MSE 3015: Electronic, Optical and Magnetic Properties of Materials (required)

Catalog Description: (3-0-3)
Prerequisites: MSE 2001 and PHYS 2212
Processes
Introduction to quantum mechanics and the band theory of solids to describe semiconducting, superconducting, dielectric, optical, and magnetic properties of nano- and micro-structured materials.

Textbook: S. O. Kasap, Principles of Electrical Engineering Materials and Devices, 2/3rd Edition, McGraw-Hill, Boston and Chicago, 2002/2006.

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Topics Covered:

1. Classical Physics: Electrical Conductivity of Metals
2. Classical Physics: Thermal Conductivity of Solids
3. Classical Physics: Motion of Electron in a Magnet Field / Hall Effect
4. Quantum Mechanics: Quantum Effects and Wave-Particle Duality
5. Quantum Mechanics: Schrödinger Equations and their Applications
6. Classical and Quantum description of a Hydrogen Atom
7. Quantum Mechanics: Absorption and Emission of Radiation and Optical Devices
8. Classical and Quantum Description: Bonding in Molecules and Solids
9. Quantum Mechanics: Band Theory, Electron Transport and Emission in Solids
10. Semiconductor Devices
11. Magnetic Properties of Atoms and Solids
12. Superconductivity
13. Classical and Quantum Description: Dielectric Properties of Insulators
14. Classical and Quantum Description: Optical Properties of Materials

Course Outcomes:
At the end of this course, students will be able to:

1. Demonstrate understanding of the behavior or electrons and nuclei in solids by answering questions and solving relevant problems.
2. Demonstrate understanding of the electrical properties of materials and applications of these properties in fabrication of modern electronic devices. Students will be able to design basic electronic devices and predict electronic properties of the samples.
3. Demonstrate understanding of the optical properties of materials and applications of these properties in fabrication of modern optical and electro-optical devices.
4. Demonstrate an understanding of the magnetic properties of materials and their applications.

Correlation between Course Outcomes and Student Outcomes:

Course Outcomes	Student Outcomes										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1. Demonstrate understanding of the behavior or electrons and nuclei in solids by answering questions and solving relevant problems.	x		x				x	x			
2. Demonstrate understanding of the electrical properties of materials and applications of these properties in fabrication of modern electronic devices. Students will be able to design basic electronic devices and predict electronic properties of the samples.	x		x	x	x		x	x		x	
3. Demonstrate understanding of the optical properties of materials and applications of these properties in fabrication of modern optical and electro-optical devices.	x		x		x		x	x		x	
4. Demonstrate an understanding of the magnetic properties of materials and their applications.	x		x		x		x	x		x	
Entire Course	**3**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong											

School of Materials Science and Engineering Student Outcomes:

a) an ability to apply knowledge of mathematics, science and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multidisciplinary 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 societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice