

MTSE-4070 ELECTRONIC MATERIALS

Spring 2026 Syllabus

Introduce the students to advanced concepts of Electrical Conduction, Modern Theory of Solids and fundamental properties of Semiconductors. Students will learn (1) the principle and operation of basic Semiconductor Devices such as Thermoelectrics, Piezoelectrics, Light Emitting Diodes (LEDs), Solar Cells, and (2) basic Integrated circuit Fabrication processes.

Professor: El Bouanani
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Office Hours: Wednesdays 10:00 AM – 12:00 PM or via appointment
Class Hours: Tuesdays/Thursdays 10:00 AM – 11:20 AM Class Location: Discovery Park; B157

Textbook: *Principles of Electronic Materials and Devices*, 3rd Edition by S.O. Kasap,
ISBN: 0-07-295791-3

The Instructor will supply complementary handouts.

Suggested reference text books:

Electronic Properties of Materials, by Rolf E. Hummel (3ed Edition,
Springer, New York, 2000)

Microchip manufacturing, by S. Wolf, ISBN: 0-9616721-8-8

Homework: The purpose of the homework is to aid in learning the material. Although some collaboration among students in preparing the homework is acceptable, the main work should be primarily yours. Late homework will not be accepted.

MIDTERM EXAMS: 03/05/2026 LOCATION: Discovery Park; B157 10:00-11:30 AM

04/23/2026 LOCATION: Discovery Park; B157 10:00-11:30 AM

FINAL EXAM (Comprehensive) 05/07/2026 LOCATION: Discovery Park; B157 7:30-9:30 AM

Grading plan:

Homework: 20%

Quizzes: 10%

Midterm Exams: 30%

Comprehensive Final Exam: 40%

If a student's grade in the comprehensive Final Exam is higher than the above grading plan, it will be used as the course grade on the condition that all HWs, Quizzes and Mid Term Exams are taken.

1. Quizzes and Exams are closed book. Pop-up quizzes will not be announced.
2. Final comprehensive exam will cover all chapters
3. Attendance of the class is required.
4. Make-up Policy: Make-up tests for quizzes will not be allowed under any circumstance.

Use of laptops, iPads, tablets, and cell phones is not allowed during class.

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Spring 2025 Syllabus

Topics:

- I. Elementary Concepts and Electrical Conduction**
- II. Modern Theory of Solids**
 - Band theory of solids,
 - Density of states,
 - Boltzmann and Fermi-Dirac statistics,
 - Electron effective mass and Fermi Energy,
- III. Semiconductors:**
 - Intrinsic and Extrinsic semiconductors,
 - Degenerate semiconductors,
 - Recombination and minority carrier injection,
 - Schottky Junctions and Ohmic Contacts.
- IV. Semiconductor Devices:**
 - Basics of a p-n junction,
 - Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET),
 - Thermoelectrics,
 - Piezoelectrics,
 - Light Emitting Diodes (LEDs) and Solar Cells.
- V. IC fabrication: brief overview**
 - Integrated-circuit types,
 - Overview of semiconductor manufacturing and silicon wafer production,
 - Thin films depositions,
 - Diffusion and ion implantation,
 - Oxidation,
 - Plasma processing,
 - Lithography

Relationship to program Objectives:

The course is integral to program objectives 1 and 2. It provides student opportunities to learn (1) advanced concepts governing electronic materials properties of inorganic conductors, semiconductors, and insulators and (2) how these electronic materials can be combined in wide range of device applications from transistors to energy conversion.