EC311- Electronic Materials

CREDIT HOURS

3 Hours

CONTACT HOURS (Hours/week)

Lecture: 2; Tutorial: 2; Lab: 2

COURSE COORDINATOR

Dr. Amr Byoumi

TEXT BOOK

A. Omar, Elementary Solid State Physics

COURSE DESCRIPTION

Free electron model, Electric conductivity, and Dielectric properties: Microscopic electric field Dielectric constant and polarisability, local electric field at an atom. Magnetic materials and Ferro electric Crystals. Diamagnetism and Para-magnetism, Ferromagnetic order. Antiferro magnetic order. Ferromagnetic domains, superconductivity. Destruction of superconductivity by magnetic fields, Meissner effect.

PREREQUISITE:

EC 210

RELATION OF COURSE TO PROGRAM

Required

COURSE INSTRUCTION OUTCOMES

The student will be able to understand the properties of:

- Dielectrics
- Ferromagnetic materials
- Magnetic materials
- Superconductor materials at microscopic and macroscopic level

TOPICS COVERED

- Free electron gas model and Fermi-Dirac statistics.
- Modern theory of metals and electric conductivity.
- Introduction to Dielectrics “Introduction, Basic Formula”
- Dielectric constant & Local Field” Polarisability, Local field, Lorentz sphere and its field.
- Clausius Mossoti relation, Sources of Polarisability, Relation Between polarisability and frequency.
- Approximations of dipolar polarisability, Distinguish Between polar and non polar materials, Dipolar Dispersion, Complex dielectric constant, Dipolar polarization in solids
- Polarisability and Electrical Properties ““Ionic Polarisability, Electronic Polarisability, Piezoelectricity, Ferro electricity.

- Introduction to Magnetism, classification of material" "Introduction, Review of Basic formula, Zee -man splitting"
- Diamagnetism and its material, Kinds of magnetic materials and its classifications, Classical Diamagnetism, Langavin Diamagnetism, Diamagnetic susceptibility
- Para magnetism and its material. Classical Para magnetism, Quantum Para magnetism, Atomic origin of magnetism (Hand's Rule), Magnetism in metals
- Ferromagnetism, Molecular Field Theory, The Physical origin of molecular field theory
- Antiferrimagnetism and magnetic domain "Antiferromagnetism, Ferrimagnetism, Ferromagnetism in metals, Magnetic domains"
- Introduction to Superconductivity and magnetic domain. "Introduction and overview, Zero resistance (resistivity - temperature curve), Occurrence of superconductivity"
- "Perfect Diamagnetism (Meissner Effect), Critical Field, Curves of the critical field"
- Electrodynamics of superconductivity and revision" Electrodynamics of Superconductivity (Using Maxwell equations), Revision"

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_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.	
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.	