

MAE 4301-007 AE 5301-002 ME 5390-004

Multifunctional Smart Composite Space Structures

(3-0-3)

Spring Semester 2011

Course Syllabus

Instructor(s): Dr. D. Stefan Dancila

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Office Hours: Tuesdays and Thursdays, 16:00:00-17:20

Section Information: MAE 4301-007/AE 5301-002/ME 5390-004 Multifunctional Smart Composite Space Structures

Time and Place of Class Meetings: Woolf Hall 210, Tuesdays and Thursdays 16:00-17:20

There will be no class the week of Spring Break (March 14-18, 2011).

Description of Course Content: A broad, new interdisciplinary senior/graduate level course in multifunctional smart composite space structures. The course will address the need for multifunctional characteristics in space structures, launch costs from energy and financial perspectives, the launch and space environments, fundamentals of composite material concepts, structural dynamics and vibration, heat transfer, active/smart materials and structures, electromagnetism, and optics, optimization, and fundamental multifunctional aspects relevant for inflatable/erectable/deployable space structures, reflectors, habitats.

Topics:

1. **Fundamental Composite Materials Concept Review:** High performance fibers, polymeric matrix materials, anisotropy, lamina response, classical lamination theory, failure criteria, environmental effects.
2. **Fundamental Structural Dynamics and Vibration Review:** Vibration modes and frequencies, forced vibration, nonlinear vibrations, resonance, acoustic excitation, random excitation.
3. **Fundamental Heat Transfer Phenomenology Review:** Convective, conductive, and radiative heat transfer.
4. **Active/Smart Material Concepts:** Piezoelectric effect, piezoresistive effect, magnetostrictive effect, shape memory alloys.

5. **Carbon Nanotubes:** Basic results and properties, physical effects of interest.
6. **Relevant Electromagnetism Phenomenology and Applications Review:** Basic results, DC circuits, AC circuits, electromagnetic waves, antennae.
7. **Relevant Optics and Optical Semiconductors Phenomenology and Applications Review:** Light emitting diodes, laser diodes, fiber optics, optical sensors, reflectors, parabolic concentrators, etc.
8. **Space Structures:** Environment (launch, space, atmospheric entry/reentry); margins of safety requirements; acoustic and vibration excitation launch environment.
9. **Inflatable Structures:** Habitats, reflectors, rigidizable inflatable structures.
10. **Erectable/Deployable Structures:** Mechanisms, compliant mechanisms, compliant unfolding/unfurling structures.
11. **Space Tethers:** Classical tethers, electrodynamic tethers, deorbiting tether concepts, space elevator concept.
12. **Composite Flywheels:** Energy storage concepts and limitations.
13. **Smart Material Structural Damping:** Vibration reduction using smart material actuators.
14. **Gossamer Structures:** Solar sails, very large area reflectors, decelerators.
15. **Integration of Structural Multifunction Components:** Structure-antenna, structure-reflector.

Student Learning Outcomes: Students will study and understand the requirements imposed upon multi-functional space structures - environmental, operational, functional, margin of safety, reliability, endurance, environmental resistance, etc. Students will understand a wide range of multifunctional structural concepts, with emphasis on their fundamental operating principles, capabilities, and limitations of each concept.

Requirements: Instructor approval.

Text: Course notes and materials.

Descriptions of major assignments and examinations with due dates:

Midterm – Tuesday, March 22, 2010, 16:00-17:20; Covers all class material to date, including homework and reading assignments;

Homework – assigned weekly after Thursday class and due before the following Thursday class meeting; Covers all class material to date, including new reading assignments.

Final Exam – on the date scheduled by the University during the Final Exam Period; Covers all class material, including homework and reading assignments.

NB. Homework turned in late (after the class starts) will be considered late and penalized 20%. UTA regulations permitting, a missed midterm and/or final exam can only be rescheduled when missed due to major health problems and/or circumstances beyond the student's control, and in such cases at the earliest time possible and agreeable to the instructor thereafter.

The assignments for the undergraduate and the graduate sections of the class may differ.

Grading Policy: Each of the three components below will be graded on a scale from 0 to 100 points and the final numerical grade will be computed as a weighted average by using the weighting factors shown below.

Midterm	30%
Homework	20%
Final Exam	50%

The final letter grade will be determined by converting the numerical final grade according to the following ranges:

Final Numerical Grade	Letter Grade
85-100	A
75-84	B
65-74	C
50-64	D
0-49	F

Attendance Policy: Students are expected to attend all class meetings and to arrive on time.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. Contact the Financial Aid Office for more information. The last day to drop a class for the Spring 2010 semester is April 2, 2010.

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Academic Integrity: It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University. According to the UT System Regents' Rule 50101, §2.2, "Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any

work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts."

NB. Any violation of Academic Integrity will automatically result in a grade of F for the course.

Student Support Services Available: The University of Texas at Arlington has established a variety of programs to help students meet the challenges of college life. Support to students includes advising, counseling, mentoring, tutoring, supplemental instruction, and writing assistance. For a complete list of academic support services, visit the Academic Assistance resource page of the Office of Student Success Programs, www.uta.edu/uac/studentsuccess/academic-assistance. To help students address personal, academic and career concerns, individual counseling is also available. For more information, students are encouraged to contact Counseling Services www.counseling.uta.edu at (817) 272-3671 or visit a counselor in 216 Davis Hall.

Electronic Communication Policy: The University of Texas at Arlington has adopted the University "MavMail" address as the sole official means of communication with students. MavMail is used to remind students of important deadlines, advertise events and activities, and permit the University to conduct official transactions exclusively by electronic means. For example, important information concerning registration, financial aid, payment of bills, and graduation are now sent to students through the MavMail system. All students are assigned a MavMail account. ***Students are responsible for checking their MavMail regularly.*** Information about activating and using MavMail is available at <http://www.uta.edu/oit/email/>. There is no additional charge to students for using this account, and it remains active even after they graduate from UT Arlington.