Mechanical Engineering (MEE) 445
Aeronautics


General Dynamics F-111C Aardvark

Instructor:	Dr. David S. Rubenstein, Boardman Hall
Email:	David.Rubenstein@maine.edu
Class Hours:	Tuesdays, Thursdays, 11:00AM – 12:15PM
Location:	Remote via Adobe Connect Pro
Office Hours:	Through email and Adobe Connect meetings (Students can log on as if it were a class session) through special arrangement. Availability will be flexible.
Prerequisites:	MEE 270, MAT 258, COS 215 or 220
Text:	*Introduction to Flight,* Seventh Edition by John D. Anderson, Jr.
Technical Software:	MATLAB Student Version (includes Matlab and Simulink).
Course Homepage:	TBD

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Course description

This course provides an introduction to the dynamics and performance of aircraft flight. Topics will include basic aerodynamics and wing design theory, the primary in-flight aerodynamic forces and torques, stability and trim concepts, aircraft control surfaces, actuation and propulsion basics. Course material will be discussed in the context of several key examples including fixed-wing aircraft, steerable parachutes, the reentry (atmospheric) phase of a reusable launch vehicle (RLV) and Unmanned Aerial Vehicles (UAVs), a critical, state-of-the-art technology in the modern-day aerospace and defense industry. Modeling and simulation of a selected UAV system will provide an exciting and comprehensive application of the skills developed in the course.

Educational Objectives: After completing this course, students will be able to:

I) Perform basic analysis of aerodynamic forces and torques acting on a flight vehicle and the resulting dynamics;
II) Perform basic analysis of aircraft propulsion system characteristics;
III) Perform basic stability and control analyses associated with aircraft flight;
IV) Perform basic overall aircraft performance calculations; and
V) Demonstrate a basic understanding of Unmanned Aerial Vehicle (UAV) concepts and technologies.

Topics

1. *What is Aerospace Engineering*?
    - Astronautics
    - Aeronautics
    - Overview of Aerospace industry
    - Aerospace projects and subsystems
    - Aerospace technology applications
2. *Introduction*
    - Brief History of Aeronautics
    - Aircraft Anatomy
    - Avionics Basics
    - Standard Atmospheric Considerations
3. *Fundamentals of Aerodynamics*
    - Overview
    - Airspeed and Airspeed Measurement
    - Laminar and Turbulent Boundary Layers
    - Boundary-Layer Separation
    - Viscous Effects
4. *Wings and Airfoils*
    - Introduction and Nomenclature
    - Lift, Drag and Moment Coefficients
    - Pressure Coefficient
    - Critical Mach Number
    - Induced Drag
    - Swept Wings
    - Lift Generation – Kutta-Joukowsky Law
5. *Aircraft Performance*
    - Drag Computations
    - General Aircraft Equations of Motion
    - Thrust Considerations
    - Altitude Effects
    - Gliding Flight
    - Take-Off and Landing Performance
    - Turning
    - Rates of Climb
6. *Introduction to Unmanned Aerial Vehicles (UAVs)*
    - History
    - Remote Controlled Piloting
    - Notable UAV Systems
    - Modeling and Simulation Examples
    - Guidance, Navigation and Control (GN&C) Concepts
    - Future of the UAV

Additional References

1. McCormick, Barnes W., *Aerodynamics, Aeronautics and Flight Mechanics*, *Second Edition*, John Wiley and Sons, Inc., Canada, 1995.
2. Bertin, John L. and Cummings, Russell M., *Aerodynamics for Engineers, Fifth Edition*, Pearson Prentice-Hall, Upper Saddle River, NJ, 2009.
3. Shevell, Richard S., *Fundamentals of Flight*, *Second Edition*, Pearson Prentice-Hall, Upper Saddle River, NJ, 1989.

Class Time

Students are expected to attend the live lecture sessions.

Homework

- Homework problems will be assigned approximately every one to two weeks. You are expected to do the homework assignments individually. The homework problems are the basis for the preliminary and final exams. You are responsible for submitting the assigned homework if you are absent from the class.
- Late homework will NOT be accepted.
- Please be very neat and clear on homework. Define CLEARLY variables, vectors, reference frames, etc. Nomenclature and convention can be pretty much as you please but you MUST be clear and consistent.

Preliminary Examinations

There will be two preliminary examinations.

Simulation Project

An aircraft simulation project, involving Matlab/Simulink, will be assigned mid to late semester.

Final Exam

A comprehensive final exam will cover all material up to and including the last lecture before the exam.

Grading

Homework	5%
Preliminary Exam #1	25%
Preliminary Exam #2	25%
Simulation Design Project	20%
Final Exam	25%

Disabilities (ADA) Statement

Students with disabilities who may need services or accommodations to fully participate in this class should contact Ann Smith, Director of Disability Services in 121 East Annex, (voice) 581-2319, (TTY) 581-2325 as early as possible in the semester. Any student requiring an accommodation due to a disability is also encouraged to speak to the instructor privately at the beginning of the semester. Appropriate arrangements will be made to accommodate the student.

Academic Integrity

Academic dishonesty includes cheating, plagiarism and all forms of misrepresentation in academic work, and is unacceptable at The University of Maine. As indicated in the University of Maine's on-line "Student Handbook," plagiarism (the submission of another's work without appropriate attribution) and cheating are violations of The University of Maine Student Conduct Code. An instructor who has probable cause or reason to believe a student has cheated may act upon such evidence, and should report the case to the supervising faculty member or the Department Chair for appropriate action.

Class Disruption:

In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.