

San José State University
Department of Electrical Engineering
EE 128, Physical Electronics, Section 01, Fall, 2009

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Office Hours:	M 12:45-3:15, T 12:45-3:15
Class Days/Time:	TR 10:30-11:45
Classroom:	ENGR 345
Prerequisites:	MatE 153, Co-Req EE122

Course Description

Review of semiconductor theory, Methods of device fabrication, p-n junctions, bipolar junction transistors field-effect transistors (FETS), MOSFETs , equivalent circuits.

Course Goals and Student Learning Objectives

For the students to be able to

- Demonstrate understanding of the characteristics and behaviors of semiconductor devices.
- Derive current-voltage characteristics of several key semiconductor devices such as diodes, bipolar junction transistors, and metal-oxide-semiconductor field-effect transistors.
- Show the ability to design simple semiconductor fabrication processes
- Explain how the equivalent circuits of basic semiconductor devices are created

Course Content Learning Outcomes

To be productive members of an industrial design/testing team students should be able to:

- Describe why a device operates as it does. (h)
- Explain how devices properties (height, length, width, doping, and temperature dielectric constant) affect device performance. (o)

- Design using analytical equations current gain for a BJT, and VT for a MOSFET .(c)
- Determine IV characteristic for a device. (o)
- Show operating regions of a device.(o)
- Determine failure mode of a device based on IV curves, and recommend fixes to failure mode. (e)
- Extract device models from measured data. (b)
- Model devices in spice (LTspice.) (b,k)
- Explain second order effects in semiconductor devices. (k)

ABET outcomes

The letters in parentheses in the course learning objectives refer to ABET criterion 3 outcomes satisfied by the course. These are listed below as a reference:

- (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
- (l) Specialization in one or more technical specialties that meet the needs of companies
- (m) Knowledge of probability and statistics, including applications to electrical engineering
- (n) Knowledge of advanced mathematics, including differential and integral equations, linear algebra, complex variables, and discrete mathematics
- (o) Basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components

Required Texts/Readings

Textbook

The main book for this course is *Solid State Electronic Devices* by Streetman and Banerjee, ISBN: 0-13-14926-X, Saddle River New Jersey, Prentice Hall (2006).

Classroom Protocol

Cell Phones:

Students will turn their cell phones off or put them on vibrate mode while in class. They will not answer their phones in class. Students whose phones disrupt the course and do not stop when requested by the instructor will be referred to the Judicial Affairs Officer of the University.

Computer Use:

In the classroom, students are allowed to use computers only for class-related activities. These include activities such as taking notes on the lecture underway, following the lecture on Web-based PowerPoint slides that the instructor has posted, and finding Web sites to which the instructor directs students at the time of the lecture. Students who use their computers for other activities or who abuse the equipment in any way, at a minimum, will be asked to leave the class and will lose participation points for the day, and, at a maximum, will be referred to the Judicial Affairs Officer of the University for disrupting the course. (Such referral can lead to suspension from the University.) Students are urged to report to their instructors computer use that they regard as inappropriate (i.e., used for activities that are not class related).

Academic Honesty:

Faculty will make every reasonable effort to foster honest academic conduct in their courses. They will secure examinations and their answers so that students cannot have prior access to them and proctor examinations to prevent students from copying or exchanging information. They will be on the alert for plagiarism. Faculty will provide additional information, ideally on the green sheet, about other unacceptable procedures in class work and examinations. Students who are caught cheating will be reported to the Judicial Affairs Officer of the University, as prescribed by [Academic Senate Policy S04-12](#).

“You are responsible for understanding the policies and procedures about add/drops, academic renewal, withdrawal, etc. found at <http://www2.sjsu.edu/senate/S04-12.pdf>

- Expectations about classroom behavior; see [Academic Senate Policy S90-5](#) on Student Rights and Responsibilities.
- As appropriate to your particular class, a definition of plagiarism, such as that found on Judicial Affairs website at <http://www2.sjsu.edu/senate/plagiarismpolicies.htm>
- “If you would like to include in your paper any material you have submitted, or plan to submit, for another class, please note that SJSU’s Academic Integrity policy

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drops, academic renewal, etc. [Information on add/drops are available at http://info.sjsu.edu/webdbgen/narr/soc-fall/rec-298.html](http://info.sjsu.edu/webdbgen/narr/soc-fall/rec-298.html). [Information about late drop is available at http://www.sjsu.edu/sac/advising/latedrops/policy/](http://www.sjsu.edu/sac/advising/latedrops/policy/). Students should be aware of the current deadlines and penalties for adding and dropping classes.

Assignments and Grading Policy

There will be two midterm exams and a final exam. Exams cover the assigned reading materials and class lecture notes. There will be no make-up exams (only in very special circumstances, both written excuse and official proofs are required for extraordinary exams). Exam solutions will be discussed in class after the exam dates and posted in the web site of the course. Homework will be given as follows. Some homework problems require the use of a computer to perform simulations.

- Homework/Quiz (10%): (-20% per day late) Students are encouraged to work in groups.
- Online Quiz 10%
- Exam 1 (25%): The first exam will cover diodes.
- Exam 2 (25%): The second exam will cover MOSFETS.
- Final Exam (30%): The final exam will cover BJT, MOSFETS and Diodes.

Grading Percentage Breakdown

94% and above	A
93% - 90%	A-
89% - 87%	B+
86% - 84%	B
83% - 80%	B-
79% - 77%	C+
76% - 74%	C
73% - 70%	C-
69% - 67%	D+
66% - 64%	D
63% - 60%	D-
below 60%	F

University Policies

Academic integrity

Students should know that the University's [Academic Integrity Policy is available at http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf](http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf).

Your own commitment to learning, as evidenced by your enrollment at San Jose State University and the University's integrity policy, require you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The website for [Student Conduct and Ethical Development](http://www.sa.sjsu.edu/judicial_affairs/index.html) is available at http://www.sa.sjsu.edu/judicial_affairs/index.html.

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include in your assignment any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Policy F06-1 requires approval of instructors.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the DRC (Disability Resource Center) to establish a record of their disability.

Course Schedule

Table 1 Course Schedule (Subject to change with fair notice as announced by instructor in class)

Class #	Date	Does The Class Meet?	Sections to Read	Items Due
1	8/25/2009	Yes	Intro, Green Sheet, 3.1	
2	8/27/2009	Yes	3.2-3.4	
3	9/1/2009	Yes	3.5, 4.3. 4.4	
	9/3/2009	No (Conference Day)		
4	9/8/2009	Yes	Oxidation of Silicon	HW1 DUE
5	9/10/2009	Yes	Diffusion into Silicon	
6	9/15/2009	Yes	Examples 1	
7	9/17/2009	Yes	Examples 2	
	9/22/2009	No (Furlough Day)		
8	9/24/2009	Yes	5.2	HW2 DUE
9	9/29/2009	Yes	5.3	
10	10/1/2009	Yes	5.4	
11	10/6/2009	Yes	5.5	

12	10/8/2009	Yes	5.6, 5.7	
13	10/13/2009	Yes	Extraction	
14	10/15/2009	Yes	Review HW	HW3 DUE
15	10/20/2009	Yes	Review for MIDTERM	
16	10/22/2009	Yes	MIDTERM #1	
17	10/27/2009	Yes	6.4.1, 6.4.2	
18	10/29/2009	Yes	6.4.3, 6.4.4	
19	11/3/2009	Yes	6.4.3, 6.4.4	
20	11/5/2009	Yes	6.4.5, 6.4.7, 6.5.1	
21	11/10/2009	Yes	6.5.8, 6.5.11	
22	11/12/2009	Yes	Midterm Review	HW4 due
23	11/17/2009	Yes	Midterm #2	
24	11/19/2009	Yes	7.1, 7.2	
25	11/24/2009	Yes	7.4	
	11/26/2009	No(Holiday)	7.5, 7.6	
26	12/1/2009	Yes	7.7	
27	12/3/2009	Yes	7.8	
28	12/8/2009	Yes	Review HW	HW5 due
29	12/14/2009	0945-1200	Final Exam	