

*SYLLABUS*

**AME 459 – Flight Mechanics**  
**Department of Aerospace and Mechanical Engineering**

2025 Fall Semester

Instructor: Kamal Shweyk  
Email: [shweyk@usc.edu](mailto:shweyk@usc.edu)

**Course Sections:** 28829R  
**Course Unit:** 3 Units  
**Prerequisite:** Undergraduate Senior-Level Standing  
**Class Hours:** Thursdays, 4:00-6:30 PM (includes a brief break midway)  
**Class Location:** KAP 145  
**Office Hours:** Thursdays, 7:00-9:00 PM, OHE 430N  
**Teaching Assistant:** TBD

## **Course Background**

The focus of this class is on the aerodynamics, performance, propulsion, stability and control, and flight controls of atmospheric flight vehicles. It is assumed that the student has a basic understanding of fluid dynamics. (Recommended background: AME309, Dynamics of Fluids, and AME261, Basic Flight Mechanics.)

The class topics include the derivation of the equations of motion, aircraft static and dynamic stability, aircraft response to control inputs and atmospheric disturbances, flight simulation, and classical control theory. The instructor will apply his extensive work experience in the aerospace industry to illustrate, through real-life examples, the application of the theory to practical, real-world problems.

## **Course Components**

Students' learning experience in this course will come from three interrelated components:

- **Textbook Reading**

The class will use the textbook, entitled "Introduction to Aircraft Flight Mechanics," by Thomas R. Yechout, 2<sup>nd</sup> Edition. In general, the class will follow the basic structure of the text book, starting with a brief overview/refresher of the first three chapters on Basic Aerodynamics, Basic Performance, and Aircraft Performance. More in-depth coverage begins with Chapter 4, when the Aircraft Equations of Motion will be explained and derived, and concludes with Chapter 8, when Classical Feedback Control will be described. Additional class modules, beyond the scope of the text book, will be included to discuss special topics related to Flight Mechanics, such as Atmospheric Disturbances, Wake Turbulence, System Failure States, and Motion-Base Simulators.

- **Online Lecture**

The online lectures will discuss theories, methodologies, processes, tools, and practice used in the aerospace industry to understand and analyze atmospheric flight vehicles, and will include current news within the aerospace industry. The focus is on fixed-wing, atmospheric, flight vehicles. The lectures will generally follow the chapter sequence of the textbook, but will also contain significant other material, drawn from many reference books, technical papers, and industry standards, as well as the instructor's own extensive experience within the aerospace industry. The intent is to cover other important topics that are related to Flight Mechanics, including atmospheric disturbances, wake turbulence, aircraft system failures, and both ground and flight simulators. Lecture notes will be made available before each class session via Brightspace.

- **Supplementary Reading**

Additional reading from various references will be provided throughout the semester. All students are encouraged to prepare for the lectures by reading the assigned chapter and other suggested material.

## **Office Hours**

Office hours with the instructor will immediately follow the regularly-scheduled classes. The students are expected to notify the instructor ahead of time of the need for office hours, and may submit questions regarding the course material to the instructor at any time via email. The TA will also be available for assistance throughout the semester.

## **Required Textbook**

- “*Introduction to Aircraft Flight Mechanics*”, Second Edition, by Thomas R. Yechout, the AIAA Education Series, Second Edition, Copyright 2014.

Additional Reference Material: (The instructor will be recommending other reading material and website references during the course.)

- “*Dynamics of Atmospheric Flight*”, by Bernard Etkin, John Wiley & Sons, Inc.
- “*Flight Stability and Automatic Control*”, (2<sup>nd</sup> edition), by Robert C. Nelson, The McGraw-Hill Companies, Inc.

## **Course Material**

The students’ learning of this course is facilitated via UCS’ Brightspace. All registered students will be provided access to the site, with which they are expected to become familiar, including the following.

- Announcements – Important class announcements.
- Syllabus – Contains an up-to-date copy of the class syllabus.
- Assignments – Each homework and reading assignment will be posted.
- Content – A pdf copy of the lecture slides.
- Discussions – A place for the students to share their thoughts about class-related subjects.
- Groups – All communication tools, including emails and roster.
- Websites – links to reference material.

## **Course Grading**

The course grading structure, which is described in more details below, is as follows.

- 5% – Class Participation
- 15% – Quizzes
- 20% – Mid-Term Exam
- 30% – Homework
- 30% – Final Exam

## **Grading Components**

- **Class Participation (5%)**

Credit will be offered for class attendance, participation, and engagement, which includes providing feedback through the class survey. The students are encouraged to ask questions, complete reading assignments, and participate in classroom discussions.

- **Quizzes (15%)**

A quiz will be administered on two separate occasions during the semester to test the students understanding of lecture material and work assignments to date. Combined, these quizzes will constitute 15% of the total semester grade.

- **Homework (30%)**

In general, homework assignments will be issued on a weekly basis, except for exam weeks. Students are expected to submit their homework on time. Late homework will not be accepted without a valid and credible excuse.

- **Mid-Term Exam (20%) and Final Exam (30%)**

Both the Mid-Term and Final-Term exams will adopt the same format, and will include a Closed-Book section and an Open-Book section. The Closed-Book section is designed to test the student's comprehension of fundamental concepts, and will be limited to materials already covered in the classroom lectures. The answers are typically brief and illustrate basic understanding of key principles. The Open-Book section, on the other hand, is designed to test the student's understanding and application of methods, formulas, and data from the text book and lectures notes. Make-up exams will not be offered, except for rare occasions due to a compelling and unavoidable circumstance.

## **Academic Integrity**

The Viterbi School of Engineering adheres to the University's policies and procedures governing academic integrity as described in SCampus. Students are expected to be aware of, and to strictly observe, the academic integrity standards described in SCampus, and to expect those standards to be strictly enforced throughout this class without exception.

## **Students with Disabilities:**

Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP and handed to the instructor as early in the semester as possible. DSP office may be reached at 213-740-0776.

*The instructor reserves the right to change this schedule at any time during the semester.*

Week #	Lecture #	Date	Class Topic	Chapter #	Remarks
1	1	28 Aug 25	Introduction to Air Vehicle Stability and Flight Controls, Brief History of Flight, Overview of Class Content.	-	
2	2	04 Sep 25	Review of Basic Aerodynamics/Fluid Dynamics, Propulsion, and Aircraft Performance; Airspeeds.	1, 2, 3	
3	3	11 Sep 25	Aircraft Performance; Takeoff/Landing, Endurance/Range. Equations of Motion; Axis Systems, Forces and Moments.	3, 4	
4	4	18 Sep 25	Aircraft Static Stability; Longitudinal Static Stability, Stability Derivatives, Neutral Stability, Static Margin.	5	
5	5	25 Sep 25	Aircraft Static Stability; Lateral-Directional Static Stability, Side Force, Rolling Moment, Yawing Moment.	5	Quiz #1
6	6	02 Oct 25	Aircraft Static Stability; Roll and Yaw Control Power. Linearized Equations of Motion; Small Perturbation Theory.	5, 6	
7	-	09 Oct 25	<b>No Class.</b> (Fall Recess.)	-	
8	7	16 Oct 25	Special Topics; Inertial Coupling, Stability Criteria, Wake Vortices, Nose Vortices, Winglets, Wing Rock, Stall, Spin.	-	
9	8	23 Oct 25	Aircraft Dynamic Stability; Spring-Mass-Damper System, Laplace Transformation, Mid-Term Exam.	7	Mid Term Exam
10	9	30 Oct 25	Aircraft Dynamic Stability; Transfer Functions, 1 <sup>st</sup> and 2 <sup>nd</sup> Order Systems, Complex Plane Roots, Aircraft Modes.	7	
11	10	06 Nov 25	Aircraft Dynamic Stability; Response System Types, Flying Qualities and Design Criteria.	7	
12	11	13 Nov 25	Special Topics; Atmospheric Disturbances, Turbulence Models and Effects, Gust Sensitivity.		Quiz #2
13	12	20 Nov 25	Special Topics; Ground/Flight Simulators, Aeroelasticity. Classical Feedback Control; Transfer Functions	8	
14	-	27 Nov 25	<b>No Class.</b> (Thanksgiving Holiday.)	-	
15	13	04 Dec 25	Classical Feedback Control; Closed-Loop Control, Freq Response, Bode Plots, Stability Augmentation, Autopilots.	8	
16	14	11 Dec 25	Final Exam (4:30 - 6:30 pm).		Final Exam