

**AERO 4308**  
**Aircraft Stability and Control**

**MECH 5101**  
**Dynamics and Aerodynamics of Flight**

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Ottawa, ON, Canada



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# Course Outline

## About the Author

Steve Ulrich is an Assistant Professor at Carleton University. He earned his B.Eng. and M.A.Sc. in electrical engineering from the Université de Sherbrooke, and his Ph.D. in aerospace engineering from Carleton University. From 2006 to 2008, he was Spacecraft GN&C Research Engineer at NGC Aerospace Ltd., and in 2013 he was Postdoctoral Associate at the MIT Space Systems Laboratory. He is a senior member of AIAA and a member of IEEE. He is a member of the AIAA Guidance, Navigation and Control Technical Committee.

## Prerequisites

MAAE 3300 Fluid Mechanics II

MAAE 4500 Feedback Control Systems

Familiarity with MATLAB/Simulink (or another mathematical programming language) is an asset.

## Contact Information

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## Content

Chapter 1 - Rigid-Body Kinematics and Dynamics

Chapter 2 - Aircraft Dynamics

Chapter 3 - Stability Derivatives

Chapter 4 - State Feedback Control via Pole Placement

Chapter 5 - Optimal Feedback Control

Chapter 6 - Static Stability

## About the Course

The objective of this course is to provide students with an comprehensive treatment of aircraft dynamics, starting with the basic fundamentals of rigid-body kinematics and dynamics to more advanced topics such as multivariable state feedback control. The material is presented in a consistent manner, and the students are guided through the various derivations and demonstrations in a rigorous way. As a result, students are led to understand the underlying principles governing the main equations.

## Bibliography

There is no required textbook. Some useful textbooks upon which the course was developed include:

1. Stevens, B. L., and Lewis, F. L., *Aircraft Control and Simulation*, John Wiley and Sons Inc., 1992.
2. Lewis, F. L., *Applied Optimal Control and Estimation*, Prentice Hall, 1992.
3. Bryson, A. E., *Control of Spacecraft and Aircraft*, Princeton University Press, 1994.
4. Etkin, B., and Reid, L. D., *Dynamics of Flight: Stability and Control*, Third Ed., John Wiley and Sons Inc., 1996.
5. Ogata, K., *Modern Control Engineering*, Fourth Ed., Prentice Hall, 2001.
6. de Lafontaine, J., *Modern Aerospace Control*, Lecture Notes, Universite de Sherbrooke, Winter 2004.
7. Hughes, P. C., *Spacecraft Attitude Dynamics*, Dover, 2004.

## Course Organization

Lectures, held on Wednesdays and Fridays, 4:05 pm - 5:25 pm, UC 180

## Online Resources

Course information will be posted on cuLearn.

## Evaluation

### *Grading - AERO 4308*

Assignment: 30%  
Midterm Exam: 30%  
Final Exam: 40%

### *Grading - MECH 5101*

Individual Project: 15%  
Assignment: 15%  
Midterm Exam: 30%  
Final Exam: 40%

### *Assignment*

Due on **April 5, 2017**, the assignment consists in the development of an alternate aircraft non-linear longitudinal flight dynamics model, as well its analytical linearization which will be used for the design of the state feedback control system and related linear observer. Results of closed-loop

numerical simulations are to be provided.

### *Examinations*

Midterm Exam: closed-book, with 1 hand-written double-sided cheat sheet, held on **March 3, 2017** (80 min).

Final Exam: closed-book, with 2 hand-written double-sided cheat sheets, held during the examination period at the end of term (3 hours)

### **Academic Accommodation**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

#### *Pregnancy obligation*

Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: <http://www.carleton.ca/equity/>

#### *Religious obligations*

Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: <http://www.carleton.ca/equity/>

#### *Academic accommodations for students with disabilities*

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website ([www.carleton.ca/pmc](http://www.carleton.ca/pmc)) for the deadline to request accommodations for the formally-scheduled exam (if applicable)

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodations at <http://www.carleton.ca/equity/>

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To summarize, students creating unauthorized audio and/or video recording of lectures, and/or reproducing or redistributing without prior written consent of the instructor violate the instructor's intellectual property rights and the Canadian Copyright Act.