Washington State University
MAJOR CURRICULAR CHANGE FORM - - NEW/RESTORE COURSE

- ☐ **Please attach rationale for your request, a complete syllabus**, and explain how this impacts other units in Pullman and other campuses (if applicable).
- ☐ **Obtain all required signatures with dates.**
- ☐ **Provide original stapled packet of signed form/rationale statement/syllabus** PLUS **10 stapled copies** of complete packet to the **Registrar's Office**, campus mail code 1035.
- ☐ **Submit one electronic copy of complete packet** to wsu.curriculum@wsu.edu.

Requested **Future** Effective Date: Fall 2016 (term/year) Course Typically Offered: Spring

DEADLINES: For fall term effective date: **October 1st**; for spring or summer term effective date: **February 1st**. See instructions.

NOTE: Items received after deadlines may be put to the back of the line or forwarded to the following year. Please submit on time.

☒ **New Course** ☐ Temporary Course ☐ **Restore Course**

ECE	586	Solid State Device Design and Modeling
course subject/crosslist	course no.	title

3	(3	0)	None
Credit hrs	lecture hrs per week	lab or studio hrs per week	prerequisite

Description for catalog: Design and modeling of solid-state devices such as PN diode, BJT and MOSFET. Simulation and device design using TCAD tools for physical modeling and fabrication process integration.

Additional Attributes: Check all that apply.

☐ Crosslisting (between WSU departments)* ☐ Conjoint listing (400/500):_____

☐ Variable credit:_____ ☐ Repeat credit (cum. max. hrs):_____

Special Grading: ☐ S, F; ☐ A, S, F (PEACT only); ☐ S, M, F (VET MED only); ☐ H, S, F (PHARMACY, PHARDSCI only)

☐ Cooperative with UI ☐ Other (please list request): _____

The following items require prior submission to other committees/depts. (SEE INSTRUCTIONS.)

☐ Request to meet Writing in the Major [M] requirement **(Must have All-University Writing Committee Approval.)**

☐ Request to meet UCORE in _____ **(Must have UCORE Committee Approval › › See instructions.)**

☐ Special Course Fee_____ **(Must submit request to University Receivables.)**

Contact: Feng Zhao Phone number: (360) 546-9187 Campus mail code:_____

Email: feng.zhao@wsu.edu Instructor, if different:_____

8/28/15	8/31/15	
Chair/date	**Dean/date**	**All-University Writing Com / date**
Chair (if crosslisted/interdisciplinary)*	**Dean (if crosslisted/interdisciplinary)***	**UCORE Committee Approval Date**
Catalog Subcommittee Approval Date	**GSC or AAC Approval Date**	**Faculty Senate Approval Date**

***If the proposed change impacts or involves collaboration with other units, use the additional signature lines provided for each impacted unit and college.**

ECE 586 Solid State Device Design and Modeling

Rationale

This course is being created in order for students to understand the fundamental principle and theory of semiconductor devices, and learn device design and modeling techniques using TCAD software commonly used in semiconductor industry. The knowledge is central to a student targeting a career in the area of semiconductor device engineering.

It does not affect other units in Pullman and other campuses.

ECE 586 Solid State Device Design and Modeling
Course Syllabus

Description: Design and modeling of solid-state devices such as PN diode, BJT and MOSFET. Simulation and device design using TCAD tools for physical modeling and fabrication process integration.

Credits: 3

Prerequisite: Graduate standing

Prerequisite by Topic: None

Required Texts: Semiconductor Physics and Devices, Donald A. Neamen, 3rd edition, McGraw Hill Higher Education, ISBN-10: 0071231129; ISBN-13: 978-0071231121

Instructor: Dr. Feng Zhao

Office: VECS 201P
Phone: (360) 546-9187
Email: feng.zhao@wsu.edu
Office hours: Thursday 2:00pm-3:00pm
Lectures: VECS 104, MW 10:00am-11:15am

Course Description

This course teaches student how to apply semiconductor device principles to design pn diode, BJT, and MOS devices, obtain desired device characteristics, use device simulation software to predict device model parameters, and integrate and simulate various processing steps to obtain desired device geometry and characteristics.

Course Procedures

There will be three hours of lecture each week. Reading and homework from the required textbook will be assigned. In addition, two projects on design and modeling of (1) pn diode and (2) MOSFET device will be assigned.

Attendance Policy

Lecture attendance is highly encouraged but not required. Students are nevertheless responsible for knowing any and all material presented in lecture.

Website

All course materials (lecture notes, assignments, etc.) will be available on the course Blackboard website at https://learn.wsu.edu/.

Learning Outcomes and Assessment

Student Learning Outcomes for this Course: **At the end of the course, the students should be able to:**	**Course Topics/Dates:** **The following date(s) will address this outcome :**	**Evaluation of Outcome :** **This outcome will be primarily evaluated by:**
Students will have a depth of understanding in physics of solid state devices including P-N diode, BJT and MOSFET.	Week 1-4, 8, 10, 11	Homework, exam
Students will have knowledge in solid state device fabrication technology.	Week 5, 12	Homework, exam
Students will be able to use software to assist solid state device design, and both physics based and fabrication based modeling.	Week 6, 9, 13	Projects
Students will be able to present results of modeling projects through oral presentations and project reports	Week 7, 14	Project presentations, project reports

Composition of final grade

The course grade will be determined by four verification project assignments as follows:

1. Project assignments	25%
2. Homework	20%
3. Midterm	25%
4. Final exam	30%
Total	100%

Grading Scale (% of total score)

A	94-100	B	83-86	C	73-76	D	60-66
A-	90-93	B-	80-82	C-	70-72	F	< 59
B+	87-89	C+	77-79	D+	67-69		

Grades will be rounded up to the next point as letter grades for the course are assigned at the end.

Make-up Exam/Assignment Policy

All homework assignments are due on the specified due date in class. Late returns within 2 days will be accepted with 50% of points taken off automatically. No late returns more than 2 days will be accepted.

No make-up exam, assignments or quizzes will be given unless a medical or other emergency was the reason for missing the exam or the assignment. For any other reason you must first contact the instructor **before** missing an exam, a quiz or an assignment.

Design Project

During the semester, students will work on two term projects on design and modeling of (1) pn diode and (2) MOSFET. Specific characteristics of the pn diode and MOSFET will be provided by the lecturer, and students will use TCAD software to design the device parameters, model the devices, and simulate the results to satisfy the specifications. Report for each project will be submitted. Students will also give presentation for each project.

Project 1: Use TCAD software to design a silicon p-n diode with a specified capacitance in thermal equilibrium, and also satisfy a specified maximum electric field value at a specified reverse bias voltage. Each student will be given different values of these specified parameters by the lecturer to work out their own design. In the project report, students need to provide (1) schematic of the diode structure with doping density and geometry, (2) forward and reverse I-V characteristics, (3) C-V curve, and (4) distribution of the electric field in the diode at the specified reverse bias voltage. Project 1 will be assigned in Week 5 and report is due in Week 7.

Project 2: Use TCAD software to design a silicon MOSFET with a specified threshold voltage, and also satisfy a specified drain current at a specified drain-source voltage and gate-source voltage. Each student will be given different values of these specified parameters by the lecturer to work out their own design. In the project report, students need to provide (1) schematic of the MOSFET structure with doping density and geometry, (2) I_D-V_{DS} characteristics, (3) I_D-V_{GS} characteristics, and (4) distribution of the electric field in the MOSFET at the specified drain-source voltage. Project 2 will be assigned in Week 12 and report is due in Week 14.

Academic Integrity

Academic integrity is the cornerstone of the university. Any student who attempts to gain an unfair advantage over other students by cheating, will fail the assignment and be reported to the Office Student Standards and Accountability. Cheating is defined in the Standards for Student Conduct WAC 504-26-010 (3).

Student with Disabilities

Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please call the Access Center at (360) 546-9238 or van.access.center@wsu.edu. Accommodations may take some time to implement so it is critical that you contact the Access Center as soon as possible.

Emergency Notification System

WSU has made an emergency notification system available for faculty, students, and staff. Please register at zzusis with emergency contact information (cell, email, text, etc.). You may have been prompted to complete emergency contact information when registering for classes at RONet. In the

event of a building evacuation, a map at each classroom entrance shows the evacuation point for each building. Please refer to it. Finally, in case of class cancellation campus-wide, please check local media, the WSU Vancouver web page and/or http://www.flashalert.net/. Individual class cancellations may be made at the discretion of the instructor. Each individual is expected to make the best decision for their personal circumstances, taking safety into account. Safety plan website.

Audio, video, digital, commercial note-taking and other recording during class

Copyright 2015 Feng Zhao covers this syllabus, all lectures, and course-related written materials. During this course students are prohibited from making audio, video, digital, or other recordings during class, or selling notes to or being paid for taking notes by any person or commercial firm without the permission of the faculty member teaching this course.

ECE 586 Tentative Weekly Schedule

Week	Topics	Homework/Exam
1	Energy band structure, carrier concentrations	
2	Transport, generation-recombination	HW1
3	Non-equilibrium	
4	P-N Diode: Structure and principle of operation, electrostatic analysis, current, breakdown	HW2
5	P-N Diode fabrication technology	HW3, project #1 assigned
6	Diode modeling	
7	Project presentation	Midterm, project report #1 due
8	BJT: Structure and principle of operation, electrostatic analysis	HW4
9	BJT device modeling	
10	MOS capacitor: Structure and principle of operation, electrostatic analysis	HW5
	Spring break – no class	
11	MOSFET: Structure and principle of operation, electrostatic analysis	HW6
12	MOSFET fabrication technology	HW7, project #2 assigned
13	MOSFET modeling	
14	Project presentation	Project report #2 due
15	Final review	
16	Final exam	Final