MATSCEN 5532 (Approved): Electronic, Optical, and Magnetic Properties Laboratory

Course Description

Correlate electronic, optical, and magnetic properties of materials with structure, composition, and microstructure. Examples include, resistivity, Hall effect, ferromagnetic/ferroelectric hysteresis.

Prior Course Number: MSE679
Transcript Abbreviation: E.O.M. lab
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Senior, Masters, Doctoral, Professional
Course Offerings:
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 1.0
Repeatable: No
Time Distribution: 3.0 hr Lab
Expected out-of-class hours per week: 0.0
Graded Component: Laboratory
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: MSE2010, MSE2241, MSE3271, or permission of instructor.
Exclusions:
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.3101
Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
MATSCEN	Materials Science and Engineering

Course Goals

Learn the principle of current/voltage measurement using 4 contact method, intrinsic versus extrinsic properties.
Learn principles of the Hall effect including measurement of charge carrier type, electron or hole, and charge carrier mobility.
Learn principles of optical absorption and photovoltage. Students will measure photovoltage versus wavelength for intrinsic-Si, p+ or n+ Si, and a pn photodiode.
Measure the magnetization of ferromagnetic metals, paramagnetic metals, and diamagnetic insulators.
Measure polarization of ferroelectrics as a function of electric field.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
4-pt resistivity: Objective: learn the principle of current/voltage measurement using 4 contact method, intrinsic versus extrinsic properties.			2.0					
Hall effect: Objective: learn principles of the Hall effect including measurement of charge carrier type, electron or hole, and charge carrier mobility.			2.0					
Photovoltage: Objective: learn principles of optical absorption and photovoltage. Students will measure photovoltage versus wavelength for intrinsic-Si, p+ or n+ Si, and a pn photodiode.			2.0					
Magnetic memory materials: Objective: measure the magnetization of ferromagnetic metals, paramagnetic metals, and diamagnetic insulators.			2.0					
Ferroelectric materials Polarization of ferroelectrics as a function of electric field.			2.0					

Representative Assignments

Experiment 1: 4-pt resistivity measurements. Samples will be dropped in liquid Nitrogen to demonstrate differences in the effect of temperature on resistivity in metals versus semiconductors. Students must complete a written lab report.
Experiment 2: Hall effect measurement. Materials include n-type Si, p-type Si, Al, Cu. Magnetic field will be varied using a permanent magnet on a translation stage. Students must complete a written lab report.
Experiment 3: Magnetic materials. Students will measure the magnetization of ferromagnetic metals, paramagnetic metals, and diamagnetic insulators. Students will observe Meissner effect in a high-Tc superconductor by measuring magnetic susceptibility versus Temperature. Students must complete a written lab report.
Experiment 4: Ferroelectric materials. Students will measure polarization as a function of electric-field in ferroelectrics. Students must complete a written lab report.

Grades

Aspect	Percent
Lab report 1	25%
Lab report 2	25%
Lab report 3	25%
Lab report 4	25%

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	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.
	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.

Course Contribution		College Outcome
	h	The broad education necessary to understand the impact of engineering solutions in a global 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.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: Roberto Myers