

ME 646 Introduction to Composite Materials

UNLV Department of Mechanical Engineering

Check Web Campus regularly for updates and supplemental information

Days and Time: Tuesday-Thursday, 11:30 AM – 12:45 PM, CEB 142

Text: Fiber-Reinforced Composites: Materials, Manufacturing, & Design",
Third Edition, P.K. Mallick, Marcel Dekker, 2007

Course Website: Log in to WebCampus

Course Overview:

Students will learn introductory aspects of fiber reinforced materials including: properties of common materials, manufacturing methods, testing methods, stress and failure analysis, and design.

Course Learning Outcomes:

By the end of this course, students will be able to:

1. Select appropriate fiber and resin systems for specific applications.
2. Select a manufacturing process for a composite component based on the product needs and materials being used.
3. Determine stresses in composite laminates using hand calculations and computer software.
4. Predict maximum loads on composite structures using common failure theories.
5. Design a composite structure for a specific application.

Prerequisites

ME 302 Materials Mechanics and MATH 431 Differential Equations are prerequisites.

Summary Course Outline

Week	Chapter	Topics	Assignments
1	1	Introduction General Material Characteristics	
2	1-2	Applications Fiber and Matrix Properties	HW Ch 1: 1, 3, 6, 7, 8, 9
3	2-3	Density and Voids Quiz 1	HW Ch 2: 1, 3, 8, 9, 11, 13, 18
4	3	Longitudinal Strength Short Fiber Properties	
5	3	Transverse and Other Lamina Properties Lamina Analysis	
6	3	Lamina Analysis Laminate Properties	HW Ch 3a: 2, 5, 8, 9, 20, 24, 27
7	3	Laminate Examples Quiz 2	Project Proposals Due
8	3	Laminate Examples Project Discussions	
9	4	Static Mechanical Properties Guest Lecture: Industry Perspective	HW Ch 3b: 32, 38, 42, 47

10	4	Static Mechanical Properties Quiz 3	
11		Spring Break	
12	4	Fatigue and Other Properties Homework Problem review	
13	5	Composite Manufacturing and Inspection Quiz 4	HW Ch 4: 1, 6, 13
14	6	Design Issues and Failure Prediction	
15	6	Laminate Design Considerations Quiz 5	HW Ch 5: 2, 7, 10
16		Study Week	
17		Final Exam	Project Reports Due

GRADING:

Quiz 1 - 5	50 % (12.5 % each, drop lowest quiz grade)
Homework Assignments	15 %
Design/Research Project	15 %
Final Exam Part 1	10 %
Final Exam Part 2	10 %

Homework:

The homework assignments are due at the beginning of class on the dates specified on the previous page. The problems and due dates may be changed during the semester. Any changes will be announced in class; it is your responsibility to be aware of these changes.

Quizzes:

A series of in-class, closed book quizzes will be given throughout the semester. The quizzes will consist of several short answer questions covering topics from the reading assignments in the textbook, class lectures, and homework assignments. The quizzes may have some problem solving questions requiring the use of a calculator. The questions asked on the quizzes will focus primarily on recent topics covered in class. The quizzes will be given at the beginning of class and will last from 20-60 minutes.

Design/Research Project Schedule and Format

February 12, 2015 Design/Research proposal due

What are the geometric constraints, weight limits, approximate loading conditions (applied loads and supports), special restrictions, etc. Submit a short report defining your problem; include questions, which need answers in order to complete the design. Include rough sketches of your design problem. How will the work be divided between each group member. Each person must be in charge of a significant portion of the project. Submit a preliminary schedule for the semester.

May 7, 2015 Submit complete design report

Follow the outline below.

Project Requirements Outline

1. Group names, project title, subtasks

You must have a minimum of 2 people per group and a maximum of 4. Each person should be responsible for a specific part of the project/report.

2. Concise statement of the problem that clearly defines what you are trying to accomplish

- a) Structural analysis and design of a composite component
- b) How would the component be made
- c) Literature review of a contemporary composites research topic

3. What are the design constraints?

- a) Geometric limitations, weight limitations, etc., loading conditions

4. What are the design criteria? (How will you compare different design options?)

- a) strength, cost, stiffness, etc

5. Analysis / Fabrication / Review of literature

Material options, manufacturing options (prototype vs. production), recommended testing, test results (if possible), stress analysis, assumptions made for stress analysis, software used, assumptions used about loading conditions, confidence level in your assumptions and analysis, error estimates, etc.

6. Summary and recommendations

7. Well formatted list of references (examples below)

All references should be cited in the body of the text. There should be a minimum of 10 references per group member for any type of project. A research literature review project should have a minimum of 10 journal publication references per group member.

Example Format for Report

1. Title Page
 - A. Title of project
 - B. Author
 - C. Mail box number
 - D. Group members
 - E. Date submitted
2. Abstract
 - A. Objective
 - B. Brief summary of procedure
 - C. Summary of results
3. Introduction
 - A. Literature survey
 - B. Detailed description of the problem
 - C. Discuss design procedure, options, selection criteria
4. Analysis Methodology
 - A. Discuss methods and assumptions used
 - B. Include sketch's and free body diagrams
 - C. Use text to describe your equations
 - D. Include description of experiments (if appropriate)
5. Results
 - A. Include tables or graphs based on your analysis
 - B. Discuss results shown in tables or graphs
 - C. Select final design
6. Conclusions
 - A. Discuss the significance of your results
 - B. Did you meet your objectives?
 - C. How could you improve the design or the analysis
7. References
8. Appendices
 - A. Sample Calculations
 - B. Raw Data

Library Resources

- Students may consult with a librarian on research needs. For this class, the subject librarian is Sue Wainscott.
(https://www.library.unlv.edu/contact/librarians_by_subject). UNLV Libraries provides resources to support students' access to information. Discovery, access, and use of information are vital skills for academic work and for successful post-college life. Access library resources and ask questions at <https://www.library.unlv.edu>.

Policies:

Academic Misconduct—Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution.

An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: <https://www.unlv.edu/studentconduct/student-conduct>.

Copyright—The University requires all members of the University Community to familiarize themselves **with** and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws.** Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: <http://www.unlv.edu/provost/copyright>.

Disability Resource Center (DRC)—The UNLV Disability Resource Center (SSC-A 143, <http://drc.unlv.edu/>, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

Religious Holidays Policy—Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor within the first 14 calendar days of the course for fall and spring courses (excepting modular

courses), or within the first 7 calendar days of the course for summer and modular courses, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=6&navoid=531>.

Transparency in Learning and Teaching—The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information:

<https://www.unlv.edu/provost/teachingandlearning>

<https://www.unlv.edu/provost/transparency>

Incomplete Grades—The grade of I—Incomplete—can be granted when a student has satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student's control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

Tutoring and Coaching—The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit <http://www.unlv.edu/asc> or call [702-895-3177](tel:702-895-3177). The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

UNLV Writing Center—One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>.

Rebelmail—By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu. **Emailing within WebCampus is acceptable.**

Final Examinations—The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>.