SYLLABUS

AME 459 – Flight Mechanics

Fall Semester, 2018

Instructor: Kamal Shweyk
Department of Aerospace and Mechanical Engineering

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Course Sections:	28829R
Course Unit:	3 Units
Prerequisite:	Undergraduate Senior Level Standing
Class Hours:	Fridays, 1400-1650 PT (with 10 minutes break midway)
Class Location:	Kaprielian Hall, KAP 147
Office Hours:	Fridays, 1700-1900 PT • Meetings with students may be held in the on-campus office • Students may drop by during posted office hours for informal visits. However, prior appointments should be arranged via phone or e-mail for lengthy meetings/discussions.
Teaching Assistant:	TBD

Course Background

The focus of this course will be on the aerodynamics, performance, propulsion, stability and control, and flight controls of atmospheric flight vehicles. The class assumes a basic understanding of fluid dynamics, and will cover the development of the equations of motion, aircraft static and dynamic stability, aircraft response to atmospheric disturbances, flight simulation, and the fundamentals of classical feedback control theory.

Course Components

Students' learning experience in this course will come from three (3) interrelated components:

- **Textbook Reading**

  The class will use the textbook, "Introduction to Aircraft Flight Mechanics", by Thomas R. Yechout, 2nd Edition. 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. The class will begin in depth starting with Chapter 4, where the Aircraft Equations of Motion will be explained and derived, and concluding with Chapter 8, where an introduction to the Classical Feedback Control will be provided.

- **Classroom Lecture**

  The lectures will discuss theories, methodologies, processes, tools, and practice used in the aerospace industry to understand and analyze atmospheric flight vehicles, while covering some of the aerospace industry current news. The focus will be on fixed-wing, atmospheric vehicles. The lectures will generally follow the chapter sequence of the textbook. However, the lectures 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 in the industry. Lecture notes will be made available before Class via the AME 459 course website on USC Blackboard.

- **Supplementary Reading**

  Additional reading assignments from various reference resources will be given throughout the semester as additional required reading. All students are encouraged to prepare for the lectures by reading the assigned chapter and any additional required reading prior to the lecture.

Office Hours

Office hours are from 1700 to 1900 PT every Friday evening, at RRB 203. Students are also encouraged to meet with the TA with prior arrangements.

Required Textbook

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

Additional Reference Material:

- "*Dynamics of Atmospheric Flight*", by Bernard Etkin, John Wiley & Sons, Inc.
- *"Flight Stability and Automatic Control"*, (2^{nd} edition), by Robert C. Nelson, The McGraw-Hill Companies, Inc.

The instructor may recommend additional reading materials and website reference resources during the semester whenever appropriate.

Course Website

Students' learning of this course is supplemented by use of the UCS Blackboard instruction system (https://blackboard.usc.edu/). All registered students have access to this website. The course website structure will be implemented to support the specific organization of the course instruction, as described in this syllabus. All students should browse the entire site to familiarize themselves with various areas and functions of this course website.

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

Course Grading

Students will be graded according to the following grading system.

- 10% – Class Participation
- 30% – Homework
- 10% – Quizzes
- 20% – Mid-Term Exam
- 30% – Final Exam

Each of the above grading components is described in more details below.

Grading Components

- **Classroom/Lecture Participation (10%)**

  The intent is for AME459 to be an involved class. Class participation is more than just counting the attendance, which is also important. The students are encouraged to ask questions, to complete reading assignments, and to participate in classroom discussions. On occasion, topics for research may be noted and the students will post their discussion in the Blackboard Discussion section.

- **Homework (30%)**

  Homework assignments will be posted on a weekly basis, with the exception of exam weeks. Students are expected to submit homework on time. Late homework will not be accepted without a valid and credible excuse.

- **Quizzes (10%)**

  A short quiz (60 minutes) will be administered on two occasions during the semester to test the students understanding of covered lecture material and work assignments thus far. In total, these quizzes will constitute 10% of the semester grade.

- **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 concepts and principles. The Open-Book section is designed to test the student's understanding and application of methods, formulas, and data from the text book and/or lectures notes. Make-up exams in general will not be offered, unless there is a compelling and an unavoidable circumstance, such as an urgent health matter.

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 observe, the academic integrity standards described in SCampus, and to expect those standards to be enforced in this course 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 hand-delivered 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 and topics during the semester.

Class #	Date	Class Topic	Chapter #	Comments
1	24 Aug 18	Introduction to Air Vehicle Stability and Flight Controls, including a brief history of aircraft development		
2	31 Aug 18	Basic Aerodynamics, Propulsion and Flight Vehicle Performance	1, 2, 3	
3	07 Sep 18	Flight Vehicle Performance, Aircraft Equations of Motion, axis systems/transformations, force & moment equations	3, 4	
4	14 Sep 18	Aircraft Static Stability, including control power, longitudinal static stability, static margin	5	
5	21 Sep 18	Aircraft Static Stability, including lateral-directional static stability	5	Quiz #1
6	28 Sep 18	Linearizing the Equations of Motion, including small perturbation approximation	6	
7	05 Oct 18	Special Topics, including coordinated turns, wake vortex, nose vortex, wing rock, departure, and spin		
8	12 Oct 18	Material Review and Mid-Term Exam		Mid Term Exam
9	19 Oct 18	Aircraft Dynamic Stability, including spring-mass-damper, Laplace transformation, and roots in the complex plane	7	
10	26 Oct 18	Aircraft Dynamic Stability, including dihedral effect, vertical tail sizing, Weissinger theory, and end-plates	7	
11	02 Nov 18	Aircraft Dynamic Stability, including flying qualities and design criteria, and the Cooper-Harper rating scale	7	
12	09 Nov 18	Special Topics, including atmospheric disturbances, and ground and in-flight simulators		Quiz #2
13	16 Nov 18	Classical Feedback Control, including transfer functions and block diagram algebra	8	
	23 Nov 18	No Class (Thanksgiving Holiday)		
15	30 Nov 18	Classical Feedback Control, including root locus, frequency response, Bode plots, autopilots	8	
16	07 Dec 18	Final Exam (2:00-4:00 pm)		Final Exam