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

Section 01, Spring 2019

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: ENG 345
Prerequisites: MatE 153 with a grade of "C" or better.

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.

**ABET Student Outcomes**

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.

**Required Texts/Readings**

a. Required and recommended reference texts.


**References** (not required)


**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.

Grades

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Quiz and class participation</td>
<td>10%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>25%</td>
</tr>
<tr>
<td>Exam 2</td>
<td>25%</td>
</tr>
<tr>
<td>Final exam</td>
<td>30%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
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Grading Percentage Breakdown

- 94% and above: A
- 93% - 86%: A-
- 85% - 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 2019 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>1/24</td>
<td>Class logistics, Energy bands</td>
<td>Chapter 3: 3.1-3.2</td>
</tr>
<tr>
<td>1/29 &amp; 1/31</td>
<td>Energy band and charge carriers in semiconductor</td>
<td>Chapter 3: 3.3-3.4</td>
</tr>
<tr>
<td>2/5 &amp; 2/7</td>
<td>Fermi distribution; Carrier concentration; Drift</td>
<td>Chapter 4: 4.1-4.2</td>
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<tr>
<td>2/12 &amp; 2/14</td>
<td>Excess carriers in semiconductors, Diffusion</td>
<td>Chapter 4: 4.3-4.4</td>
</tr>
<tr>
<td>2/19 &amp; 2/21</td>
<td>P-N Junctions: Fabrication; equilibrium conditions</td>
<td>Chapter 5: 5.1-5.2</td>
</tr>
<tr>
<td>2/26 &amp; 2/28</td>
<td>P-N Junctions: p-n junction operation; steady state reverse break down</td>
<td>Chapter 5: 5.3 -5.4</td>
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<tr>
<td>3/5 &amp; 3/7</td>
<td>P-N Junctions: transient; deviation from simple theory, MS and Hetero-junctions,</td>
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<tr>
<td>3/12 &amp; 3/14</td>
<td>Review for 1st exam; 1st Mid-Exam 3/14/2019(Thurs)</td>
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<tr>
<td>3/19 &amp; 3/21</td>
<td>1st exam solution; MOS Fundamentals: transistor operation</td>
<td>Chapter 6: 6.1, and 6.4.1</td>
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<tr>
<td>3/26 &amp; 3/28</td>
<td>MOS Fundamentals: MOS capacitor</td>
<td>Chapter 6: 6.4.2-6.4.5</td>
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<tr>
<td>4/1 to 4/5</td>
<td>Spring Recess</td>
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<tr>
<td>4/9 &amp; 4/11</td>
<td>MOSFET: MOSFET Operation;</td>
<td>Chapter 6: 6.5.1-6.5.7</td>
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<tr>
<td>4/16 &amp; 4/18</td>
<td>MOSFET: MOSFET Characteristics</td>
<td>Chapter 6: 6.5.8-6.5.12</td>
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<tr>
<td>4/23 &amp; 4/25</td>
<td>Review for 2nd exam; 2nd mid-Exam, 4/24/18 (Thurs)</td>
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<tr>
<td>4/30 &amp; 5/2</td>
<td>2nd exam solution; Bipolar Transistor Fundamentals: fabrication, amplification</td>
<td>Chapter 7: 7.1-7.3</td>
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<tr>
<td>5/7</td>
<td>BJT operation terminal currents; generalized biasing and switching, HBT</td>
<td>Chapter 7: 7.4-7.9</td>
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<tr>
<td>5/9</td>
<td>5/9 Review for final</td>
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**Final Examination:** Thursday, May 16, 2019, 9:45-12:00pm
EE Department Honor Code

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.