CBEMS 157 COMPOSITE MATERIALS DESIGN

(Elective for ChE and MSE)

Catalog Data:

CBEMS 157 Composite Materials Design (Credit Units: 3)
Introduction to fiber-reinforced composites for mechanical applications. Properties of reinforcing fibers. Manufacture of fibers and composites. Micromechanics of fiber composites. Strength criteria and failure modes. Macromechanics in design of laminated composite structures. Prerequisites: ENGR54 and ENGR150. (Design units: 3)

Textbook:

Artur K Kaw, *Mechanics of Composite Materials*, CRC Press, 1997.
Class Notes

Reference:

K. K. Chawla, *Composite Materials*, Springer-Verlag, 1987.
M. Schwartz, *Composite Materials Handbook*, McGraw-Hill Inc., 1992.
C. T. Lynch and J. P. Kershaw, *Metal Matrix Composites*, CRC Press, 1972.

Coordinator:

Farghalli A. Mohamed

Course Objectives:

This course is designed to familiarize students with composite materials. These materials will be continuous fiber composites as well as short fiber composites and particle reinforced composites. Analysis techniques will be demonstrated to predict mechanical and physical properties of these materials. Tradeoffs in material selection to meet design goals are emphasized.

Course Outcomes:

Students will:
Use knowledge of mathematics, science, and engineering to solve problems.
Design a system, component, or process to meet desired needs within realistic constraints such as cost, safety, manufacturability.
Identify, formulate, and solve engineering problems, and particularly to conceptualize objectives and constraints, identify governing principles, apply fundamental analytical tools, and predict performance.
Understand basic composite materials design concepts along with professional and ethical responsibilities when selecting the composite most suitable for a given application using data on materials properties.
Understand about the impact of developing composite materials that can solve existing engineering problems in global and societal context.
Understand that composite materials, like other advanced materials, are continually being evolved requiring continuing education to stay abreast of new developments.
An ability to apply and integrate knowledge from each of the four primary elements of Materials Science and Engineering (structure, properties, processing and performance) to solve problems related to composite materials selection and design.

Prerequisites by Topics:

Structure of materials
Static engineering analysis

Lecture Topics:

Introduction to Composite Material, Fibers and other Reinforcements
Matrix materials
Micromechanical analysis of a lamina, concept of volume fraction
Macromechanical Analysis of a Lamina
Promal Software Package
Review of Design Projects
Macromechanical Analysis of Laminates
Failure, Analysis and Design of Laminates
Quality Assurance and Specific Examples
Design for creep

Class Schedule: Meets for 3 hours of lecture each week for 10 weeks.

Computer Usage: Students are requested to use basic computer skills to solve short design problems.

Laboratory Projects:

Professional Component: This course is designed to contribute towards the Materials Science Engineering major through the engineering topics and design experience that are related to composite materials. Considerations are given to manufacturing composites, predicting mechanical and physical properties, emphasizing tradeoff in materials selection to meet design goals.

Relationship to Program Outcomes: This course relates to Program Outcomes a, c, e, f, h, i, j and k as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/materials/mission

Design Content:

Approach: To familiarize students with composite materials. These materials will be continuous fiber composites as well as short fiber composites and particle reinforced composites. Analysis techniques will be demonstrated to predict mechanical and physical properties of these materials. Tradeoffs in material selection to meet design goals are emphasized.

Lectures: 100%

Laboratory Portion: 0%

Grading Criteria:

Homework	10%
Project	20%
Midterm (1h)	25%
Final (2h)	40%
Attendance	5%
	100%

Estimated ABET Category Content:

Mathematics and Basic Science: 0 credit units or 0%
Engineering Science: 0 credit unit or 0%
Engineering Design: 3 credit units or 100%

Updated by: Farghalli A. Mohamed **Date:** July 2007
CEP Approved: Fall 2004