to meet desired needs.
	d	An ability to function on multi-disciplinary teams.
**	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.

Course Contribution		College Outcome
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Additional Notes or Comments

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