MATSCEN 6778 (Approved): Magnetic Materials

Course Description

This course teaches the basic properties of magnetic materials in a wide class of materials including metals, insulators, semiconductors. The relationships between structure, composition, processing, and magnetic properties will be reviewed with a special focus on the atomic origins of magnetism and the ability to engineer these mechanisms through alloying or doping, or layered structures.

Transcript Abbreviation: Magnetic Matls
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Graduate
Student Ranks: Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Even Years
Course Length: 14 Week
Credits: 2.0
Repeatable: No
Time Distribution: 2.0 hr Lec
Expected out-of-class hours per week: 4.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Graduate standing in Engineering or Mathematical and Physical Science; permission of instructor
Exclusions:
Cross-Listings:

Course Rationale: The topic addresses an important area of materials research.

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: 14.1801
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
MATSCEN	Materials Science and Engineering

General Information

Students will find that a working knowledge of solid state physics, basic quantum mechanics, and basic magnetostatics will be helpful.

Course Goals

Develop a technical knowledge of fundamental magnetic properties
Develop a working knowledge of the atomic origins of magnetism
Develop theoretical understanding of types of magnetism
Develop an understanding of the role of domain structure in magnetization
Develop understanding of Anisotropy
Introduce the concept of engineering magnetic properties by composition, structure, and processing control.
Introduce how magnetic properties affect other functional properties such as structural, electronic, and optical properties.
Develop the ability to critically examine and understand recent scientific literature
Develop the ability to give oral presentations on scientific literature as well as write review papers on scientific sub-fields.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Fundamental magnetic properties	3.0							
Atomic origins of magnetism	5.0							
Theories of magnetism	5.0							
Domain structure	3.0							
Anisotropy	3.0							
Magnons spin waves	3.0							
Magnetotransport	3.0							
Spin Caloritronics	3.0							

Representative Assignments

Students will select a recent (last 1 to 6 months) journal article from a high impact journal (impact factor of 10 or more) on the topic of magnetic materials and their functional behavior. They will give an in-class presentation between 5 and 10 minutes in length to describe the paper to the class (25% of grade).
Students will participate in the questions and answers period of the lecture (~40 minutes per week) which will be open-forum. Students will ask substantive questions concerning critical analysis of the research project (journal article) being discussed. Students will engage in online discussions through carmen. (25% of grade).
Students will write a critical review of a sub-field of research work within the larger field of magnetic materials / functional properties therein. This critical review must review a topic in the field of magnetic materials and functional properties. At a minimum it should critically review a body of work (for example a minimum of 10 cited journal articles) demonstrating the students understanding of the materials synthesis, device fabrication, measurement techniques, basic theoretical understanding of the topic, as well as a proper motivation for why this topic is being studied. The final report will be submitted at the conclusion of the course (50% of grade).

Grades

Aspect	Percent
In-class presentation	25%
In-class open forum participation	25%
Final written report	50%

Representative Textbooks and Other Course Materials

Title	Author
Magnetism and Magnetic Materials	J M D Coey
Magnetic Materials	Nicola Spaldin

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.
**	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.

Additional Notes or Comments

Concurrence from Physics and ECE received

Prepared by: Mark Cooper