

ME 485 – Aircraft Design: Structures

Dr. D.P. Romilly

Course Objectives:

The objectives of this senior elective course are:

1) To introduce the student to the basic and essential elements of aircraft structural design as required by regulatory requirements for civilian aircraft design, and

2) To provide some of the essential design and structural assessment techniques for the development of lightweight structures.

Once completed, the student should have a basic knowledge of the regulatory requirements for aircraft structural design, and understand the basic analysis methods and design philosophies for ensuring structural integrity of a structural component for a civilian aircraft.

Course Description:

Proper aircraft structural design involves the proper integration of stress analysis, materials and assessment tools to meet regulatory requirements for civilian aircraft, in order to ensure the life and safety of aircraft and passengers. This course will introduce the student to the overall concept and procedures for aircraft design, discuss the regulations and certification requirements for the design of civilian aircraft, establish the techniques for defining aircraft loading during service, and then develop and utilize stress analysis and structural assessment techniques (based on background knowledge of the student from the pre-requisite courses) for the optimal design of lightweight structures as utilized in aircraft design. Structural failure modes such as component overload, buckling and crippling, plus fatigue and fracture will be considered. These concepts and techniques are generally applicable to a broad range of aircraft components (e.g. wings, fuselage, vertical and horizontal stabilizers, etc.) so the student will be able to utilize these techniques to analyze a range of structural components. (A prior course in structural mechanics is essential).

The course consists of two hours of lecture per week and a two hours lab/tutorial period utilized for: 1) presenting additional material (both UBC lecture, visiting lecture and video based), 2) problem demonstration, 3) review of assigned problems and 4) evaluation of students on the course material (i.e. exams). When possible, the course may utilize available visiting speakers from industry, academia, regulatory bodies, and/or the military as can be arranged. It is also possible to have an industry site/hanger tour during the term.

Course Textbook: (recommended but not required)

"Airframe Structural Design" - Michael C.Y. Niu (approximately \$140)

(Note: This textbook will serve as a valuable reference book for those continuing to work in the aircraft industry. This reference (required reading) will supplement the course lecture notes and provide a broader framework for the application of the presented techniques.)

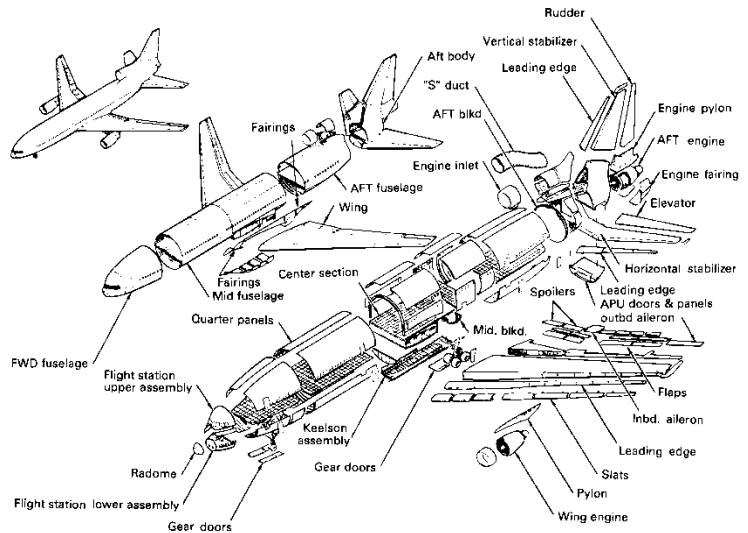


ME 485 – Aircraft Design: Structures (cont .)
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Course / Lecture / Tutorial Topics

(Note: This is a sample syllabus and is subject to slight changes each year)

- Aircraft Development Process
- Design for Manufacturing
- Basic Structural Analysis
- Design of Lightweight/Optimized Structures
- Trusses and Space Frames
 - Tutorial: Trusses and Space Frames
- Joints, Beam Optimization and Energy
 - Tutorial: Joints, Beam Opt. & Energy
- Certification Process
- Aircraft Loads (Intro) / (V-n) diagrams
 - Tutorial: Aircraft loads
- Materials & MIL Handbook V
- Buckling and Stability
 - Tutorial: Column Buckling
- Crippling stress
- Skin-Stringer Panels
 - Tutorial: Crippling
- Fasteners & Joints / Joint efficiency
- Fastener types and selection
- Gusseted and other joint types
 - Tutorial: Joints and fasteners
- Tension Joints
 - Tutorial: Tension joints
- Damage Tolerance Analysis (DTA)
(use of AFGROW software)
- Fail-safe design
 - Tutorial: AFGROW software /
DTA & Fail-safe design
- Fatigue/cumulative damage
 - Tutorial: Fatigue/review



(c) Commercial airliner
 Fig. 1.1.1 (continued).



Course Evaluation: (subject to change)
 Midterm exam – Open Book (40%)
 Final Exam – Closed/Open Book (60%)

Note: Weekly problems will be assigned but not collected. Completion is essential to preparing for the exams as full solutions will not be provided.