MATSCEN 5572 *Materials for Energy Technology*

Course Description

Structure property relationships of materials in energy applications. Photovoltaic materials, solid state photonic materials, electrochemical devices such as batteries, fuel cells and chemical sensors, superconductors, memory and nuclear materials.

Transcript Abbreviation: Matl. Energy Tech.

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Undergrad, Graduate

Student Ranks: Junior, Senior, Masters, Doctoral

Course Offerings:

Flex Scheduled Course: Never

Course Frequency: Every Year

Course Length: 14 Week

Credits: 3.0

Repeatable: No

Time Distribution: 3.0 hr Lec

Expected out-of-class hours per week: 6.0

Graded Component: Lecture

Credit by Examination: No

Admission Condition: No

Off Campus: Never

Campus Locations: Columbus

Prerequisites and Co-requisites: MSE 2010 and either MSE 3271 or ECE 2300; permission of instructor.

Exclusions:

Cross-Listings:

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Course Rationale: Existing course.

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: ☑

Subject/CIP Code: 14.3101

Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
MATSCEN	Materials Science and Engineering

Course Goals

Introduce students to structure property relationships of materials in energy applications.
Introduce students to the technology and materials involved in photovoltaics. Understand structure property relationships in processing and synthesis of these materials. Understand degradation related to applications.
Introduce students to materials for solid state lighting. Understand structure property relationships in processing and synthesis of these materials. Understand degradation related to applications.

Introduce students to electrochemical devices and materials: batteries, fuel cells and chemical sensors. Understand structure property relationships in processing and synthesis of these materials. Understand degradation related to applications.
Introduce students to high-TC superconductor materials and their application for energy efficient technology.
Introduce students to memory materials: ferromagnets, phase change materials and spintronics for low power switching devices. Understand degradation related to applications.
Introduce students to materials for nuclear energy production. Understand structure property relationships in processing and synthesis of these materials. Understand degradation related to applications.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to photovoltaic (solar cell) materials	6.0							
Wide Band Gap Materials for energy efficient photonics	6.0							
Basics of electrochemical devices [including point defects and ionic conductivity]	3.0							
Battery Materials	3.0							
Fuel Cell Materials	3.0							
Chemical sensors	3.0							
Superconductors for Energy Transmission [efficient transformers]	6.0							
Memory Materials for Energy: Ferromagnets for efficient generators and transformers, phase change materials and spintronics for low power switching devices.	6.0							
Nuclear Materials	6.0							

Representative Assignments

Explain the differences in the optical and structural characteristics between different solar cell materials. Select the appropriate material given a set of design constraints.
Calculate the bandgap, emission wavelength, and lattice constant of a compound semiconductor for a blue LED.
Describe ionic conductivity and the importance of point defects in batteries, fuel cells, and sensor technology.

Grades

Aspect	Percent
Homework and Quizzes	20%
Mid-term Exam	40%
Final Exam	40%

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
Significant contribution (7+ hours)	a	An ability to apply knowledge of mathematics, science, and engineering.
No contribution	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
Significant contribution (7+ hours)	c	An ability to design a system, component, or process to meet desired needs.
No contribution	d	An ability to function on multi-disciplinary teams.
Significant contribution (7+ hours)	e	An ability to identify, formulate, and solve engineering problems.
No contribution	f	An understanding of professional and ethical responsibility.
No contribution	g	An ability to communicate effectively.
No contribution	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
No contribution	i	A recognition of the need for, and an ability to engage in life-long learning.
Some contribution (1-2 hours)	j	A knowledge of contemporary issues.
No contribution	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: Roberto Myers (original semester syllabus; 2/14 revision by Megan Daniels