MECH3670 Aircraft Performance and Stability Syllabus

Course Code: MECH3670	**Course Title:** Aircraft Performance and Stability
Required Course Or Elective Course: Required	**Terms Offered (Credits):** Fall 23-24(3 credits)
Faculty In Charge: Prof. S. REDONNET **TA in charge**: Mr. K. LEUNG	**Pre/Co-Requisites:** CENG2220 OR CIVL2510 OR MECH1907 OR MECH2020 OR MECH2210
Course Structure: 2 lectures/week (80 minutes each); 1 tutorial/week (50 minutes each)	

Learning Resources:

1. Textbook: Yechout *et al.*, « Introduction to aircraft flight mechanics », AIAA Education Series, 2003
2. Lectures material
3. Other recommended references
   - Cook, M. V. « Flight Dynamics Principles », 2nd ed. Elsevier, 2007
   - Stengel, R. F., « Flight Dynamics », Princeton University Press, 2004

Course Description:

The flying capacity of an airborne vehicle depends on its performance and stability qualities, which are driven by the way its overall design can fit with flight dynamics constraints.

This course provides an introduction to flight dynamics, with emphasis on aircraft performance and stability. To do so, the course introduces the fundamentals of flight dynamics, focusing more especially on the key concepts pertaining to flight performance and stability. The course then covers the methodological tools (fundamental theories and mathematical models) that are commonly used for analyzing the performance and stability characteristics of aircraft. Finally, the course illustrates how these theoretical and methodological knowledge are used across aerospace industries for the safety and efficiency of aircraft can be maximized.

Course Topics:

1. Aircraft components (incl. stability & control systems)
2. Mechanics of flight equilibrium (level flight, climbing/gliding flight, turning flight, etc.)
3. Flight performance (endurance, range, etc.)
4. Equations of motion (non-linear, linearized, state-space form, etc.)
5. Static stability (longitudinal, lateral/directional, coupling effects, etc.)
6. Dynamic stability (longitudinal, lateral/directional, coupling effects, etc.)
7. Flight dynamics modes (phugoïd, short period, Dutch roll, spiral, etc.)
8. Stability augmentation (control systems)

Course Objectives: (correlated program objectives)	1. To understand the fundamental laws of flight dynamics in view with aircraft performance and stability (P-O1) 2. To grasp the key concepts of aircraft static and dynamic stability (P-O1, P-O3) 3. To become familiar with analysis tools pertaining to aircraft performance and stability (P-O1, P-O3, P-O5)
Course Outcomes: (correlated course objectives and program outcomes)	A. Describe the fundamental concepts of flight dynamics (POC1, POC3, POC5, POC6, POC9) B. Solve typical problems related to aircraft performance and stability (POC1, POC3) C. Assess the performance and stability characteristics of aircraft (POC1, POC3, POC6, POC9) D. Conduct a team research action (group project) pertaining to aircraft

	performance and stability (POC 1, POC2, POC3, POC4, POC5, POC6, POC7, POC8)
Assessment Tools: (correlated course outcomes)	- Final exam: 45% - Midterm exam: 15% - Homework assignments (incl. group project): 35% - Class participation: 5%

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 aerospace 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