San José State University  
Department of Electrical Engineering  
EE 128, Physical Electronics  

Section 01, Spring 2017

Instructor: Lili He  
Office Location: ENGR 357  
Telephone: (408) 924-4073  
Email: lili.he@sjsu.edu  
Office Hours: TuTh 1:45-2:45pm  
Class Days/Time: TuTh 10:30-11:45am  
Classroom: BSC 202  
Prerequisites: MatE 153 with a grade of "C" or better. PHYS 53 or PHYS 52.

Course Description

The course objective is for students to be able to understand characteristics and behavior of semiconductor devices. In the process, fundamental concepts in solid-state semiconductor physics are reviewed and applied to derive current-voltage characteristics of several key semiconductor devices such as diodes, bipolar junction transistors, and metal-oxide-semiconductor field-effect transistors. Methods of device fabrication are introduced.

Course Goals and Student Learning Objectives

GE/SJSU Studies Learning Outcomes (LO), if applicable

Upon successful completion of this course, students will be able to:

LO1 Demonstrate an understanding of the fundamentals of Electrical Engineering, including its mathematical and scientific principles, analysis and design.

LO2 Demonstrate the ability to apply the practice of Electrical Engineering in real-world problems.

Course Content Learning Outcomes

Upon successful completion of this course, students will be able to:

LO3 Describe fundamental concepts of solid-state physics applied to the semiconductor devices.
LO4 Explain general electrical behavior of semiconductor and construct appropriate physical models.

LO5 Illustrate structural details and current-voltage characteristics of diodes, BJT, and MOSFET.

LO6 Apply the fundamental understandings of semiconductor devices with knowledge on the limitations of physical models.

**Relationship of Course to Program Objectives**

This course supports the achievement of the following objectives (numbers in parentheses refer to specific ABET criteria).

(a) (3.a) an ability to apply knowledge of mathematics, science, and engineering
(b) (3.c) an ability to design a system, component, or process to meet desired needs
(c) (3.e) an ability to identify, formulate, and solve engineering problems
(d) (EE.3) a knowledge of advanced mathematics such as differential equations, differential and integral calculus, linear algebra and vector analysis.

**Required Texts/Readings**

d. Required and recommended texts.


**References**


*Physics and Technology of Semiconductor Devices*, by A.S. Grove, Wiley, 1967

**Classroom Protocol**

Students are expected to participate actively in class. Students will turn their cell phones off or put them on vibrate mode while in class. They will not answer their phones in class.
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/web-dbgen/narr/soc-fall/rec-298.html. Information about late drop is available at 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. Homework will be assigned and collected to evaluate effort.

<table>
<thead>
<tr>
<th>Grades</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>5%</td>
</tr>
<tr>
<td>Quiz and class participation</td>
<td>10%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>25%</td>
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<tr>
<td>Exam 2</td>
<td>25%</td>
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<tr>
<td>Final exam</td>
<td>35%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Grading Percentage Breakdown

- 90% and above: A
- 89% - 85%: A-
- 84% - 80%: B+
- 79% - 75%: B
- 74% - 70%: B-
- 69% - 65%: C+
- 64% - 60%: C
- 59% - 55%: C-
- 54% - 50%: D+
- 49% - 45%: D
- 44% - 40%: D-
- below 40%: 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. 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 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.
# EE128/Physical Electronics

## Spring 2017 Course Schedule

Schedule is tentative and subject to change

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/26</td>
<td>Class logistics, Energy bands</td>
<td>Chapter 3: 3.1-3.2</td>
</tr>
<tr>
<td>1/31 &amp; 2/2</td>
<td>Energy band and charge carriers in semiconductor</td>
<td>Chapter 3: 3.3-3.4</td>
</tr>
<tr>
<td>2/7 &amp; 2/9</td>
<td>Fermi distribution; Carrier concentration; Drift</td>
<td>Chapter 4: 4.1-4.2</td>
</tr>
<tr>
<td>2/14 &amp; 2/16</td>
<td>Excess carriers in semiconductors, Diffusion</td>
<td>Chapter 4: 4.3-4.4</td>
</tr>
<tr>
<td>2/21 &amp; 2/23</td>
<td>P-N Junctions: Fabrication; equilibrium conditions</td>
<td>Chapter 5: 5.1-5.2</td>
</tr>
<tr>
<td>2/28 &amp; 3/2</td>
<td>P-N Junctions: p-n junction operation; steady state reverse break down</td>
<td>Chapter 5: 5.3-5.4</td>
</tr>
<tr>
<td>3/7 &amp; 3/9</td>
<td>Review for 1st exam; 1st Mid-Exam 3/9/17(Thurs)</td>
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</tr>
<tr>
<td>3/14 &amp; 3/16</td>
<td>1st exam solution; P-N Junctions: transient; deviation from simple theory, MS and Hetero-junctions,</td>
<td>Chapter 5: 5.5-5.8</td>
</tr>
<tr>
<td>3/27 &amp; 3/31</td>
<td>Spring Recess</td>
<td></td>
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<tr>
<td>4/4 &amp; 4/6</td>
<td>MOS Fundamentals: MOS capacitor</td>
<td>Chapter 6: 6.4.2-6.4.7</td>
</tr>
<tr>
<td>4/11 &amp; 4/13</td>
<td>MOS FET: MOSFET Operation;</td>
<td>Chapter 6: 6.5.1-6.5.7</td>
</tr>
<tr>
<td>4/18 &amp; 4/20</td>
<td>MOSFET Characteristics</td>
<td>Chapter 6: 6.5.8-6.5.12</td>
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<tr>
<td>4/25 &amp; 4/27</td>
<td>Review for 2nd exam; 2nd mid-Exam, 4/20/17 (Thurs)</td>
<td></td>
</tr>
<tr>
<td>5/2 &amp; 5/4</td>
<td>2nd exam solution; Bipolar Transistor Fundamentals: amplification</td>
<td>Chapter 7: 7.1-7.3</td>
</tr>
<tr>
<td>5/9 &amp; 5/11</td>
<td>Bipolar Transistor Fundamentals: BJT operation; terminal currents; generalized biasing and switching, HBT</td>
<td>Chapter 7: 7.4-7.9</td>
</tr>
<tr>
<td>5/16</td>
<td>Review for final</td>
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**Final Examination:** Monday, May 22, 2017, 9:45-12:00pm
The Electrical Engineering Department will enforce the following Honor Code that must be read and accepted by all students.

“I have read the Honor Code and agree with its provisions. My continued enrollment in this course constitutes full acceptance of this code. I will NOT:

• Take an exam in place of someone else, or have someone take an exam in my place
• Give information or receive information from another person during an exam
• Use more reference material during an exam than is allowed by the instructor
• Obtain a copy of an exam prior to the time it is given
• Alter an exam after it has been graded and then return it to the instructor for re-grading
• Leave the exam room without returning the exam to the instructor.”

Measures Dealing with Occurrences of Cheating

• Department policy mandates that the student or students involved in cheating will receive an “F” on that evaluation instrument (paper, exam, project, homework, etc.) and will be reported to the Department and the University.
• A student’s second offense in any course will result in a Department recommendation of suspension from the University.