ECE 7032: Physical Electronics of Advanced Semiconductor Devices

Course Description

MOSCAPs, Gated Diode, CMOS Bulk/SOI Transistors, Photodiodes, Carrier Transport/Storage, Scaling, Mobility, CCDs, CMOS, EEPROMs, SiGe, SiC, ISFETs, BJTs, Noise and Modeling.

Prior Course Number: 894, 8194.04
Transcript Abbreviation: Adv Semicond 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: Prereq: 5530 (730) or 6531.
Exclusions: Not open to students with credit for 894 (Spring 12, Class number 26147) or 8194.04.
Cross-Listings:

Course Rationale: Train graduate students in advanced semiconductor topics.

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

Course Goals

Students learn about quantum effects of device scaling on performance and reliability
Students learn modeling of MOS transistors, CCDs, EEPROMs and other devices
Students learn measurement techniques for device characterization

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Historical overview: MOSCAP, gated diode, high-K dielectrics, amphoteric traps	7.0							
Generation-recombination theory, equilibrium, non-equilibrium, steady-state and non-steady-state, conductance, surface recombination boundary conditions	4.0							

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
CCDs, carrier transport and operation, transfer efficiency, charge control model	4.0							
CMOS transistors (bulk, SOI, mobility, transconductance, subthreshold operation, SPICE modeling, short-channel and narrow-width effects, surface and buried channel devices, propagation delay, ion-sensitive FETs (ISFETs), hot carrier injection	7.0							
Charge pumping, interface and dielectric traps	3.0							
Physics of tunneling- floating gate and SONOS EEPROMs	4.0							
Theory of drift-field bipolar junction transistors (BJTs)	4.0							
SiGe FETs and SiC devices	3.0							
Advanced research topics (e.g. mobility, surface roughness, Coulomb scattering, noise)	3.0							

Grades

Aspect	Percent
Homework	60%
Midterm Exam	20%
Final exam	20%

Representative Textbooks and Other Course Materials

Title	Author
Course notes and selected papers from the literature	

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.
	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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