# EC210- Solid State Electronics

## CREDIT HOURS

3 Hours

## CONTACT HOURS (Hours/week)

Lecture: 2; Tutorial: 2; Lab: 2

## COURSE COORDINATOR

Dr. Amr Byoumi

## TEXT BOOK

S. O. Kasap, Principles of Electronic Materials and Devices, 3rd Edition, McGraw-Hill 2006

## COURSE DESCRIPTION

Elementary materials science concepts: Atomic structure, Bonding and types of solids, the crystalline state, lattice vibrations, the Hall Effect and Hall devices. Quantum mechanics: photons, particles and waves, the electron as a wave, infinite potential well, Heisenberg's uncertainty principle, Tunneling phenomenon (potential barrier). The band theory of solids: .E-K diagram, energy bands diagram, Electrons and holes, effective mass Semiconductors: Intrinsic semiconductors, Extrinsic semiconductors (n-type doping, p-type doping, compensation doping), Electron and holes Concentrations, Fermi energy level position, Conductivity of a semiconductor, Diffusion and conduction currents equations. Definitions for dielectric and magnetic materials and superconductivity.

## PREREQUISITE:

BA114, BA118

## RELATION OF COURSE TO PROGRAM

Required

## COURSE INSTRUCTION OUTCOMES

The knowledge of the fundamental principles is described in this course; the student will be able to follow the theoretical details of the advanced-level courses.

## TOPICS COVERED

- General introduction for the course contents and the grading system.
- Atomic structure, Molecules and general bonding principles.
- Types of crystals models.
- Covalent Bond, Metallic Bond, Ionic Bond
- Miller indices: crystal directions and planes.
- The dispersion relationship of a mono atomic lattice vibrations, phase and group velocities.
- Particles and waves
- De Broglie relationship, time independent Schrödinger equation, Heisenberg's uncertainty principle.

- Application on Schrödinger equation (Infinite potential well: A confined electron)
- Application on Schrödinger equation (Tunneling phenomenon: Quantum leak)
- Energy Band theory of solids: (energy bands, effective mass, concept of a hole)
- (Semiconductors) Intrinsic semiconductors (Si crystal and energy band diagram, electrons and holes, conduction in semiconductors, electrons and holes concentrations).
- (Semiconductors ) Extrinsic semiconductor: (n-type doping, p-type doping, compensation doping) and carriers concentrations. Fermi energy level position.
- Semiconductor conductivity and resistivity.
- Semiconductors (Diffusion and conduction current equations).

**CONTRIBUTION OF COURSE TO MEET THE REQUIREMENTS OF CRITERION 5:**

| **Professional component Content** | | | |
|---|---|---|---|
| **Math and Basic Sciences** | **Engineering Topics** | **General Education** | **Other** |
| ✓ | ✓ | | |

**RELATIONSHIP OF COURSE TO STUDENT OUTCOMES:**

| Student Outcomes | | Course aspects |
|---|---|---|
| A | An ability to apply knowledge of mathematics, science, and engineering | $a_1$ $a_2$ |
| B | An ability to design and conduct experiments, analyze and interpret data. | $b_2$ $b_3$ $b_4$ |
| C | An ability to design a system, component, or process to meet desired needs within realistic constraints such as economics, environmental, social, political, ethical, health, and safety, manufacturability, and sustainability | |
| D | An ability to function on multi-disciplinary teams. | |
| E | An ability to identify, formulate, and solve engineering problems | $e_1$ $e_2$ $e_3$ |
| F | An understanding of professional and ethical responsibility | |
| G | An ability to communicate effectively | |
| H | The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social content | |
| I | A recognition of the need for, and an ability to engage in life-long learning. | |
| J | A knowledge of contemporary issues within and outside the electrical engineering profession. | |
| k | An ability to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice. | |