

ME 538 – Experimental Characterization of Polymeric Composites Spring 2010

Textbooks: Composite Materials Handbook (Mil Handbook 17) - Contents of the working version of Vol. 1F June 2002 *Polymer Matrix Composites Guidelines for Characterization of Structural Materials* (MIL-HDBK-17_1F complete.pdf). The handbook is now known as Composite Materials Handbook 17 (CMH-17).

ASTM standards student campus package from
<http://www.astm.org/campusstandards.html> (details concerning instructions to access the standards package will be provided to you in class)

Current literature related to characterization of polymeric composites

Reference: Adams, Donald, Leif A. Carlsson, and R. Byron Pipes, *Experimental Characterization of Advanced Composite Materials*, CRC Press, 2003.

Statistical Software:

Stat17, the software recommended for performing statistical analysis in conjunction with the MIL-HDBK-17 procedures will be used in the course. These procedures are described in detail in Vol. 1, Chapter 8 of the handbook. The Stat17 Excel macro program will be provided to you.

Instructor/Contact

Information: Dr. Ellen Lackey, Associate Professor, Mechanical Engineering
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Course Description:

This course will introduce students to the field of polymeric composites, the numerous techniques available for experimental characterization of polymeric composites, and the processes and procedures associated with the standardization procedures followed in the industry. This will be accomplished through lectures, discussions, demonstrations, projects, and quizzes. Through this course, students will examine both the theoretical and practical aspects of experimental characterization of composites. Students will gain experience in the use of these characterization techniques through hands-on projects. Safety precautions related to fabrication and testing of composites will also be emphasized.

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Course

Objectives: Students will apply knowledge of mathematics, science, and engineering to as they identify, discuss, and review information related to the area of experimental characterization of polymeric composites.

Students will apply course topics to select, design, and conduct and evaluate appropriate testing methods and procedures to provide required data for polymeric composites. Students will also analyze data obtained from the test methods. These projects will require the hands-on use of modern engineering tools to acquire the required data. Students will also utilize their abilities to identify, formulate, and solve engineering problems in the context of these projects.

Students will identify, present, and discuss and evaluate contemporary issues related to the area of experimental characterization of polymeric composites through the examination of current research literature.

Students will recognize and develop an understanding of professional and ethical responsibility through the application of the Engineering School Honor Code to class assignments.

Students will practice effective communication through the preparation of written reports and the presentation of oral reports. Modern tools including computers, presentation software, and state-of-the-art presentation tools will be employed for all reports.

Class Grade:

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|---------------------------|-----|
| Test 1 | 20% |
| Final Exam | 20% |
| Quizzes | 20% |
| Projects | 25% |
| Participation/Assignments | 15% |

Graduate students will have additional requirements on tests, assignments, and projects.

Project:

A testing project making use of the characterization techniques discussed and demonstrated in class will be assigned during the course. The project will be conducted in teams, and students will be expected to draw on class lecture material to design and implement the appropriate test techniques necessary to obtain the desired material property data. Students will work in teams to conduct the necessary laboratory tests and analyze their data. In addition, graduate students will produce a report of their findings in the form of a research paper suitable for publication. Students will not be allowed to use test equipment which will be necessary for completion of the project until they have demonstrated sufficient understanding of the safe operation of the equipment.

Honor Code:

In all classes, engineering students are expected to uphold the standards expected in the engineering profession. All tests, quizzes, projects, assignments, and homework are to be completed in accordance with the School of Engineering Honor Code. As such, a student may not give or receive any assistance on any of these unless specifically noted. Students may have general discussions concerning homework sets, but, because homework is a graded component of the course, students must independently work to solve the homework problems. A complete copy of the Honor Code may be obtained from the School of Engineering Honor Council or over the WWW at

http://www.olemiss.edu/depts/engineering_school/students/current/honor_council.html

Class Preparation:

Each student should read all assigned material prior to the scheduled class meeting and be prepared to ask questions and/or discuss the material covered in the class lecture.

Topics to be covered in class are shown below. Students are expected to read the relevant textbook material for each topic **prior** to the class meetings. In addition to the Mil-17 pages listed, appropriate ASTM (or other) standards and relevant pages in the provided course pdf files should also be read as assigned. Topics to be read for the upcoming class will be announced prior to that class period.

- General Composites Introduction
- Composites Manufacturing Methods
- Composite Constituent Materials
- Quality Assurance Methods for Composites
- Introduction to Mil-17 (CMH-17)
- Standards Development Procedures
- Webinar by ASTM D30 Committee
- Application of Testing to Building Block Approach to
 - Composite Design and Test Methods (Mil-17 Vol. 1 - Ch. 2, pp. 2-1 - 2-10)
- Statistical Data Analysis (Mil-17 Vol. 1 - Ch. 8)
- Sample Prep, Conditioning, and Testing Equipment (Mil-17 Vol. 1 - Ch. 6, pp. 6-1 - 6-27)
- Tensile Testing (Mil-17 Vol. 1 - Ch. 6, pp. 6-89 - 6-102)
- Compression Testing (Mil-17 Vol. 1 - Ch. 6, pp. 6-104 - 6-115)
- Shear Testing (Mil-17 Vol. 1 - Ch. 6, pp. 6-116 - 6-127)
- Flex Testing (Mil-17 Vol. 1 - Ch. 6, pp. 6-128)
- Volume Fraction Determination (Mil-17 Vol. 1 - Ch. 6, pp. 6-42 - 6-50)
- Fracture Toughness Testing/Delamination Characterization (Mil-17 Vol. 1 - Ch. 6, pp. 6-128 - 6-137)
- DSC/Rheology (Mil-17 Vol. 1 - Ch. 6, pp. 6-13 - 6-19)
- Flammability and Smoke Generation Testing (Mil-17 Vol. 1 - Ch. 6, pp. 6-78 - 6-87)
- Electrical Property Testing (Mil-17 Vol. 1 - Ch. 6, pp. 6-87 - 6-88)
- Structural Element Characterization (Mil-17 Vol. 1, Ch. 7)
- Other test methods