

Oregon Institute of Technology
Certificate of Completion in Composite Engineering Technology

ENGR407C
Composite Materials & Processes I

COURSE OBJECTIVES

Composite Materials & Processes I covers the basics of polymer chemistry, physics and *Material* forms. Major topics of concern are as follows:

1. Introduction to composite materials and processes.
2. Fibers, reinforcements and product forms.
3. Resins.
4. Ply Collation.
5. Curing.
6. Physiochemical testing and quality Control

This course will provide practical hands on knowledge of composite materials and their constituents. Students completing the Composite Materials & Processes curriculum will possess the tools necessary to engage in product development activities such as: trade studies, Integrated Product Team (IPT) membership, methods/materials down select, prototyping and production implementation. As evidenced by Boeing's commitment to the extensive use of composites on several key next generation programs (787, Unmanned Combat Air Vehicle, Sea Launch, etc.), such broad based materials and processing knowledge is key for Engineers, Technicians and Production Personnel engaged in or contemplating work in the field.

In addition, the ENGR version of 407A places additional math based emphasis on advanced topics. It requires completion of all the ENGT material plus extra HW3, HW6, midterm and final ENGR specific questions. The HW will be graded as 30% ENGT and 70% ENGR & tests will be graded as 70% ENGT and 30% ENGR.

COURSE REQUIREMENTS

- Prerequisite: none, must be Boeing, U.S. Person
- Required - An active e-mail account for receiving information via Boeing File Transfer Service. PowerPoint, Word and Acrobat Reader software.

GRADING

- Homework – 100 points, see below
- Mid Term Exam – 100 points, take home open book
- Final Exam – 100 points, take home open book

A	B	C	D	F
300-270	269-240	239-210	209-180	<180

COURSE MATERIALS

1. Lectures/learning module material is compiled from Campbell & Miracle and S.L. Donaldson, texts, industry sources, and Boeing documents.
2. Primary Textbook
 - P.K. Mallick, “Fiber-Reinforced Composites: Materials, Manufacturing, and Design,” CRC Press; 2 edition, (2007):1-1201, (ISBN-10: 0849342058)2nd Textbook
 - F. C. Campbell, “Manufacturing Processes for Advanced Composites,” *Elsevier Science Ltd*, (2004): 1-448, (ISBN: 1856174158)
[\\nw\data\Composites-Data\Text, Calender, Lab\Text - Campbell](#)
3. Miscellaneous videos will be shown highlighting specific topics.
4. Course material will be shared via the following methods:
 - **Boeing e-mail and Message Courier** – encrypted when material is proprietary

ADDITIONAL RESOURCES

- United States Patent and Trademark Office <http://www.uspto.gov/patft/index.html>
- Boeing Library Services: <http://library.web.boeing.com/>
- Product Standards Data System:
<https://psds.web.boeing.com/psds/servlet/Psds?action=DisplayMainMenu>
- Technology Exchange Forum:
<http://pe.ca.boeing.com/people/PETechnicalExcellence.asp>

HOMEWORK

There will be 6 homework assignments. Late homework will be docked 10%. Up to 110 points worth of homework is allowed (i.e., one extra homework can be handed in for extra credit). Each homework activity is worth 16.7 points

Homework Description	Due Date
HW1	
HW2	
HW3	
HW4	
HW5	
HW6	
Extra credit: Article review: read and provide a 2-page summary/review of a trade journal article concerned with some facet of composite materials. Boeing Product or Component Presentation: provide a Powerpoint presentation concerning something you are working on and be prepared to discuss it with the class	

Tests

Tests will be take-home. The Midterm will cover material from the first half of the course and the Final will cover material from the second half. The tests will be a combination of short answer, fill in the blank, multiple choice and short essay. Questions will be taken from lecture and reading material. They will be e-mailed out 2 weeks prior to the due date. Completed tests must be e-mailed by midnight on the date due. Be sure to retain a copy of all work.

COURSE OUTLINE

Week	Date	Reading & Material covered
1		Module 1 Campbell Chapter 1.1 to 1.8 ASM pp. 3-17 (Introduction to Composites), 421-422 (Manufacturing Processes/Introduction to Manufacturing of Polymer-Matrix Composites) <i>Introduction to composite materials and processes:</i> laminates, fibers, matrices, product forms, overview of fabrication processes, advantages and disadvantages of composites, and applications.
2		Module 2 Campbell Chapter 2, Chapter 8.8-8.13, Chapter 9.1-9.13 ASM pp. 21-77(Constituent Materials/Introduction to Constituent Materials to Braiding), 180-183 (Constituent Materials/Lightweight Structural Cores) <i>Fibers, reinforcements and product forms:</i> fiber terminology, glass fibers, aramid fibers, UHMWPE fibers, carbon/graphite fibers, woven fabrics, reinforced mats, chopped fibers, prepregs, preform technology, knitting, stitching, braiding and sandwich structures.
3		Module 3 Campbell Chapter 3, 10.1-10.3 ASM pp. 78-149 (Constituent Materials/Epoxy Resins to Molding

		Compounds) <i>Resins:</i> thermosets, thermoplastics, polyester, vinyl ester, epoxy, bismaleimide, cyanate ester, polyimide, phenolics, toughening, chemical characterization & quality control and Tg
4		Module 4
		<i>Midterm Exam Due (Covers weeks 1-4) (contains Extra ENGR content)</i>
5		Module 5 ASM pp. 677-681 (Quality Assurance/Introduction to Quality Assurance & Resin Property Analysis), <i>Physiochemical testing and Quality Control:</i> prepreg physical, chemical, thermal and rheological properties; and laminate evaluations
6		Module 6 Campbell Chapter 5.1-5.6, 5.10 ASM pp. 470-476 <i>Ply Collation:</i> Prepreg control, tool preparation, manual lay-up, ply collation, flat ply collation, and vacuum forming.
		<i>Watch Guest Videos</i>
7		Module 7 Campbell Chapter 6.1-6.8 ASM pp. 486-491 (Manufacturing Processes/Curing) <i>Curing I:</i> Prepreg control, tool preparation, manual lay-up, ply collation, flat ply collation, vacuum forming, void formation, hydrostatic resin pressure, chemical composition, net and low flow resins, lay-up variables, debulking, caul plates and pressure intensifiers.
8		Module 8 Campbell Chapter 7 685-691 (Quality Assurance/reinforcing Material Lay-up Quality Control)
		<i>Final Exam (Covers weeks 6-9) (contains Extra ENGR content) & all Homework Due</i>

* HW due

*- HW due

Incomplete “I” Grade:

An “Incomplete” will only be given in extenuating circumstances at the discretion of the instructor for which official work conflicts, illness or emergency situation has precluded completion of a major course event prior to the end of the course. An “Incomplete” must be resolved between the instructor and student during the term immediately following the course or the instructor-designated alternate grade will result and will be permanent.

Primary ABET CRITERIA:

- a. An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines.
- b. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology.
- f. An ability to identify, analyze and solve technical problems
- k. A commitment to quality, timeliness, and continuous improvement.

Disability Support:

If you may need a course adaptation or academic accommodation because of a disability, please contact Disability Services as soon as possible at the OIT main campus in Klamath Falls, Oregon. Their number is (541) 885-1129. The director is Dr. Joan Loustalet and she will verify the need for accommodations and develop accommodation strategies. She will coordinate a plan with you and the Seattle OIT program office.