

School of Engineering

Course ID and Title

AME 499 – Advanced Mechanics of Composite Materials for Modern Structures Spring 2017

Mondays: 4:30p to 7:00p

Location:

Instructor: Vinay Goyal Office: Office Hours: Contact Info: vinay.k.goyal@gmail.com

Teaching Assistant: Requested Office: Office Hours: Contact Info:

IT Help: None Hours of Service: Contact Info:

Course Description

Composites materials are extensively used in the aircraft, launch vehicles, spacecraft vehicles, automotive industry, sporting goods, construction, and marine industries due to their high-performance, high strength-to-weight ratio, and aesthetics. This course will cover current and potential applications of composite materials including: (1) Manufacturing methods for composites; (2) Elasticity of anisotropic solids; (3) Methods for determining composite mechanical properties; (4) Analysis of composite materials using laminated plate theories and approximate solutions for bending, vibration, and buckling; (5) Failure analysis of composite materials; and (6) Design considerations: design, inspection, and repair processes.

Learning Objectives

The fundamental concepts in the analysis and design of laminated composite Structures will be developed. Students are expected to learn:

- (1) Manufacturing and analysis of composite materials
- (2) Experimental methods for the characterization of composite materials
- (3) Failure criteria to predict failure of composite structures
- (4) Design considerations and applications

Prerequisite(s): AME 204 Co-Requisite (s): None Concurrent Enrollment: None Recommended Preparation: None

Course Notes

Copies of lecture slides and other class information will be posted online.

Technological Proficiency and Hardware/Software Required

Mathematica, Matlab Not Required, but will be taught as part of the course

Required Readings and Supplementary Materials

Primary Textbook: Mechanics of Laminated Composite Plates and Shells: Theory and Analysis, Second Edition, by J. N. Reddy, CRC Press

Additional Textbooks:

- 1. Mechanics of Composite Materials, Second Edition, by R. M. Jones, Taylor & Francis, Inc
- 2. Engineering Mechanics of Composite Materials, by I. M. Daniels, Oxford University Press, USA
- 3. Principles of Composite Materials Mechanics, Third Edition R. F. Gibson, CRC Press
- 4. Composite Filament Winding, by S. T. Peters, ASM International
- 5. Mechanics of Composite Materials with MATLAB, G. Z. Voyiadjis, Springer.

Description and Assessment of Assignments

Homework will be assigned approximately weekly and will generally be due at the beginning of class one week after the date assigned.

Grading Breakdown

Weekly Homeworks

Assignment and Exams Submission Policy

Homework will be submitted to professor. Late assignments will not be accepted. Exams will be take-home.

Course Schedule: Weekly Breakdown

	Topics/Daily Activities
Week 1	Introduction to Composite materials, fibers, matrices
January 9	
Week 2	MLK Birthday
January 16	
Week 3	Micromechanics, Manufacturing Processes and
January 23	Nomenclature
Week 4	Stress, Strain, Constitutive Law, and Equilibrium
January 30	Equations Part I
Week 5	Stress, Strain, Constitutive Law, and Equilibrium
February 6	Equations Part II
Week 6	Characterization of Fundamental Macromechanical
February 13	Properties of Composites
Week 7	President's Day
February 20	
Week 8	Effective 3D Orthotropic Material Properties of
February 27	Laminates
Week 9	Classical Lamination Plate Theory
March 6	
Week 10	RECESS
March 13	
Week 11	Tailoring and Optimization of Composites
March 20	
Week 12	Tailoring for Dynamic and Buckling Problems
March 27	
Week 13	Energy Methods and Approximation Theory
April 3	
Week 14	First Order Shear Deformation Theory
April 10	
Week 15	Failure Theories
April 17	
Week 16	Review
April 24	

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) <u>ability@usc.edu</u>.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.