Advanced Design of Modern Aerospace Structures

Lecture: Virtual: Zoom

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

Course description: Real life applications to aircraft, spacecraft, and launch vehicles. Topics include the design of composite overwrapped pressure vessels, sandwich structures, pressurized systems such as bellows, analysis of bonded and bolted joints, non-destructive evaluation and repairs of aerospace vehicles, fatigue and fracture test and analysis, buckling of aerospace structures, treatment of stress concentrations, thermal protection systems, and dynamic analysis (undamped/damped free vibrations, forced vibrations, linear frequency response analysis, linear transient response analysis via direct time integration, steady state dynamics, modal dynamic transient analysis, response spectra analysis, pogo, random vibrations, jitter analysis, acoustics). Special applications to engine rotor analysis, rocket engine nozzle, and spacecraft designs. Additive Manufacturing and the use of structural optimization using commercial codes. Weekly term projects.

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: Spacecraft Structures and Mechanisms, From Concept to Launch: Thomas P. Sarafin

Optional Textbooks:

1. Spacecraft Structures, J. Wijker, Springer
2. Space Vehicle Design, Griffin and French
3. Analysis and Design of Structural Bonded Joints, Liyong Tong

Grading: 10 Design Projects, Equally Weighted

Software: Abaqus Finite Element Software Package, NASGRO

Outline Course:

1. Course Overview, Introduction to Launch Vehicles and Aircraft Vehicles (2 hrs.)
2. Design of Composite Overwrapped Pressure Vessels
3. Design of Unvented Honeycomb Sandwich Structures
4. Thermal Protection Systems
5. Design of Pressurized Systems (e.g. Bellows)

6. Design of Aerospace Structures - Buckling
7. Design of Aerospace Structures - Stress Concentrations
8. Design of Bolted Joints
9. Design of Bonded Joints
10. Design of Aerospace Structures - Fatigue (Low Cycle and High Cycle)
11. Design of Aerospace Structures - Fracture (Testing, Analysis, Numerical Methods)
12. Design of Aerospace Structures - Dynamics: Undamped/damped free vibrations, forced vibrations, linear frequency response analysis, Linear transient response analysis via direct time integration, steady state dynamics, modal dynamic transient analysis, response spectra analysis
13. Aircraft dynamics, Launch Vehicle, Spacecraft Vehicle, LV/SV coupled Loads Analysis; Pogo; random vibrations, jitter analysis, acoustics, engine rotor analysis, rocket engine nozzle, spacecraft deign drivers
14. Welds, Repairs and NDE, Additive Manufacturing, Structural Optimization with TOSCA/Abaqus

Course website: Piazza

Academic Integrity: Students should abide by the University Academic Integrity Policy and the UCLA Student Code of Conduct. Acts of academic dishonesty will be reported to the Office of the Dean of Students. The honor code will be strictly enforced in this course. Honesty in your academic work will develop into professional integrity. The faculty and students of UCLA will not tolerate any form of academic dishonesty.

You are encouraged to discuss the course material with others, but your submitted work must be your own. Please note that unauthorized collaboration, and transfer and/or use of another person computer files are considered acts of academic dishonesty by the University Academic Integrity Policy and the UCLA Student Code of Conduct, to which I will hold you accountable. Under no circumstances should you share (by electronic, printed, visual, or any other means) any of your computer code with another student.

Quoting from http://www.deanofstudents.ucla.edu/integrity.html: When a student is suspected to be involved in academic dishonesty, the Academic Senate requires that the instructor report the allegation to the Dean of Students Office. The instructor will file a report and provide supporting evidence such as a copy of the exam or paper in question.

Disabilities: Any student who feels that s/he may need an accommodation because of disability (learning disability, attention deficit disorder, psychological, physical, etc.), please contact the Office for Students with Disabilities (OSD) http://www.osd.ucla.edu/