

Department of Materials Science and Engineering
University of Maryland, College Park, Maryland

ENMA 421: Design of Composite Materials

Course Description: This course covers fundamentals of design, processing and selection of composite materials for structural applications. The topics include a review of all classes of engineering materials, an in-depth analysis of micro and macro mechanical behavior including interactions at the two-phase interfaces, modeling of composite morphologies for optimal microstructures, material aspects, cost considerations, processing methods including consideration of chemical reactions and stability of the interfaces and material selection considerations.

Prerequisites: Permission of the department.

Text Book: "Composites Materials: Engineering and Science" by F.L. Matthews and R.D. Rawlings, Published by CRC Woodhead Publishing Limited, 2002.

Reference Book: "Material Selection in Mechanical Design" by M.F. Ashby, Pergamon Press, 1992.

Course Objective: The main objective of this course is to teach fundamentals of composite materials as related to design, processing selection for structural applications. Satisfactory completion of the course should demonstrate the ability to:

1. Understand the basic principles of composites materials.
2. Learn about various types of composites including processing.
3. Predict composite behavior from the knowledge of component phases properties and
4. Design and select composites for a given structural application.

Course Goals to meet ABET 2005 Criteria:

1. Classes of materials and similarities and differences
2. Materials / process selection
3. Structure property relationships
4. Processing - structure relationships

Topics Covered:

1. Introduction
2. A Review Of All Classes Of Engineering Materials
Metals, Ceramics, Glasses, Polymers, Elastomers and Composites.
3. A Review Of Mechanical Properties
Strength, Hardness, Fatigue, Toughness, Damping capacity, Creep, Thermal shock resistance, Wear, Corrosion.
4. Overview Of Composites
Definition and classification
Prediction of mechanical properties

5. Reinforcement And The Reinforcement-Matrix Interface
6. Types Of Composites
 - Metal Matrix Composites
 - Ceramic Matrix Composites
 - Polymer Matrix Composites
7. Fracture Mechanics And Toughening Mechanisms
 - Energy analysis, Local stresses, Fracture initiation, Impact, Toughening mechanisms.
8. Joining
9. Special Topics

Class Schedule:

Lecture: Tuesday and Thursday 3:30 to 4:45 PM, Room CHE 2120

Grading:

Two 1 hr exams

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| I. March 4, 2004 | 20% |
| II. April 13, 2004 | 20% |

Design Project/Presentation	20%
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Quizzes	10%
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Final Exam (Comprehensive)	30%
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Instructor: Prof. S. Ankem

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Office Hours: Tuesday and Thursdays 1:30 – 3:30 PM.

Design project will be different for students registering for ENMA 489A as compared to those who registered for ENMA 698A.

Prepared by: Prof. Ankem, January 2004