

# MTSE-4070 ELECTRONIC MATERIALS

## Spring 2020 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  
Office: E-111 Discovery Park Phone: 940-369-8109 E-Mail: bouanani@unt.edu  
Office Hours: Tuesdays 9:00 AM – 11:00 AM or via appointment  
Class Hours: Wednesdays 2:30 PM -5:20 PM Class Location: Discovery Park; D212

**Textbook:** *Principles of Electronic Materials and Devices*, 3<sup>rd</sup> 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:**                    **03/04/2020** LOCATION: Discovery Park; D212 2:30-4:30 PM  
    **04/15/2020** LOCATION: Discovery Park; D212 2:30-4:30 PM

**FINAL EXAM (Comprehensive)** **05/06/2020** LOCATION: Discovery Park; D212 1:30-3:30 PM

### 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.**

# MTSE-4070 ELECTRONIC MATERIALS

## Spring 2020 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 pn 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.