Advanced Aerospace Structural Design
USC

Lecture: Virtual

Instructor: Dr. Vinay K. Goyal (vinay.k.goyal@gmail.com)

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 Optional: Analysis of Metallic Aerospace Structures: Goyal and Goyal (https://www.aeiservices.org/products/)

Optional Textbooks:

1. Spacecraft Structures and Mechanisms, From Concept to Launch: Thomas P. Sarafin
2. Spacecraft Structures: J. Wijker, Springer
3. Space Vehicle Design: Griffin and French
4. Analysis and Design of Structural Bonded Joints: Liyong Tong

Grading: Weekly Projects. 200 Points Each.

Software: Abaqus Finite Element Software Package, NASGRO

Outline Course:

1. Topics
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: Collaboration: Piazza
Course Website: https://piazza.com/usc/spring2023/ame585

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