

EEE 3396c Solid State Electronic Devices

(Fall, 2020, MWF 6, 12:50-1:40pm)

Goals: To present the theoretical and practical background of device physics so that students understand and are able to design and optimize the charge transport properties of semiconductor materials and devices.

Instructor: Dr. Jing Guo (NEB 551, guoj@ufl.edu)

TA: Colleen Weller (colleenweller@ufl.edu)

Text (required):

"Solid State Electronic Devices," 7th Edition by Ben Streetman and Sanjay Banerjee, published by Pearson, Prentice Hall

References:

Semiconductor Device Fundamentals

Pierret, Robert F.

Addison-Wesley, 1996

Office hours:

Dr. Guo: 2-4pm, Mon. or by email appointment (NEB551), Email: guoj@ufl.edu

TA: TBD

Topics:

Crystal Properties of Semiconductors - Chap. 1

Semiconductor materials

Crystal Lattices

Charge Carriers in Semiconductors- Chap. 3

Energy Band Model

Bonding Model

Carrier Energy Distributions

Carrier Concentrations

Fermi Level in Equilibrium

Carrier Drift in Electric Fields

Excess Carriers in Semiconductors -Chap. 4

Optical Absorption & Recombination

Carrier Lifetime & Photoconductivity

Quasi-Fermi Levels

Carrier Diffusion

Drift & Diffusion

Einstein Relation

Junctions- Chap.5

Contact Potential

Forward & Reverse Bias

Diode Equation

Reverse Bias Breakdown

Junction Capacitance

Field-Effect Transistors - Chap.6

MOSFET Basic Concepts

Ideal MOS Capacitor

Threshold Voltage

Capacitance vs. Gate Voltage

Real Surface Effects

MOSFET Voltage/Current Relations

Frequency Response

Bipolar Junction Transistors-Chap. 7

BJT Basic Concepts

Current Distribution Diagrams

Emitter Injection Efficiency

Current Amplification Factor

Base Charge Transit Time/Lifetime

Common Emitter Amplification

Optoelectronic Diodes - Chap. 8

Photodetectors

Solar Cells

Light Emitting Diodes (LEDs)

Labs (NEB 289, Lab attendance, lab quiz and lab report required)

Periods: R 9-10 (NEB 289), M E2-E3 (NEB 289, T 11-E1 (NEB 289)

- (1) Lab on bandstructure of semiconductor materials
- (2) Lab on fabrication technology and process simulation
- (3) Lab on PN junction
- (4) Lab on Metal-Oxide-Semiconductor Capacitors
- (5) Lab on MOSFETs.
- (6) Lab on LED

Grading:

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- (1) Homework (10%): 8 homework sets, highest 7 count.
- (2) Labs (25%): 5 labs.
Lab quiz, attendance, and reports are required.
- (3) Midterm Exam (25%), in class, **Oct. 28, 2020**
- (4) Final Exam (40%): **7:30-9:30am, Dec. 16, 2020.**

The overall class average will determine the B-/ B breakpoint. The A range will start one standard deviation above this point, the C- range one standard deviation below.

5) Make-up Exam Policy

University attendance policies can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> (Links to an external site.).

If you have a University-approved excuse and arrange for it in advance, a make-up test will be arranged. The student must submit a written petition to the instructor one week prior to the scheduled exam with the supporting document, and the instructor must approve the petition. The make-up test will be comprehensive and arranged after the Final Exam date, with an equal or greater difficulty level. If the deadline for finalizing the grade cannot be met, it will result in an “Incomplete” grade and the make-up exam will be arranged in the next semester.

Partial credit:

The following policy for test and quiz partial credit applies.

1. All requests for partial credit should be directed, **in writing and documented**, to Prof. Jing Guo within one week after the work has been returned.
2. You will only receive credit for work handed in for grading.
3. You cannot receive full credit for wrong answers.

Computer, Equipment, and Tools Requirements:

<https://www.ece.ufl.edu/academics/undergraduate/advising/computer-equipment-and-tools-requirements/>

Academic Honesty Statement:

All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others.

Course Summary:

| Date | Details | |
|------------------|---|-------------------|
| Mon Aug 31, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Sep 2, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Sep 4, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Sep 7, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Sep 9, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Sep 11, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Sep 14, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Sep 16, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Sep 18, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Sep 21, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Sep 23, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Sep 25, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Sep 28, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Sep 30, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Oct 2, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Oct 5, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Oct 7, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Oct 9, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Oct 12, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Oct 14, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |

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| Fri Oct 16, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Oct 19, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Oct 21, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Oct 23, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Oct 26, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Oct 28, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Oct 30, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Nov 2, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Nov 4, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Nov 6, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Nov 9, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Nov 11, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Nov 13, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Nov 16, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Nov 18, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Nov 20, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Nov 23, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Nov 25, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Nov 27, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Nov 30, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |

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| Wed Dec 2, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Dec 4, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Dec 7, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Wed Dec 9, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Fri Dec 11, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |
| Mon Dec 14, 2020 | Calendar Event EEE3396C-0001,0002(11948,11949) - Solid State Electron | 12:50am to 1:50am |