

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

1. **ENMA 421 – Design of Composites**
2. **Credits and contact hours – 3 credits.** The University of Maryland follows the Maryland Higher Education Commission's policies on "contact hours;" specifically, one semester hour of credit will be awarded for a minimum of 15 hours, of 50 minutes each of actual class time, exclusive of registration, study days, and holidays.

Schedule: meets two 75 minute periods per week

3. **Instructor's or course coordinator's name:** Prof. Rama Ankem
4. **Text book, title, author and year:** Composite Materials: Science and Engineering” 3rd Edition by K. Chawla, Springer Science, 2012
 - a. **Other supplemental materials:**
 1. “Material Selection in Mechanical Design” by M.F. Ashby, Pergamon Press, 1992.
 2. “Composites Materials: Engineering and Science” by F.L. Matthews and R.D. Rawlings, CRC Woodhead Publishing Limited, 2002.
 3. “Mechanical Properties of Alloys Consisting of Two Ductile Phases” by S. Ankem, H. Margolin, C.A. Greene, B.W. Neuberger, and P.G. Oberson, *Progress in Materials Science*, 2006, available online.In addition, several journal articles will be used, and will be posted on Blackboard when needed.

5. **Specific course information**
 - a. **Brief description of the content of the course (catalog description):**

Fundamentals of design, processing and selection composite materials for structural applications will be covered. The topics include a review of all classes of 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 materials selection considerations.
 - b. **Pre-requisites or co-requisites:** Permission of the department.
 - c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** ENMA 421 is an elective course for Materials Science and Engineering majors.
6. **Specific goals for the course:**

a. Specific outcomes of instruction:

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.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed in this course.

ABET A: Ability to apply mathematics, science and engineering principles. to design a system, component, or process to meet desired needs.

ABET B: Ability to design and conduct experiments, analyze and interpret data.

ABET C: Ability to design a system, component, or process to meet desired needs.

7. Brief list of topics to be covered.

1. Introduction: Review of All Classes of Engineering Materials: Metals, Ceramics, Glasses, Polymers, Elastomers and Composites. 2. A REVIEW OF MECHANICAL PROPERTIES
2. Strength, Hardness, Fatigue, Toughness, Damping capacity, Creep, Thermal shock resistance, Wear, Corrosion.
3. Overview of Composites and Types of Reinforcements
4. Micromechanics, Macromechanics and Finite Element Modeling
5. Matrices and the Reinforcement-Matrix Interface
6. Types of Composites- Metal Matrix Composites, Ceramic Matrix Composites, Polymer Matrix Composites
7. Monotonic Strength and Fracture
8. Fatigue
9. Low and High Temperature Creep
10. Design with Composites