MSE 456/TAM 428/AE 428 Mechanical Behavior of Composite Materials

Professor: Nancy R. Sottos, *n-sottos@illinois.edu*
Office Hrs: Mon. 3-4 pm, Tue. 2:30-3:30 pm, 210 MSEB

Textbook: I.M. Daniel and O. Ishai, *Engineering Mechanics of Composite Materials*.

Webpage: Illinois Compass *https://compass2g.illinois.edu*

Prerequisites: TAM 251, MSE 206 or equivalent;
Knowledge of basic matrix algebra and computations.

Grading Breakdown:

25%	Midterm
20%	Homework
20%	Project/Presentation
35%	Final Exam (Comprehensive)

Approximate Grade Scale:
(based on class average, the minimum for the range could be scaled lower)

A+	96-100
A-/A	88-95
B-/B/B+	75-87
C-/C/C+	62-74
D-/D/D+	49-61

Class Policies:

- Homework will be due 1 week after being assigned. Solutions will be available after the assignments are graded.
- Late homework will be accepted at a penalty of five percent a day until the solutions are made available. Hence, homework can only be a maximum of one week late.
- In general, makeup exams will not be given. Exam conflicts must be discussed with me at least two weeks prior to the exam.
- *Academic Integrity* - Any project, homework or exam handed in by an individual must represent their own original work. It is the responsibility of the student to refrain from infractions of academic integrity, which includes cheating, fabrication and plagiarism. Such infractions will be given no credit and will be subject to penalties outlined by the University of Illinois code of conduct.

Objectives:

- Develop orthotropic stress–strain relations and failure criteria for a broad spectrum of composite materials.
- Predict the properties of a broad spectrum of composite materials based on: the properties, relative amounts, the geometry, and orientation of the constituent fiber and matrix materials.
- Calculate the stress-strain response and failure of a laminated composite material under in-plane loading and/or bending using classical laminated plate theory.
- Analyze a particular composite design and determine if it meets appropriate design criteria such a failure or deflection specification.

Course Topics/Section:

I. MATERIALS BACKGROUND

- Types of Composites
- Reinforcements
- Matrices

II. MECHANICS ESSENTIALS

- Generalized Hooke's Law For Anisotropic Materials
- Orthotropic Symmetry

III. COMPOSITE PROPERTIES

- Elastic Stiffness - Micromechanics
- Expansion & Transport
- Short Fiber Composites
- Particulate and Nanocomposites

IV. LAMINATED COMPOSITES

- Laminate Properties
- Laminate Strength and Failure Modes
- Thermal Stress and Warpage

References:

- Agarwal, B. and L. Broutman, *Analysis and Performance of Fiber Composites*, 1990.
- Hull, D. and T.W. Clyde, *An Introduction to Composite Materials*, 1996
- Jones, R.M., *Mechanics of Composite Materials,* 1999.
- Lekhnitskii, S. G., *Theory of Elasticity of an Anisotropic Elastic Body*, 1963