

Department of Electrical and Computer Engineering

Course **Solid State Electronics ECE 511** **Fall, 2023**

- Books:**
- **Physics of semiconductor devices (third edition) by S. M. Sze, Kwok K. Ng. (reference book),** ISBN-13: 978-0-471-14323-9, ISBN-10: 0-471-14323-5
 - **Physics of Semiconductor devices by Michael Shur (textbook)**
ISBN-13: 978-0136664963

A. Course Description

The course introduces physics of semiconductor devices. It covers fundamental aspects of semiconductor physics necessary for understanding operation principles and characteristics of semiconductor diodes and transistors.

B. Grading

Attendance	15%
Midterm	45%
Project (execution, report, presentation)	40%

C. Prerequisites

Prerequisite: BS in Physical Sciences or Electrical Engineering

D. Student Responsibilities

Each student is expected to:

1. Complete assigned **readings** and **homework**
2. **Participate** in classroom activities
3. Successfully complete the **Midterm Exam and the Project**

E. Content

Basic Semiconductor Physics

Fundamentals of semiconductor devices

- Introduction (Lecture 1)
- Semiconductor crystals lattices (Lecture 2)
- Semiconductor band diagram.
- Statistics of electrons and holes. (Lecture 3)
- Electron and hole transport in semiconductors (Lecture 4)
 - Time and length scales of the electrons in solids
 - Drift-diffusion approximation
- Recombination processes.

p-n Junctions, Schottky Barrier Junctions

- P-N junction and P-N diodes (Lecture 5, 6)
- Bipolar transistor (Lecture 7)
- Schottky Barrier Junctions and Schottky diodes (Lecture 8-9)
- MESFET

Metal-Insulator-Semiconductor (MIS) contact

- MIS capacitor (Lecture 9-10)
- Metal –Oxide-Semiconductor (MOS) diode (Lecture 10)
- MOSFET
- Photodetectors (Lecture 11)
- CCD (Lecture 12)

F. Objectives

The course intends to give students a broad understanding of fundamentals, and applications of semiconductor devices.

After taking this course, students should be able to:

- Understand physics of semiconductors;
- Use knowledge of semiconductor physics for understanding characteristics of specific semiconductor structures and devices based on these structures;
- Understand physical processes which underlay equivalent circuits of semiconductor diodes and transistors
- Apply theoretical concepts and basic formulas to solving homework problems;
- Continually develop in life skills of:
 - Making reasonable assumptions which enable solving technical problems in optimum way
 - Reading and understanding books and journal publications in the field of semiconductor devices
- Study and analyze literature, make oral presentation, write formal report.

DISABILITY SUPPORT SERVICES (DSS) STATEMENT (must be the following language)

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

[In addition, this statement on emergency evacuation is often included, but not required:

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website: <http://www.stonybrook.edu/ehs/fire/disabilities>]

ACADEMIC INTEGRITY STATEMENT (must be the following language as approved by the undergrad council):

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at

<http://www.stonybrook.edu/uaa/academicjudiciary/>

CRITICAL INCIDENT MANAGEMENT (must be the following language as approved by the undergrad council):

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.