MECH3650 Aircraft Structural Analysis
Syllabus

Course Code: MECH3650	**Course Title:** Aircraft Structural Analysis
Required Course or Elective Course: Required for AE Major/Elective for BEng(MECH)	**Terms Offered (Credits):** Fall 2023-24 (3 credits)
Lecturer: Prof Jinglei YANG (maeyang@ust.hk) TA in charge: Mr Hongxu (hzhanaa@connect.ust.hk)	**Pre/Co-Requisites:** Background: MECH 2040 or CIVL 2120
Course Structure: 2 lectures/week, 80 minutes each; 1 tutorial/week, 50 minutes	

Textbook/Required Material/tool:

- *Primary textbook: An Introduction to Aircraft Structural Analysis*, 2nd Ed. by THG Megson
  Reading list:
  1. Analysis of Aircraft Structures An Introduction, 2nd Edition, Bruce K. Donaldson, Cambridge University Press, 2012
  2. Aircraft Loading and Structural Layout, Denis Howe, Professional Engineering Publishing, 2004
  3. Airframe Structural Design: Practical Design Information and Data on Aircraft Structures, Michael Chun-Yung Niu, Conmilit Press, 1999
- Lecture notes & Home works on Canvas

Course Description:

The components of aircraft structures are subjected to forces and deformed elastically during the life of service.

1. This course covers the general information of aircraft structures and materials, and transfer of external aerodynamic loads into structural internal forces. The focus is to deliver the fundamental knowledge for stresses, deflection, and buckling analysis of these structural components under various static loading conditions including torsion, bending and shear.
2. There are two main activities in this course. The first is lectures, which emphasize the fundamentals of structural mechanics and analytical approaches for analysis of aircraft structures. The students will learn to derive the theory of linear elasticity and apply it to analyze the components subjected to typical aircraft loading conditions and design requirements.
3. The second is tutorials, which provide a set of lessons and exercises teaching the concepts and methodology in analysis of aircraft structures. The students will be able to learn and understand the procedure of aircraft structural analysis from following tutorial problem solving exercises with group discussions.

Course Topics:

1. Historical development of aircraft structures and materials
2. Loads and forces in aircraft structures
3. Stress, Strain, and the Theory of Elasticity
4. Stress analysis of structural components under torsion, bending, and shear
5. Practical stress analysis of fuselages and wings
6. Deflection and buckling with exact solutions and energy methods

Course Objectives: (correlated program objectives)	1. To know the basic structures and materials used in aircraft and aerospace. (P-O1, P-O2) 2. To understand the loads and forces in aircraft structures. (P-O3, P-O5) 3. To be familiar with stress analysis of various aircraft structures using elasticity theory under different static loading conditions, including torsion, bending, and shear loads. (P-O1, P-O2, P-O3)

	4. To understand stability/buckling issues of thin-walled structures. (P-O1, P-O2, P-O3) 5. To understand the basic principles of energy method for deformation analysis. (P-O4, P-O5)
Course Outcomes: (correlated course objectives and program outcomes)	A. Able to visualize the complexity of structural components and materials of the aircraft and understand their functions. (POC1, POC7, POC10) B. Able to visualize how external aerodynamic loads are transferred to internal stresses and deformations. (POC1, POC3) C. Able to apply the theories to analyze various aircraft structural components subject to different loading conditions. (POC1, POC3, POC7, POC11) D. Able to apply energy methods for deformation analysis. (POC1, POC3, POC6, POC11) E. Have the capability to assess whether aircraft structural components are able to withstand the applied loads and meet specified performance. (POC1, POC3, POC11, POC12)
Assessment Tools: (correlated course outcomes)	Attendance : 5% (Attending ≥ 80% lectures) Homework : 20% [ABCDE] Midterm exam: 20% [ABCE] Final exam: 55% [ABCDE]

BEng in Aerospace Engineering (4-year program)
Program Objectives:

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,
P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,
P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,
P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,
P-O5. Continuously improve through lifelong learning.

Program Outcomes:

POC1. Ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints
POC2. Ability to design and conduct experiments as well as analyze and interpret data
POC3. Ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career
POC4. Ability to develop specification and to design system, component, or process to meet needs
POC5. Ability to understand the design, operation, and maintenance of aircraft components and systems
POC6. Ability to use modern engineering tools, techniques, and skills in engineering practice
POC7. Ability to communicate effectively
POC8. Ability to function in multi-disciplinary teams and provide leadership
POC9. Broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context
POC10. Clear understanding of professional and ethical responsibilities
POC11. Recognition of the need for life-long learning and continuing education
POC12. International outlook with knowledge of contemporary issues