General Dynamics F-111C Aardvark

### Instructor:
Dr. David S. Rubenstein, Boardman Hall

### Email:
David.Rubenstein@umit.maine.edu

### Class Hours:
Tuesdays, Thursdays, 11:00AM – 12:15PM

### Location:
Remote via Adobe Connect Pro, Broadcast Live in 126 Barrows

### Office Hours:
Tuesdays, Thursdays, 9:30 – 10:30 AM through email and Adobe Connect (Students can log on as if it were a class session). Availability other times will be through email and special arrangement.

### Prerequisites:
MEE 270, MAT 258, COS 215 or 220

### Text:

### 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. Also, an introduction to flight dynamics and control will be provided. 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;

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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. Basic Flight Dynamics, Control and Stability
   - Introduction
   - Static Stability and Control
   - Pitching Moment
   - Dynamic Stability and Control
   - Longitudinal (Pitch) Static Stability
   - Directional (Yaw) Static Stability
   - Lateral (Roll) Static Stability
7. 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

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 will be assigned mid to late semester. There may be multiple options for project choice.

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

Grading
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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
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<tr>
<td>Preliminary Exam #1</td>
<td>25%</td>
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<tr>
<td>Preliminary Exam #2</td>
<td>25%</td>
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<tr>
<td>Simulation Design Project</td>
<td>15%</td>
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<tr>
<td>Final Exam</td>
<td>25%</td>
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Any student requiring an accommodation due to a disability is encouraged to speak to the instructor privately at the beginning of the semester. Appropriate arrangements will be made to accommodate the student. If you have a disability for which you may be requesting an accommodation, please contact Ann Smith, Director of Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term.