MATSCEN 6765: Mechanical Behavior of Materials

Course Description
Mechanical response of materials to loads and deformation.

Prior Course Number: 765
Transcript Abbreviation: MecBehavMats
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Graduate
Student Ranks: Masters, Doctoral
Course Offerings: Autumn, Spring
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: Grad standing in MatSc&En or permission of instructor.
Exclusions: Not open to students with credit for MATSCEN-765
Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: Yes
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

Course Goals

The development of a quantitative understanding of the scientific principles that govern the material response to mechanical forces or stresses.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Stress and Strain; Fundamentals, Variation, and Invariants	4.0							

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Elastic Behavior of Solids, Physical Origins and Concepts; Anisotropy and Mathematics	4.0							
Continuum Plasticity	2.0							
COMSOL Finite Element Analysis Module 1	1.0							
COMSOL Finite Element Analysis Module 2	1.0							
Dislocations: Basic Concepts, Movement of Dislocations	2.0							
Dislocations: Elastic Properties of Dislocations	2.0							
Dislocations: Dislocations in Crystals, Dislocations in FCC Metals (perfect dislocations, partials, stacking faults), Dislocations in Other Crystal Structures	1.0							
Dislocations: Intersections of Dislocations, Dislocation Pile-ups, Multiplication of Dislocations	1.0							
Strengthening Mechanisms Part 1: Strengthening Models, Lattice Resistance	1.0							
Strengthening Mechanisms Part 2: Dislocation-Solid Solution Interaction and Strengthening, Dislocation-Precipitate Interaction Strengthening	1.0							
Strengthening Mechanisms Part 3: Dislocation-Precipitate Interaction Strengthening, Dislocation-Grain Boundary Interaction Strengthening	1.0							
Strengthening Mechanisms in Thin Films and Nano materials	2.0							
Mechanical Behavior of Polymers, Composites, and Ceramics	3.0							
Mechanical Behavior of Ceramics	1.0							
Fatigue & Fracture Mechanics	3.0							
High Temperature Deformation	2.0							
Environmental Degradation	1.0							
Corrosion Fatigue & Stress Corrosion Cracking	2.0							
Experimental Techniques For Understanding Mechanical Behavior	1.0							
Enhancing Mechanical Properties, Case Study: Aluminum Alloys	1.0							
Enhancing Mechanical Properties, Case Study: SiC/Al Composites	1.0							

Representative Assignments

ICME COMSOL PROJECT Integrated Computational Materials Engineering (ICME) is an approach used to quantity relationships between materials properties, processing, and micro/macro structures using computational models and tools. ICME enables these relationships to be quantified at multiple length scales which reduces the time to advanced novel materials as well as improve performance in mature systems. In this project, students will learn what Finite Element Analysis (FEA) is and how it is used to solve problems in systems with complicated geometries and materials properties when analytical solutions cannot be easily obtained.
Project Deliverables ICME COMSOL Project Topic ICME COMSOL First Draft Project Proposal ICME COMSOL Revised Project Proposal ICME COMSOL Final Project Report ICME COMSOL Presentations

Grades

Aspect	Percent
Homework & In-Class Activities	10%
Midterm Exam 1	30%
Final Exam	30%
ICME COMSOL Project	25%
Discussion Forum	5%

Representative Textbooks and Other Course Materials

Title	Author
Mechanical Behavior of Materials (Second Edition)	T.H. Courtney
Introduction to Dislocations (Fifth Edition)	D. Hull and D.J. Bacon

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics - pre-2019 EAC SLOs (a) and (e); (k) is implied
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors - pre-2019 EAC SLO (c); (k) is implied
	3	an ability to communicate effectively with a range of audiences - pre-2019 EAC SLO (g)
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts - pre-2019 EAC SLOs (f) (h) and (j)
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives - pre-2019 EAC SLO (d)
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions - pre-2019 EAC SLO (b); (k) is implied
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies - pre-2019 EAC SLO (i)

Additional Notes or Comments

AML wanted to expand content thus an increase in credits from 2 to 3. Approved by MSE GSC 8/10/21

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