EC233- Electronic Devices (1)

CREDIT HOURS

3 Hours

CONTACT HOURS (Hours/week)

Lecture: 2; Tutorial: 2; Lab: 2

COURSE COORDINATOR

Dr. Khaled Shehata

TEXT BOOK

NEAMEN, DONALD A., "SEMICONDUCTOR PHYSICS & DEVICES: BASIC PRINCIPLES", 3rd Ed McGraw-Hill

COURSE DESCRIPTION

P-N junction diodes, current components, junction capacitance, junction diode as a circuit element, special types of P-N junctions, diode applications and optoelectronic diodes.

PREREQUISITE:

EC 210

RELATION OF COURSE TO PROGRAM

Required

COURSE INSTRUCTION OUTCOMES

The student will be able to understand P-N junction diode as a device, P-N junction as a circuit element, Special types of p-n junction diodes, Optoelectronic devices.

TOPICS COVERED

- Introduction to the course (Motivation and History)
- Revision on solid state fundamentals
- Energy band model
- Concept of the hole
- Intrinsic semiconductor
- Doping and Extrinsic semiconductors
- Binding energy
- Energy band model of Extrinsic semiconductors
- Effect of temperature variation on Extrinsic semiconductors
- Semiconductor density of states
- The Fermi-Dirac Distribution function
- Distribution of Occupied States
- Equilibrium Carrier Concentration
- Degenerate and non-degenerate semiconductors
- Mass-action law

- Charge-neutrality equation
- The Fermi level in intrinsic and extrinsic semiconductors
- Temperature effects
- Thermal Equilibrium in Electronic Systems
- Diffusion of Carriers
- Einstein Relations
- Constancy of the Fermi level at equilibrium
- Band Bending
- Application on energy band diagrams
- Excess Carriers in Semiconductors
- Carrier injection
- Generation and Recombination
- Net Recombination Rate
- Continuity Equation
- Poisson and Laplace equations
- p-n Junction at Thermal Equilibrium
- The built-in potential
- The depletion region (space charge region)
- The electric field in the space charge region
- Energy band diagram
- Biasing of pn Junctions
- I-V Characteristics
- Junction Capacitances (Varactor)
- Junction Breakdown (Zener and avalanche)
- pn junction diode models
- Introduction to diode applications
- Application 1: clipping and clamping circuits
- Application 2: Half and full wave rectifiers
- LED fundamentals
- Application 3: Diode logic gates
- Application 4: Zener diodes
- Application 5: Limiter Circuits
- Photodetectors fundamentals
- Work function
- Schottky barrier
- Summary of used relations in thermal equilibrium schottky diodes
- Rectifying contacts (forward +reverse bias)
- Capacitances
- advantages over pn junctions
- Ohmic contacts
- Tunnel diode and gun diode

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_1 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	
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.	i_2 i_4
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.	