22.597 Processing of Composites
Department of Mechanical Engineering, UMass Lowell

Fall 2013 (last updated 9/7/2013**)**

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Textbook: Principles of the Manufacturing of Composite Materials,
Suong V. Hoa. DEStech Publications. ISBN: 978-1932078268
Note: This textbook is a *recommended* textbook, but is *not required* for purchase, as it is available as an eBook through the UML library. If you wish to order a hardcopy of the text, you can receive a discount by ordering direct through DesTech Publications.

References: The course will have a "research guide" website hosted on the library website and is available at: http://libguides.uml.edu/content.php?pid=498109. This site lists the electronic resources that are available to all enrolled students free of charge, including the course text. If you have any issues accessing the material, please contact me or the engineering librarian (Margaret Manion, Margaret_Manion@uml.edu) so that we can resolve them. Some of the key references used are:

- Fundamentals of Composites Manufacturing: Materials, Methods, and Applications by Brent A. Strong, Society of Manufacturing Engineers (SME), 2008.
- Composites Manufacturing by Sanjay K. Mazumdar, CRC Press, 2001.
- Manufacturing Processes for Advanced Composites by F.C. Campbell, Elsevier, 2004.
- Processing of Composites edited by Raju S. Dave and Alfred C. Loos, Hanser Publishers, 2000.
- Handbook of Composite Reinforcements edited by Stuart Lee, Wiley, 1993.
- Fundamentals of Metal-Matrix Composites edited by Subra Suresh, 1993.
- Ceramic Matrix Composites - Microstructure, Properties, and Applications edited by I.M. Low, Woodhead Publishing, 2006.
- Process Modeling in Composites Manufacturing edited by Suresh G. Advani, CRC Press, 2002.
- Innovations in Materials Manufacturing, Fabrication, and Environmental Safety edited by Mel Schwartz (specifically chapters 17-22), CRC Press, 2010.
- Assorted journal articles
- ASTM STPs (Selected Technical Papers)

Class: Tuesdays 6:00-9:00pm

Office hours: Contact me via email or phone with 24 hours notice to schedule an appointment.

Grades:		
	Homework	25%
	Midterm exam	25%
	Final report	25%
	Final presentation	25%

Note: the final report and presentation will replace a final exam.

Homework: Homework will be assigned in class and be due Friday by 9am the following week (10 days after being assigned). Solutions will be handed out in class two weeks after homework is assigned. Late homework will be docked by 33% for each day late, unless prior arrangements are made.

Midterm exam: The midterm exam will cover material discussed in class on and prior to October 22 2013. Make-up exams will not be given, and all exam conflicts must be discussed with me at least 2 weeks prior to the exam.

Final report: The final report will provide an in-depth explanation of a specialized composites manufacturing technique. Topics and a grading rubric will be provided during the semester.

Final presentation: The final presentation will present a literature analysis of a particular topic in modern composite materials processing and/or in-class manufacturing projects.

Tours, speakers: In order to provide as much practical experience regarding industrial processes used in composites manufacturing, the instructor is organizing multiple tours and speakers. These will be announced in class at least a week in advance. Tours may be of sensitive defense-related installations and require pre-registration so that the manufacturers can proceed with the proper protocols for foreign national students.

Echo360, Blackboard: The course will have all classroom lectures recorded using the Echo360 system. Course materials will be posted on a Blackboard Learn website in order to minimize the paper used in class.

Academic integrity:
All homework, exams, and projects are to represent their own original work. Students are prohibited from infractions of academic integrity, which includes cheating, fabrication, plagiarism, or facilitating dishonesty. Infractions will <u>not</u> be tolerated and will be reported the department chair to initiate a formal process. For more information, the university policy on academic integrity is available at:
http://www.uml.edu/catalog/graduate/policies/academic_dishonesty.htm

Course Objectives

The goal of this course is to provide an overview of the both the scientific and practical aspects of processing composites. An emphasis will be placed on polymer matrix fiber-reinforced composites, though short fiber-reinforced composites and metal- and ceramic-matrix composites will be discussed briefly. Nanocomposites will not be discussed in depth, as this is covered in-depth in 22.570 "Polymer Nanocomposites." Overarching topics to be covered include:

- An understanding of the end goal of successful composites processing
- Intuitive understanding of polymer matrix chemorheology
- Hands-on familiarity with hand lay-up, thermoforming, compression molding, and braiding.
- Analysis of forming, permeability, and consolidation of composite parts.
- Grasp composite design methodology as it relates to factors of strength, assembly, cost, and environmental impact.

Topic schedule: (subject to revision)

Lecture	Date	Lecture topic	Reading
1	9/10	Introduction. End goal of processing. Definition of composite. Fibers, matrix, interface.	
2	9/17	Matrices: materials, rheology, infiltration	
3	9/24	Fibers: materials, formats, strengths. Possible supplemental tour of Specialty Materials (Lowell MA)	
4	9/31	PMC: Molds, hand lay-up (hands-on in ACTMRL)	
5	10/8	PMC: Compression molding (tour of ACMTRL), thermoforming (tour of composites machine),	
6	10/15	PMC: Pultrusion and (possible) tour of Pulsan (Woburn MA)	
7	10/22	In-class mid-term exam. RTM/VARTM	**NA**
8	10/29	PMC: Braiding (lecturer, ACMTRL lab tour), filament winding, automated tape placement	
9	11/5	MMC: infiltration, dispersion, deformation	Supplemental
10	11/12	CMC: various ceramic matrix-fiber combinations	
11	11/19	Assembly: design to avoid, joining, machining	Supplemental
12	11/26	Repairs: fill, scarf, injection, bolted, bonded	Supplemental
13	12/3	Industrial aspects: safety, storage, handling, disposal, economics	Supplemental
14	12/10	TBA	**NA**
Finals	TBD	Final project presentations	**NA**