MSE 456 / TAM 428 / AE 428
Mechanical Behavior of Composite Materials – Spring 2023

Professor: Jeff Baur jwbaur@illinois.edu
Office Hrs: Monday 2-3 pm, 305 Talbot Lab
(or by appointment)

TAs: Daniel Steinberg
Office Hrs: 3-5 pm, Tuesday in 319M Talbot
2-4 pm, Thursday in 319M Talbot

Textbook: I.M. Daniel and O. Ishai, *Engineering Mechanics of Composite Materials*, 2nd ed.

Canvas Site: https://canvas.illinois.edu/courses/33766
Spring 2023-MSE 456-Mechanics of Composites-Section A (illinois.edu)

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

Grading Breakdown:

25%	Exam 1
25%	Exam 2
15%	Homework
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:** Homework will be due approximately 1 week after being assigned. Solutions will be available after the assignments are graded.
- **Late assignments**: Late homework will be accepted at a penalty of 10% a day until the solutions are made available. Hence, homework can only be a maximum of 10 days late.
- **Exams**: While we reserve the right to change the time of the exams, the current planned dates for the mid-term and final exams are currently:

  Mid-term Exam 1- Friday March 3rd , 2023 (50 min during class time)

  Mid-term Exam 2 – Monday April 17th, 2023 (50 min during class time)

  Final Exam – Friday May 5th, 2023 at 7-10 pm (3 hour at TBD location)

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 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:

- Become familiar with common reinforcement and matrix materials used in advanced composites.
- Predict the properties of a broad spectrum of composite materials based on the properties, relative amounts, the geometry, and orientation of the constituent reinforcement and matrix materials.
- Develop stress–strain relations and failure criteria for a broad spectrum of composite 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 as failure or deflection specification.

Course Topics/Section:

I. MATERIALS BACKGROUND

- Types of Composites
- Reinforcements
- Matrices

II. COMPOSITE PROPERTIES

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

III. ORTHOTROPIC MATERIALS

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

IV. LAMINATED COMPOSITES

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

V. RESIDUAL STRESS & SPECIAL TOPICS

Additional References (on line or on reserve at Grainger)

- K.K. Chawla,*Composite Materials*, 3rd Edition
  http://link.springer.com/content/pdf/10.1007%2F978-0-387-74365-3.pdf
  You can download for free from Springerlink from an Illinois IP address
- Agarwal, B. and L. Broutman, *Analysis and Performance of Fiber Composites*, 3rd ed, 2006.
- Hull, D. and Clyne, T.W., An Introduction to Composite Materials, Cambridge Univ. Press, 2nd ed., 1996.
- Jones, R.M., *Mechanics of Composite Materials, 2nd ed.* 1999.