

**SMFG 347- Sustainable Polymer Composites – 3.0 Units**

Prerequisite: MECH 210 or SMFG 211

Course Times: Lecture T, R 9:30 – 10:20 AM LANG 104

Instructor: Professor Joe Greene (jpgreene@csuchico.edu)

Web page: <http://www.csuchico.edu/~jpgreene>

Office: Location- O’Connell 416 – Phone: 898-4977
Hours T, W 11:00 AM – 12:50 PM

Course Objective: Provide students an introduction to composite materials and processing by investigating thermoplastic composites, thermoset resins, glass and carbon reinforcements, core materials, tooling, and thermoset processing equipment.

Laboratory Objectives: Provide students a basic knowledge of molding thermoplastic and thermoset composites, including epoxy, polyester, vinyl ester, and polyurethane. Processing methods include hand-layup, vacuum assisted molding, injection molding, RTM, and compression molding.

Textbook

- Fundamentals of Composites Manufacturing, 2nd Edition Strong, SME, Dearborn, MI 2008

Safety: Safety glasses with side shields must be purchased by the student and worn at all times in the lab. Failure to do so will result in the student being removed from the lab and being dropped from the class. The student must read, understand and follow all safety procedures at all times. If there are any questions about the process, operation, or safe handling of materials, the student must talk to the instructor.

General

1. The student is responsible for understanding the policies and procedures about add/drops, academic renewal, etc. found <http://www.csuchico.edu/catalog/>. The student should be aware of the new deadlines and penalties for adding and dropping classes.
2. Absences are allowed only for illness (doctor’s note required) or other serious reasons with permission prior to the class.
3. Grades will be reduced one full grade for each week assignment is late.



4. Class announcements regarding tests, class cancellations, etc., will be done via the student WildcatMail email account as required per University policy. If the student has another preferred email provider, the student may set up automatic forwarding of the student WildcatMail to that address via www.csuchico.edu/itss

Grading

1 Midterm exam	20%
1 Final exam	20%
Unannounced Quizzes	20%
Homework	10%
Polymer Composite Material (1 paper)	20%
Literature Review (2 papers)	<u>10%</u>
	100%

Reports (All reports will be typed and double spaced.)

1. Literature Review (Individual)

- Report on any current article (2018 or 2019) concerning thermoset composites. Available resources include Composites Magazine, Composites World (www.compositesworld.com), web sources (www.sciencedirect.com), Journal of Composites (<https://journals.sagepub.com/home/jcm>), (4 to 5 pages typed and double-spaced).

- **Paper 1 – Due Feb 6, 2014**

- **Paper 2 – Due Apr 2, 2014**

2. Polymer Composite Paper (Groups of 2 students) Paper 1: **Due April 30, 2014**

Each student group of two students will be responsible for **one** paper on composite materials, processing, and design. The project paper will be chosen by the student from a list provided by the professor and can be a thermoplastic or thermoset polymer composite. The paper should be 8 to 12 pages typed and double spaced. It should include the following:

- Chemistry and properties of matrix resin.
- Reinforcement type and properties.
- Processing method, e.g., hand-layup, vacuum assisted molding, injection molding, resin transfer molding, or compression molding.
- Applications and commercial uses.
- Products made with the composite material and material cost estimates.
- CAD design of a part made with the material.
- FEA of the part under load. Loading conditions provided by the professor.
- References from published papers.



MECH 410 Schedule

<u>Week</u>	<u>Chapter</u>	<u>Homework*</u>
1. Jan 21	Introduction	Chapters 1 and 2
2. Jan 28	Polyester resins	Chapter 3
3. Feb 4	Epoxy resins	Chapter 4 (Lit 1 due)
4. Feb 11	Specialty resins	Chapter 5
5. Feb 18	Thermoplastic Composites	Chapter 6
6. Feb 25	Glass and Carbon Reinforcements	Chapter 8
7. Mar 3	Reinforcement Forms and Cores	Chapter 9 & 12
8. Mar 10	<u>Mid-term</u>	
March 17 th	Spring Break No School	
9. Mar 24	Advanced Composites	Chapters 13, 14
10. Mar 31	Resin Infusion Technologies	Chapter 16 (Lit 2 due)
11. Apr 7	Compression Molding and Composites	Chapters 15, 19
12. Apr 14		
13. Apr 21	Composites Design	Chapter 11
14. Apr 28	(Composites Material Paper due)	
15. May 5	FEA of Composites	
16. May 11	Final Exam TBD	

- Note: Homework will be due on Tuesdays (one week after assigned)
- Note: Papers are due on Thursdays on BlackBoard Learn
- Note: Scheduled dates may change during the semester



Format for Literature Review Individual assignment

SMFG 347
Your Name
Date

Author, "Title," *Periodical Source*, **volume**, page (month year)

For Example

Cox, H., Mentzer, C., et.al., "The Flow of Thermoplastic Melts," *Polymer Engineering and Science*, **24**, 501 (October 1984)

Introduction

[Introduce the subject matter and any major contributors or companies. Explain the significance of the topic and the intended audience]

Summary

[Summarize the main points of the article including assumptions, materials, properties, experimental procedures, results, and implications]

Conclusions

[List interesting features in the article and any conclusions or recommendations that you can draw. Also, identify errors or miscalculations in the article if you find them]



Format for Materials Paper Group of two students

SMFG 347

Your Name

Date

Paper Title

Introduction

[Introduce the composites part that you will design and build. Explain resin and fiber materials that can be used to build it. Explain how the part is used and any mechanical or performance constraints on the part. Explain the significance of the composite part and the intended audience.]

Design

[Summarize the design in CAD and the performance criteria and provide proper views. Summarize the FEA on the part to achieve a deflection equal to the thickness of the part? How much loading and what are the Von Mises stresses?]

Material

[Summarize the resin material in terms the chemistry, properties, and special features. Summarize the fiber materials for carbon ,glass, and Kevlar. Describe the properties, fiber layup, and other special features of fiber.]

Processing method

[Describe the processing methods used to make parts. Describe the experimental conditions and results for temperature, pressure, cycle time, mold prep, etc.]

Tooling

[Describe the tooling method, materials, and process to produce tooling]

Costs

[Describe the costs to manufacturing the part in production assuming steel tooling and fast cycle times. Costs should include resin and fiber materials, machine time, labor, tooling, etc.]

Conclusions

[List interesting features in the paper about the part design, processing, materials, etc. Described any significant knowledge gained during the assignment.]