USC Viterbi
School of Engineering

AME 499 – Applied Modern Composites

Spring 2018

Wednesdays: 4:10p to 6:20p

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
ALL NOTES WILL BE PROVIDED

Additional Textbooks:

1. Mechanics of Composite Materials, Second Edition, by R. M. Jones, Taylor & Francis, Inc
2. Mechanics of Laminated Composite Plates and Shells: Theory and Analysis, Second Edition, by J. N. Reddy, CRC Press
3. Engineering Mechanics of Composite Materials, by I. M. Daniels, Oxford University Press, USA
4. Principles of Composite Materials Mechanics, Third Edition R. F. Gibson, CRC Press
5. Composite Filament Winding, by S. T. Peters, ASM International
6. 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 Projects

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
Lecture 1	Lessons Learned in the Certification of Composite Structures – Lab Demonstration
Lecture 2	Qualification, workmanship, and acceptance philosophy of composite structures.
Lecture 3	Micromechanics, Manufacturing Processes and Nomenclature (45 minutes additional time) Composite materials, fibers, matrices
Lecture 4	Unvented Honeycomb Designs Stress, Strain, Constitutive Law, and Equilibrium Equations Part I
Lecture 5	Stress, Strain, Constitutive Law, and Equilibrium Equations Part II
Lecture 6	Characterization of Fundamental Macromechanical Properties of Composites, A-Basis and B-Basis Allowable
Lecture 7	CMH17 Building Block Approach Predicting Failure of Sandwich Structures
Lecture 8	Effective 3D Orthotropic Material Properties of Laminates (45 minutes additional time)
Lecture 9	Classical Lamination Plate Theory COPV Design and Analysis (Netting Analysis)
Lecture 10	Seminar on Composite Impact Damage and Progressive Failure Analysis of Composites
Lecture 11	Tailoring and Optimization of Composites (45 minutes additional time)
Lecture 12	Tailoring for Dynamic and Buckling Problems Optimization of Composites
Lecture 13	Energy Methods and Approximation Theory
Lecture 14	First Order Shear Deformation Theory Application to the Analysis of Sandwich Structures
Lecture 15	Failure Theories (45 minutes additional time) Bearing and Bypass Failure Modes in Composites
Lecture 16	Review

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) ability@usc.edu.

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.