# AEE 313 Aircraft Dynamics and Control

*Spring 2024*

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**Lecture**: MW: 4:30 – 5:45 PM COORL1-74

**Class Website**: ASU Blackboard System
Log on: https://myasucourses.asu.edu or http://my.asu.edu

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**Instructor**: Fred Garrett
**Contact Info**: E-mail: Frederick.Garrett@asu.edu
Phone: 480.814.6234 (office)
**Office Hours**: W: 5:50 – 7:00 PM COORL1-74
MW: 7:30 – 8:30 AM Zoom (https://asu.zoom.us/j/5042975080)
or other times by appointment

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**Reference Texts**: *Dynamics of Flight: Stability and Control, 3rd Edition, Bernard Etkin and Lloyd Duff Reid, John Wiley and Sons, ISBN 978-0-471-03418-6*

* Supplemental notes and resources will be posted on the blackboard as well.

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**Course Description**: Aircraft static stability; derivation of aircraft equations of motion; aircraft dynamic modes and stability; aircraft stability derivatives; aircraft response to controls; introduction to automatic control systems for aircraft. Through a group project, students will be introduced to the Entrepreneurial Mindset (https://engineeringunleashed.com/), which goes beyond the concept of traditional entrepreneurship and "start-up" mentality to provide the best possible professional preparation for any job in engineering or a career that can be built on the combination of *engineering skillset* and *entrepreneurial mindset*. The core components of the entrepreneurial mindset are the 3C's: **Curiosity**, **Connections**, and **Creating Value**. The project will involve a analysis of the stability and control of an existing aircraft design. The group will then modify this design such that the vehicle has an expanded market while still meeting the original customer's requirements. Students will then assess the stability and control characteristics of this new design compared to the original design.

**Pre-requisites:** Students in Engineering BS/BSE. MAE 301 with a grade of C or better, MAE 318 with a grade of C or better and AEE 360 (or MAE 360) with a grade of C or better

**Topics**:

- Aircraft Static Stability and Control
- General Aircraft Equations of Unsteady Motion
  - Coordinate Systems and Transformations
  - Aircraft Rigid Body Equations of Motion
  - Euler's Equations of Motion
  - Gyroscopic Effects
  - Stability Axes
  - Non-dimensional Equations of Motion
  - Elastic Degrees of Freedom
- Linear Aircraft Equations of Motion
  - Small Disturbance Theory
  - Linearization Methodologies

Aircraft Stability Derivatives
Stability of Uncontrolled Motion
- Routh-Hurwitz Stability Criterion and Routh's Discrminant
- Longitudinal Modes of Flight
  - Phugoid and Short Period Modes
  - Approximation of Longitudinal Flight Modes
- Lateral Modes of Flight
  - Roll, Dutch Roll and Spiral Modes
  - Approximation of Lateral Flight Modes
- Effects of Wind
- Flying Qualities

Aircraft Response to Open Loop Control Inputs
- Response to Elevator and Throttle Inputs
- Response to Aileron and Rudder Inputs
- Inertial Coupling

Introduction of Aircraft Closed Loop Control Systems
- Phugoid Suppression
- Speed Controller
- Altitude and Glide Path Control
- Yaw Damping
- Roll Control
- Gust Alleviation

Entrepreneurial Mindset (EM)
- The 3 C's of EM
- Modifying A Design To Expand Market Share

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**Homework**: Homework will be assigned, submitted and graded via Canvas. **Unless there are extraordinary circumstances late homework assignments will not be accepted**. You are encouraged to work together on the homework; however, **copying is unacceptable**

**Exams and Project**:

1 midterm (take home), 1 team project (5 person team) and 1 final (take home). Open-book, open-notes.

Tentative due dates for midterm: **3/15**
Tentative project assignment date **4/1**
Tentative project due date: **4/29**
Final exam: Date: **TBA**

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| **Grading**: | | |
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| | Homework | 20% |
| | Midterm | 25% |
| | Project | 25% |
| | Final | 30% |
| | Total | 100% |

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**General Course Policies**

Classroom Behavior:
Cell phones and pagers must be turned off during class to avoid causing distractions. The use of recording devices is not permitted during class. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

Until further notified, per ASU policy, faculty, staff, students and visitors, are required to wear face coverings in classrooms, labs, offices and community spaces.

Academic Integrity and Copyright Laws:
Students in this class must adhere to ASU's academic integrity policy, which can be found at https://provost.asu.edu/academic-integrity/policy). Students are responsible for reviewing this policy and understanding each of the areas in which academic dishonesty can occur. In addition, all engineering students are expected to adhere to both the ASU Academic Integrity Honor Code and the Fulton Schools of Engineering Honor Code. All academic integrity violations will be reported to the Fulton Schools of Engineering Academic Integrity Office (AIO). The AIO maintains a record of all violations and has access to academic integrity violations committed in all other ASU college/schools.

Course content, including lectures, are copyrighted materials and students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute course content or notes taken during the conduct of the course (see ACD 304–06, "Commercial Note Taking Services" and ABOR Policy 5-308 F.14 for more information). You must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

Policy Against Threatening Behavior:
Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services. Interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. All incidents and allegations of violent or threatening conduct by an ASU student (whether on- or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students.

Disability Accommodation:
Suitable accommodations will be made for students having disabilities. Note: To qualify for disability accommodations here at ASU, you must register and qualify for services through the Disability Resource Center (DRC) located on the first floor of the Matthews Center Building 480.965.1234 (Voice), 480.965.9000 (TTY)

Harassment and Sexual Discrimination:
Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.
Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As an employee of the University the instructor is considered a mandated reporter and they are obligated to report any information regarding alleged acts of sexual discrimination that they are made aware of or have a reasonable basis to believe occurred.
ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish to discuss any concerns confidentially and privately.

How Long Students Should Wait for an Absent Instructor: In the event the instructor fails to indicate a time obligation, the time obligation will be 15 minutes for class sessions lasting 90 minutes or less, and 30 minutes for class sessions

lasting more than 90 minutes. Students may be directed to wait longer by someone from the academic unit if they know the instructor will arrive shortly.

The instructor reserves the right to update or change the information in this syllabus with reasonable advance notice to students.