

ECE 542: Semiconductor Device Fundamentals  
Spring 2020

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Office Hours: Mondays 11 am – noon  
Or by appointment: Contact me!

Lecture: M W F 10:00 – 10:50  
WS 108

Text: Operating Principles of Semiconductor Devices, S. McNamara, ISBN-13:  
9781530354061.

Alternative Reading:

1. <http://ecee.colorado.edu/~bart/book/book/title.htm>  
This website is free and contains a lot of good information.
2. Solid State Electronic Devices; 7<sup>th</sup> edition, B.G. Streetman, Prentice Hall  
This is the textbook that I previously used for this class.

Description: This is the first course on semiconductor device physics. The physics of electronic transport in semiconductors will be presented, followed by a description of the following: MOSFETs, diodes, solar cells, LEDs, and IGBTs.

Grading:

Daily Quiz	10 %	(best 34/37)
Weekly Homework:	30 %	(best 14/15)
Exam #1:	15 %	
Exam #2:	15 %	
Exam #3:	15 %	
Final Exam:	15 %	

Daily Quiz: There will be an assigned reading assignment for every class to help prepare you for the class activities. A short quiz will be given at the beginning of each class based upon this reading. The score of the lowest three daily quizzes will be dropped. There will be no make-up quizzes.

Weekly HW: There will be a weekly homework assignment. Typically, you should hand in your homework in class. However, if you need more time, you may submit it at any time that day. Late assignments will be accepted at a penalty of 10% per day. You may work with other students on the homework, but do not copy from

another student or from homework solutions obtained elsewhere. The score of the lowest homework assignment will be dropped.

Exams: There will be three mid-term exams and a final. The mid-terms will be in class, and the final will be at the University specified time. No books or notes are allowed for the exams. A formula sheet will be provided. A copy of the formula sheet will be handed out prior to the exam. Calculators are permitted, but I request that you do not use them to store equations or text.

Grades: Grades will be assigned on a plus/minus scale.

A+	Top Student
A	90 – 100
A-	88 – 90
B+	85 – 88
B	80 – 85
B-	78 – 80
C+	75 – 78
C	70 – 75
C-	68 – 70
D	60 – 68
F	< 60

Copying: Please do not copy. It is exceedingly easy to tell who works together. It is also exceedingly easy to tell when students copy. The first incident will result in a zero for the assignment and a warning. The second incident is grounds for lowering the final grade a full mark (i.e., B -> C), a failing grade, and/or referral to the academic integrity committee.

Modified Schedule: If the course schedule must be modified, such as for cancelled classes due to snow, then a best effort will be given to cover all topics. If fewer than 15 homeworks are assigned, the lowest will still be dropped. If an exam is canceled, then the weighting of the exams will be evenly distributed as 60% divided by the number of exams.

### **Title IX/Clery Act Notification**

Sexual misconduct (including sexual harassment, sexual assault, and any other nonconsensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain **confidential** support from the PEACC Program (852-2663), Counseling Center (852-6585), and Campus Health Services (852-6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (852-5787) or University of Louisville Police (852-6111).

Disclosure to **University faculty or instructors** of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is **not confidential** under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the University's Title IX officer.

For more information, see the Sexual Misconduct Resource Guide (<http://louisville.edu/hr/employeerelations/sexual-misconduct-brochure>).

Date	Week No.	Note: Reading Assignments are to be completed before class.
Jan. 6	1	M: W: Read: Ch.1, Ch.2, Ch. 3.1, 3.2 (no quiz) F: Read: Ch. 3.3, 3.4
Jan. 13	2	M: <b>HW #1</b> Due. Read: 3.5, 3.6 W: Read 3.7, Review F: Read: 3.8, 3.9, 3.10, 3.11
Jan. 20	3	M: <b>No class. MLK Holiday</b> W: <b>HW #2</b> Due. Read: 4.1, 4.2, 4.3, 4.4 F: Read: 4.5, 4.6, 4.7, 4.8
Jan. 27	4	M: <b>HW #3</b> Due. Read: 4.9 W: <b>Exam #1</b> F: Read: 5.1, 5.2
Feb. 3	5	M: Read 5.3 W: <b>HW #4</b> Due. Read 5.4 F: Read 5.5
Feb. 10	6	M: <b>HW #5</b> Due. Read 5.6.1 W: Read 5.6, 5.7 F: Read 5.8
Feb. 17	7	M: <b>HW #6</b> Due. Read 5.9 W: <b>Exam #2</b> F: Read 6.1
Feb. 24	8	M: Read 6.2 W: <b>HW #7 Due.</b> Read 6.3, 6.4 F: Read 6.5, 6.6
Mar. 2	9	M: <b>HW #8 Due.</b> Read 6.7 W: Read 6.8, 6.9 F: Read 6.10
Mar. 9	10	Spring Break
Mar. 16	11	M: <b>HW #9</b> Due. Read 7.1 W: Read 7.2 F: Read 7.3, 7.4
Mar. 23	12	M: Read 7.5 W: <b>HW #10</b> Due. Read 8.1, 8.2 F: <b>Exam #3</b>

Mar. 30	13	M: Read 9.1, 9.2 W: Read 9.3, 9.4 F: Read 10.1, 10.2
Apr. 6	14	M: <b>HW #11</b> Due. Read 10.3 (skip 10.4) W: Read 10.5, 10.6 F: Read 10.7
Apr. 13	15	M: <b>HW #12</b> Due. Read 10.8, 10.9, 10.13 (skip 10.10 - 10.12) W: Read 11.1, 11.2.1, 11.2.2 F: Read 11.2 (finish section)
Apr. 20	16	M: <b>HW #13</b> Due. Last day of classes. Read 11.3, 11.4, 11.5. T: <i>Reading Day</i>
Apr. 24		<b>Final Exam, 8:00 am – 10:30 am</b>

**At the completion of ECE 542, the student should be able to accomplish the following:**

1. Draw band diagrams for doped and undoped semiconductors.
2. Calculate carrier concentrations using the Fermi distribution function.
3. Calculate current density and conductivity.
4. Describe band diagrams, charge density, electric field and potential distribution for a pn junction.
5. Describe pn-junction current-voltage characteristics and variation of pn junction parameters with bias.
6. Calculate junction breakdown voltages for pn junctions.
7. Describe solar cell operation.
8. Describe MOSFET operation.
10. Describe IGBT operation.
11. Use probability and statistics to calculate yield information for integrated circuits.