SE 160A
Aerospace Structural Mechanics I

Designation: Required Course (AE majors), Elective (ME and SE majors)

Description

Aircraft and spacecraft flight load definition and operational envelopes, three-dimensional stress and strain relations, metallic and composite material selection and comparison, failure theories and fatigue, three-dimensional truss analysis, stiffened shear panels, pressure vessels, combined extension-bend-twist-shear behavior of thin-walled open cell and closed multi-cell beam structures, modulus-weighted section properties, shear center, and shear lag.

Prerequisites

SE-2, SE 101A, B (or MAE 130A, B), SE 110 A (or MAE 131A)

Textbook and Other Required Material

Kosmatka, J.B.; Aerospace Structural Mechanics (Course Reader for SE-160A), UCSD Book Store, 2006.

Kosmatka, J.B.; Aerospace Structural Mechanics - Appendices, UCSD Book Store, 2006.

Class/Laboratory Schedule

4 hours of classroom instruction per week

Course Topics:

- Aircraft/spacecraft structural definitions and examples, safety factor, margins of safety, and weight distributions
- Aircraft, helicopter, launch vehicle, and spacecraft load definitions, and flight envelopes
- Three-dimensional stress and strains definitions and transformations
- Materials properties of metallics and laminated composites. Comparison and selection.
- Failure theories for metallics and composites, stress concentration and fatigue effects
- Three-dimensional truss analysis, shear-stiffened panels, and pressure vessels
- Combined extension-bending-torsion-shear behavior of open-cell and closed multi-cell beam structures
- Modulus-weighted section properties, shear center and shear lag

Course Objectives

Numbers in parentheses relate to the aerospace program's educational outcomes

1. To provide a general introduction to the wide range of structural systems that can be studied using aerospace structural analysis techniques (1a, 2b, 3c)
2. To introduce the student to the different types of loadings experienced by air vehicles and space vehicles (1a, 2b, 3c, 5e)
3. To teach students the fundamentals of materials engineering and identify the important material properties for these weight critical structures (1a, 2b, 3c, 5e)
4. To teach students a wide range of analysis techniques used to design and determine the behavior of thin-wall aerospace structural components (1a, 2b, 3c, 5e, 6f, 7g, 8h, 9i, 10j, 11k, AE12, AE13, AE14)

The course is structured to provide a thorough understanding of the different design concerns, loads, and analysis techniques that are associated with light-weight air vehicle (aircraft, helicopters) and space vehicles (launch vehicles, spacecraft). The course material is presented for the design and analysis of "minimum-weight" structures, so that applications to other structural systems (i.e. sports structures, sailboats, race cars) can easily be drawn. The course builds upon a student's ability to apply principles of mathematics, strength of materials, and structural mechanics to design and analyze aerospace structural components, assemblies and systems. The homework assignments, quizzes, and exams build skills in written communication. The aspects

of professional responsibility and ethics are emphasized through classroom discussions relating to real world applications.

Method of Assessment and Evaluation

- Weekly home-work assignments with questions designed to build problem formulation and solving skills (15%)
- Weekly in-class quizzes designed to promote student learning (10%)
- Mid-Term Exams, (40%)
- Final Exam (35%)

Contribution of Course to Meeting the Professional Component

The course exposes the student to many different design and analysis techniques for studying the behavior of modern air vehicle and space vehicle structural systems. The techniques taught in this course can be applied to other light-weight structural systems including mechanical and sport structures.

Person Who Prepared This Description and Date of Preparation

John B. Kosmatka, 2/18/2001
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