MAE 155/255: Composite Materials and Structures
Spring Quarter 2017

Syllabus

Instructor: *Lorenzo Valdevit*
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Class schedule:
Lecture: TTh 8.00 – 9.20pm, MDE AUD
Discussions: F 9.00 – 9.50am, SH 128
F 12.00 – 12.50pm, SH 128

Textbook: IM Daniel, O Ishai, *Engineering Mechanics of Composite Materials*, Oxford University Press, 2nd ed., 2006.

References: Instructor's notes

KK Chawla, *Composite Materials: Science and Engineering,* Springer, 2nd Ed., 1998.

D Hull, *An introduction to composite materials,* Cambridge University Press, 1985.

PC Powell, *Engineering with fibre-polymer laminates*, Chapman & Hall, 1994.

PK Mallick, Fiber-Reinforced Composites – Materials, Manufacturing and Design, CRC Press, 3rd Ed., 2008.

MF Ashby, *Materials selection in mechanical design,* Butterworth-Heinemann, 3rd Ed., 2005.

Course website: https://eee.uci.edu/17s/19155

Course description: The course will present the motivations underlying the development of all classes of composite materials and structures. You will learn the basic macro and micro mechanics and will appreciate the unique failure mechanisms exhibited by each

class of composite materials. At the end of the course you will be able to select the appropriate composite material or structure to meet design requirements that are unreachable for monolithic materials. Aerospace applications are emphasized.
In particular, you will:

- Understand how the need for man-made composite materials arises from empty regions in materials selection charts
- Appreciate the rich variety of composite materials
- Learn the basic mechanical principles that describe the stiffness and strength of materials reinforced by long and short fibers, whiskers and particulates
- Be exposed to the most common failure mechanisms of all classes of composites
- Assess advantages and limitations of the most commonly available homogenization techniques for the finite elements modeling of composite materials and structures
- Design composite materials and structures to meet realistic load-bearing capabilities under stringent constraints

The lecture topics for MAE255 are the same as for MAE155. MAE255 students will occasionally have separate discussion periods, covering more details on the mechanics of composites (e.g. homogenization techniques and failure criteria). The topics presented in the discussion periods are integral part of the course; as such, they are "fair game" in homework problems and exams.

Prerequisites By Topic: Statics of solid bodies. Analysis of structures. Mechanics of materials. Stress and strain.

Lecture topics: See attached document

Computer Usage: A commercial programming language (e.g. MATLAB) will be used in MAE255 to develop codes for matrix analysis of laminates. In addition, students will use a commercial Finite Element code (ABAQUS) to test the reliability of homogenization techniques available for the modeling of composite materials and structures.

Grading Criteria:
Homework: 25%
Midterm: 30%
Final: 45%
Attendance to lectures and discussion sessions is required.

Homework Policy:
There will be a number of homework assignments throughout the course. Homework assignments are typically posted on the website on Monday afternoons. They are due on the following Monday before 6.00pm, in the dropbox on the 2nd floor in EG. Not all problems will be necessarily graded, but solutions to all problems will be posted on the website on the Wednesday at 6.00pm. Late homework is not accepted and will not be graded. Nonetheless, one opportunity is provided to each student to turn in ONE late assignment and receive full credit for it. This is meant to provide a "stress-release valve"

when things get hectic in the quarter. In any case, this late assignment needs to be turned in BEFORE the solution is posted, i.e. before 6.00pm on Wednesday. No other exception will be granted.

Working together is strongly encouraged (but NOT copying each other). Identical homework assignments from two students will be considered cheating and not tolerated.

Some homework assignments might require the use of computational resources (primarily ABAQUS and/or MATLAB) available in the computer lab as noted above.

These factors ALL contribute to the grade:

- Conceptually sound problem-solving approach.
- Numerical accuracy of results.
- Neatness of the presentation and description of the procedure.

Please, format your homework in a clear way. I should not have to make effort in interpreting or guessing your thinking process. All the fundamental steps of your derivations need to be clearly stated. Illegible homework will not be graded.
A correct solution obtained with a wrong or unclear methodology will be given no credit. Conversely, numerical mistakes associated with sound and reasonable approaches will result in partial credit.

Midterm and final examinations

There will be one midterm and one final examination. The final examination has been set by the Registrar's office on Tue, June 13, 8–10am.
The midterm is tentatively scheduled on week 7. This schedule is tentative and subject to change. The same grading approach that was described for homework applies to midterms and finals: all the derivations need to be clearly shown. Correct but unjustified answers will receive no credit. Neatness is required.