

SYLLABUS, ENME 489D

Fundamentals of Aircraft Stability & Control

Spring Semester

Course Description

This course will cover the fundamentals of near earth aeromechanics associated with fixed wing air vehicle atmospheric flight. Primary topics will include review of basic aerodynamics and an introduction to basics of configurational aero effects, flight performance, vehicle stability, and aeromechanics control. This will be done through processes such as lectures, tests, homework assignments, lab events with flight simulators, and a special project involving an RC aircraft instrumentation and flight. Periodic relevance to real-world examples of applied aerodynamics based on the instructors 30+ years of experience within the area of aeromechanics toward military aviation will be included.

Lecturer

Dr. David Findlay

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Office Hours: after class or by appointment

Credit hours

3

Textbook

- Dynamics of Flight Stability and Control; by Bernard Etkin;
Edition:#3; (Publisher: John Wiley & Sons)

MATERIAL

Classroom

The book for the course is very good. The class lectures will cover material in the text as well as some additional material. *I will use classroom time to supplement the material in the book and answer any questions you have about the reading.* Thus, it is critical for students to be sure to proactively be reading the sections of the book associated with the material as it is being covered within the class. Lectures will be presented using Powerpoint and the overhead projector. The lecture notes will be distributed via a series of pdf files. Students are encouraged to seek and review other sources of information in the literature that relates to the course material.

SPECIFIC COURSE INFORMATION

This course is the second of a two semester series. However, this course is a complete and stand-alone subject that will provide a full understanding of the fundamentals without having to take

the 1st course in the series. However, this course assumes that the student has taken a course that provides at least an introduction to the field of Aircraft Aerodynamics.

Pre-requisites: Physics, Thermodynamics, Fluid Mechanics & Differential Equations.
Fundamentals of Aerodynamics of Atmospheric Flight Mechanics (ie, ENME 489F) or equivalent.

The course is considered as a recommended Elective for students in the UMD SMHEC Joint NAVAIR Program.

SPECIFIC GOALS OF THE COURSE

Understanding in fundamental principles required to address solution of basic flight mechanics analysis associated with low speed steady flight conditions. Course intent includes:

- Provide fundamental understanding of full aircraft aerodynamics, performance, and stability & control
- Introduce a spectrum of key concepts and theories to grasp primary relevant topics
- Introduce students to major elements of concern for analysis and evaluation of aircraft configurations
- Experience within a team environment toward simulation and testing of a flight vehicle
- Exposure to the Flight Simulator within the Lab
- Mathematical formulations developed as classical theory of aircraft configuration aerodynamics
- Past, present and future state-of-the-art methods employed by applied aerodynamicists (including inherent limitations of the techniques.)
- Add to the basic building blocks obtained with the previous course in the series course ENME 489D (Fundamentals of Aerodynamics of Atmospheric Flight Mechanics).

Measurable Outcomes

Specific sections of the course, listed below, will enable to student to understand and assess basics of aircraft configuration aerodynamics, flight performance, and vehicle stability and control characteristics.

Course sections:

- Background and basic aerodynamics terms/concepts
- The flight environment – near earth atmosphere
- Fundamental Flight Performance
- Static longitudinal stability
- Longitudinal control & trim
- Pull-up maneuver & other effects
- Static lateral / directional stability & control

This class includes a brief review of applied aerodynamics and modern approaches in aircraft stability and control. Topics covered include flight performance; static stability and trim; stability derivatives and characteristic longitudinal and lateral-directional motions; and physical effects of the wing, fuselage, and tail on aircraft motion. Control methods and systems are

discussed, with emphasis on flight vehicle stabilization by classical and modern control techniques.

Further, course content includes an ability to assess the stability and control of an RC model aircraft to estimate basic aerodynamic parameters for a specific application. Evaluation of the assessment methods will be enabled through a teaming effort involving the instrumentation and flight testing.

Students will be involved with a hands-on introduction through the use of

- Two (or more if desired) Flight Simulation Lab Events
 - everyone will fly and evaluate FW & RW aircraft flight simulators
- Team Project
 - “Build”, Instrument, Measure, Analyze, Evaluate, and Document RC Aircraft

This course will address the following student outcomes:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (d) an ability to function on multidisciplinary teams
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

SCHEDULE

The class schedule will be distributed. *It is subject to update and change as we proceed through the semester.* When the schedule is changed, the changes will be discussed during class. Students are expected to take note of these and other announcements as they occur.

ASSESSMENT

The course grade will be calculated as follows. Point breakdowns for each of these major components will be posted online.

Mid-term Exam	30%
Homework	10%
Project	30%
Final Exam	30%
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TOTAL	100%

Grading will not be on a curve. Notional numerical grading (i.e. for things like exams) will be as follows.

A: 90-100	A+ 100	A ~95	A- ~92
B: 80-89	B+ ~89	B ~85	B- ~82
C: 70-79	C+ ~79	C ~75	C- ~72
D: 60-69	F: 0-59		

With respect to the project, excellent work will receive an A, good work a B, and acceptable work a C. At my option, any unacceptable work may be handed back to redo.

ASSIGNMENTS

In general, homework will be assigned approximately once per week with the assignments due exactly one week later. In exceptional circumstances (illness, university business, religious observances, etc.), extensions may be granted for assignments. However, all extensions must be approved by the instructor BEFORE the due date.

Reading

Students are expected to keep pace with reading the relevant sections within the text and should be prepared to discuss it in class.

Homework

Homework assignments will be presented and problem solutions can be discussed upon request in class. Students should consider homeworks as learning experiences. *You may work together on homework, but should work through the problems on your own (i.e., no copying).* The purpose is not just to hand something in, but to use the exercises to understand and gain familiarity with the material/concept being presented.

As a courtesy to the professor and the teaching assistant, solutions should be written neatly. Work that is difficult to read may be given a lower grade at their discretion. Show all work, or full credit will not be given.

Projects

There will be a project that each student individually will complete through the semester. You will be asked to create a MATLAB code to estimate the aerodynamics of a wing. The formulation will be based on a series of lecture notes and material to be provided during the period of the course.

There may be intermediate due dates on components of the project throughout the semester. The reviews of the intermediate reports are to give indication of proper direction, focus and progress. The Student will be expected to report on their progress as requested by the instructor. The grade will be based on the final performance / outcome of the code (with some attention paid to the intermediate progress/reviews.)

EXAMS

There will be two in-class exams (a mid-term & a final.) Exams will be comprehensive. In grading, consideration is given to the reasoning that is used to solve the problems. It is worthwhile to carefully set up the problem on paper, even if you cannot solve it completely. If you know your answer is wrong, say so and explain why, even if you can't figure out how to get to the right answer. *Show work and explain your reasoning, or partial credit cannot be given.*

Makeup exams will not be given unless a student can present evidence that an absence was caused by serious illness, a death in the immediate family, religious observance, or participation in University activities at the request of University authorities, or another approved reason. Please contact me before an anticipated exam absence, if at all possible. If you have a

documented disability and wish to discuss academic accommodations with me, contact me as soon as possible at the beginning of the semester.

The following university rules govern all in-class examinations. A breach of any of the rules constitutes a "disruption of class," a disciplinary offense (Code of Student Conduct, section 9.m.), or may serve as the basis of an allegation of academic dishonesty.

1. Students arriving late for an examination may not unreasonably disrupt the examination room.
2. Students must leave all unauthorized materials (e.g., books, notes, calculators) with the proctor before being seated.
3. Where seating arrangements are established by proctors, student must conform to these arrangements.
4. Students may not return to an examination room after leaving, unless permission to do so has been granted by the proctor prior to the student's departure.
5. Students must cease conversation prior to the passing out of examination papers and maintain silence during the entire examination period.
6. Students must place examination papers face down on the writing desk until the examination is officially begun by the proctor.
7. Students must keep examination papers flat on the writing desk at all times.
8. Students at an examination must be prepared to show current University identification.

In addition, exams will be conducted according to the following guidelines:

1. Seating may be assigned.
2. Unless allowed for use in the examination by the instructor, books, papers, & clothing can be placed well back under the seats on the floor instead of given to the proctor.
3. Pencils, pens, an eraser, and a calculator (if so stated) are the only items allowed on the desk top during the exam unless otherwise specified.
4. Put your name on each sheet of the exam.
5. When time is called, stop working and hand in your exam.
6. Know the Code of Student Conduct.

I may attach to the exam a sheet with some of the equations you may need on that test.

ATTENDANCE AND PARTICIPATION

Attendance and active participation are required. Students are expected to attend the entirety of each class and to draw from the assigned homework material in class participation.

The format of the course will be lecture and discussion. Classroom time offers the opportunity to ask questions about the reading or other topics. Lectures will deal with the general subject matter of the textbook but will also include material not in the text. Students will be expected to discuss the materials that have been covered in class.

EFFECTIVE NOTE-TAKING

A substantial amount of material will be presented to the student orally in this class. *You will be responsible for all the material discussed in class.* In order to get the most out of the course, I suggest following these note-taking strategies.

- Review the lecture notes before the class which will be presented/discussed. Print them and add to them any added information from class or your reading.
- Take notes of things that are said and discussed, as well as what's written on the board. *If I'm talking about something, then it is generally important.*
- It is a good habit every evening after class, or at the latest the next day, to recopy your notes into a neat, organized format. Use this time to review the material and make sure that you understand it. This is a key step in the learning process and will aid you in studying for exams.
- Ask, either privately, during office hours, or during class time, for clarification of those points that are not clear to you or that you didn't catch. Take notes of the explanation, and modify your class notes accordingly.

ACADEMIC INTEGRITY

The University of Maryland, College Park has a nationally recognized code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduates and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information, please visit <http://www.shc.umd.edu/>.

University Course Related Policies

- For further details on course related policies as specified by the University, go to <http://www.ugst.umd.edu/courserelatedpolicies.htm>

Academic integrity is a foundation for learning. The University has approved a Code of Academic Integrity available on the web at <http://www.testudo.umd.edu/soc/dishonesty.html>. The Code prohibits students from cheating on exams, plagiarizing papers, forging signatures, etc. The Code is administered by a Student Honor Council, which strives to promote a community of trust on the College Park campus. Allegations of academic dishonesty can be reported directly to the Honor Council by any member of the campus community.

Students are strongly encouraged to discuss the course material with each other to help understand and learn it. However, this should take place *before* you do the homework or take the exam. (After you have started the homework it is still OK to discuss the meaning of a question.) Everything you turn in must be your own work. It is expected that you are capable of distinguishing between helping others and cheating. *You should never look at another student's answers, work together to come up with those answers, or copy someone else's answers, either from this class or any previous classes, nor should you ever look at a solution set from a previous year.* Likewise, you should never give anyone else the answers to questions on homework or exams. *You should also never copy a process sequence from anywhere, not even from the textbook.* If you would like clarification, please see the instructor.