ME414/CEE414: Mechanics of Composite Materials Fall 2020

Instructor:

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Lectures:

TTh 2:40-4:00pm – via Zoom

Course Website:

Course announcements, lecture notes, homework assignments, readings, etc... will be posted on the course Canvas website.

Course Description:

Composite materials are materials comprising two or more material phases with different physical properties. Because they usually exhibit remarkable physical properties, in general superior to the properties of their individual components, they appear pervasively in engineering applications (e.g., reinforced concrete in construction, fiber-reinforced materials for aircraft structures, reinforced rubber in car tires, ...). Despite being comprised multiple material phases with different physical properties, these materials may be considered for practical purposes as homogeneous materials with physical material-like effective properties.

The course will focus primarily on the elastic properties of a wide range of composites (laminated materials, particulate/fiber-reinforced composites, multidirectional laminates) and will cover a number of engineering methods for the computation of the effective properties of these materials based on the properties and spatial arrangement (volume fraction, shape, orientation, ...) of their underlying constituents.

Course Outline:

I. **Introduction**
   Basic concepts, Materials, Processes
II. **Elastic behavior of deformable solids**
   Isotropic/Anisotropic Elasticity
III. **Elastic properties of composite materials**
   Particulate composites, Unidirectional fiber-reinforced composites
IV. **Elastic properties of laminated composites**
   Laminated composite materials, beams, and plates
V. **Hygrothermal effects**

Prerequisites and Software:

The course will be self-contained but will rely on descriptions of the mechanics of deformable solids (MECH_ENG 327, MECH_ENG 362, or equivalent). The numerical computing environment MATLAB will be used for matrix manipulation throughout the course.

Textbooks:

There is no required textbook for this course.

Additional References:

Daniel, I., Ishai, O., 2006. Engineering Mechanics of Composite Materials.
Torquato, S., 2002. Random Heterogeneous Materials: Microstructure and Macroscopic Properties. Springer.

Tentative Grading Scheme:

Participation:	10%
Homework assignments:	30%
Midterm exam:	30%
Final exam:	30%

Homework assignments/Midterm exam/Final exam:

- Homework assignments will be assigned on a regular basis.
- The midterm and final exams are open-book, open notes.