

## AME 485: Structures I

**Lecture:** Virtual: Zoom

**Instructor:** Dr. Vinay K. Goyal (vinay.k.goyal@gmail.com)  
Office: Via Piazza and Zoom

**Course description:** The course is an introduction to aerospace structures from a practical perspective.

Introduction to the analysis and testing of aerospace structures – aircraft and launch vehicles. Design criteria, structures standards per FAA regulations, AIAA, SMC, and ASME. Lessons learned from aircraft and launch vehicle failures. Design loads and failure criteria of aerospace structures. Design, qualification, and workmanship verification of aerospace structures.

### **Learning Outcomes:**

- Gain a fundamental understanding of launch vehicle, spacecraft vehicle, and aircraft vehicle structural design considerations.
- Understand the structural failure modes driving the designs, lessons learned from failures, and failure investigations.
- Material selection for various applications and limitations of various materials
- Analyze the external and internal loads in these aerospace structures
- Analysis test requirements per FAA, AIAA, NASA regulations

**Text and References:** All materials for this course will be provided in the form of briefing packages, paper publications, NASA, and FAA publications.

Primary Textbook: Aerospace Structures for Engineers, 2020 Edition, by V. K. Goyal, V. K. Goyal

1. Spacecraft Structures and Mechanisms, From Concept to Launch: Thomas P. Sarafin
2. Aircraft Structures for Engineering Students (3rd Edition), T H.G. Megson, 1999.
3. Aircraft Structures, Peery, David J., Dover Publications, 1950
4. Airframe Structural Design: Practical Design Information and Data on Aircraft Structures, Niu, Michael Chun-Yung, Adaso/Adastr Engineering Center 1999
5. Airframe Stress Analysis and Sizing , Niu, Michael Chun-Yung, Adaso/Adastr Engineering Center, 1999
6. Composite Materials for Aircraft Structures (2nd Edition), Baker, Alan; Publisher American Institute of Aeronautics and Astronautics, 2004

Letter Grade	Percentage	Letter Grade	Percentage
A	>89.99%	C	70-73.99%
A-	87-89.99%	C-	67-69.99%
B+	84-86.99%	D+	64-66.99%
B	80-83.99%	D	60-63.99%
B-	77-79.99%	D-	57-59.99%
C+	74-76.99%	F	0 -56.99%

**Grading:** 13 Weekly projects, Equally Weighted (200 pts each).

There will be no “grade curving” at the end of the semester. Your grade will be determined by the following fixed grade scale:

**Software:** Abaqus Finite Element Software Package

**Outline Course:**

1. Introductory Remarks Course Overview
2. Stress, Strain, Constitutive Law, and Equilibrium Equations
3. Launch Vehicle Structures, Space Structures, and Aircraft
4. Failure Modes and Causes for Aerospace Vehicle Failures Failure Investigations
5. Material Selection, Material Testing, and Material Allowable
6. Launch Vehicle Sizing
7. Launch Vehicle Design
8. Analysis of Propulsion Systems - Solid Rocket Motors and Liquid Rocket Engines
9. Space Structures Analysis, Test, and Acceptance Requirements
10. Aircraft Construction, Loads, Assessment, and FAA Regulations
11. Space and Aircraft Mechanisms Failure Lessons Learned
12. Case Studies - Lessons Learned in Certifying Space Structures
13. Case Studies - Engine Nacelles

**Course website:** Piazza

**Academic Conduct:** Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus Section 11, Behavior Violating University Standards <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions>. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct:

<http://policy.usc.edu/scientific-misconduct>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the OED and Diversity: <http://equity.usc.edu> or to the DPS <http://adminopsnet.usc.edu/department/department-public-safety>. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

**Support System:** A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs [http://sait.usc.edu/academicssupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicssupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.