MAE 3405-001, Flight Dynamics
Fall 2013

Instructor(s): Baxter R. Mullins, Jr., Ph.D.

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Office Hours: MW 2:00-3:00 pm

Section Information: MAE 3405-001

Time and Place of Class Meetings: Pickard Hall (PKH) #321, MW 4:00-5:50PM

Emergency Exits: Straight out the door and down the steps. If blocked there are exits at end of hallway to the left and right. **DO NOT USE ELEVATORS**!

Description of Course Content: MAE 3405 FLIGHT DYNAMICS (4-0) Derivation of equation of motion (EOM) of a flight vehicle. Trimmed flight condition analysis based on the nonlinear EOM. Linearization of EOM for a given trimmed flight condition. State-space and transfer-function representations of the linear EOM. Aircraft stability and dynamic performance analysis based on the linear EOM.

Student Learning Outcomes: With the successful completion of this course, the student shall have basic understanding of how to develop models for aerospace vehicles, the short falls of such models, and basic understanding of analysis techniques commonly used.

Required Textbooks and Other Course Materials:

- Mechanics of Flight – 2nd Edition by Warren F. Phillips, John Wiley & Sons, Inc. 2010, ISBN 978-0-470-53975-0
- Software: MATLAB Student Edition by Mathworks Inc.

References:

- Etkin, B., and Reid, L. D., "Dynamics of Flight," John Wiley & Sons, 3 ed. (October 31, 1995), ISBN 0471034185, (Note: Older versions are good!)
- McRuer, D., Ashkenas, I., and Graham, D., "Aircraft Dynamics and Automatic Control," Princeton University Press, 1990, ISBN 069102024405
- Blakelock, J. H., "Automatic Control of Aircraft and Missiles," Wiley-Interscience; 2 ed.n (January 18, 1991), ISBN: 0471506516, (Note: Earlier version very good!)
- Roskam, J., "Airplane Flight Dynamics and Automatic Flight Controls, Part 1 & 2," DarCorp; 6th ed. (2011), ISBN 1884885179
- Napolitano, M., "Aircraft Dynamics: From Modeling to Simulation," Wiley, 1 ed., Nov. 15, 2011

- Johnson, W., "Rotorcraft Aeromechanics," Cambridge Aerospace Series No. 36, April 29, 2013, ISBN: 1107028078 (If you like rotorcraft, this is the place to start!)
- Anon, "USAF Stability and Control DATCOM (DATa COMpendium)," ADB072483 is a downloadable pdf file – called the "Yellow Books" - over 3,000 pages (Public Domain)
- Anon, "USAF Digital DATCOM," Software version of the USAF DATCOM, (Public Domain)
- MIL-F-8785C, MILITARY SPECIFICATION: FLYING QUALITIES OF PILOTED AIRPLANES (05 NOV 1980)
- Federal Aviation Regulation: Part 23 & Part 25
- MIL-C-005011B (USAF)
- AS-5263 (USNAVY)

Descriptions of major assignments and examinations:

Exams:

- Two (2) 50 minute exams will be given during the semester
- Comprehensive Final Exam

Project:

- An individual project will be assigned. Assigned projects may vary from student-to-student but be of equivalent status.

Homework:

- Homework will be assigned on a class-by-class basis. Homework will be due one (1) week from the date of assignment at the beginning of the class period. Assignments due on a holiday will be due the next class period. Late assignments will be assessed at least a 10 % penalty.

Other Requirements:

- Modeling software such as MATLAB® and SIMULNK® will be useful in working some homework problems and the project. Student versions are available at the UTA Bookstore. MATLAB® and SIMULNK® are programs commonly used in industries including aerospace companies and learning the use of these programs will enhance your future career no matter your area of work – STUDENT VERSION.
- There is a powerful full-function, free and open source modeling software available from Scilab/Xcos. (See http://www.scilab.org/) This software is used throughout European universities and industries as their standard for engineering and scientific computations.

Attendance: With the exception of Exams, attendance is not mandatory although highly recommended. Makeup Exams are at the discretion of the Instructor within university regulations as described in the current Undergraduate Catalog under Authorized Absences.

Other Requirements: Prerequisite: MAE 3306 (or concurrent enrollment), C or better in MATH 3330.

Grading:

- Final Grade Weighting:

Homework	10%
Exam 1	20%
Exam 2	20%
Project	25%
Final Exam	25%

- Grade Allocation: Course grades will be assigned

A	90 – 100
B	80 – 89
C	70 – 79
D	60 – 69
F	≤ 59

Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.

Expectations for Out-of-Class Study: Beyond the time required to attend each class meeting, students enrolled MAE 3405, a 4-credit hour course, should expect to spend at least an additional 12 hours per week of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc. (The general rule of thumb is for every credit hour earned, a student should expect to spend 12 hours per week working outside of class.)

Grade Grievances: Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current undergraduate catalog.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance**. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/ses/fao).

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable

accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Academic Integrity: All students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

Instructors may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at www.uta.edu/resources.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at http://www.uta.edu/oit/cs/email/mavmail.php.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as lecture, seminar, or laboratory shall be directed to complete a Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit http://www.uta.edu/sfs.

Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Course Schedule

Fall Term - Regular Session, 2013 (16 meeting weeks: 15 instructional weeks + 1 final exam week)

First day of classes	August 22, 2013
Labor Day holiday	September 2, 2013
Census date	September 9, 2013
Exam #1	**September 30, 2013**
Last day to drop classes	October 30, 2013
Exam #2	**November 4, 2013**
Project Assigned	**November 6, 2013**
Thanksgiving holidays	November 28 – 29, 2013
Project due	**December 2, 2013**
Last day of classes	December 4, 2013
Final exams	December 5 – 6, 9 – 11, 2013
Final Exam for MAE 3405-001	**TBD**

In your course schedule, be sure to indicate (to the extent possible) dates for all major work to be completed. (The definition of "major" is left to the discretion of each instructor.)

"As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course. – Baxter R. Mullins, Jr."

Topics covered:

- Review
  - Subject of Flight Mechanics
  - Static Stability and Control
  - Flying Qualities and the Human Pilot
  - Axes and Notation
- General Equations of Motion
  - Rules and Assumptions
  - Kinematic Equations
  - Rigid-body Equations of Motion

  - Evaluation of Angular Momentum
  - Elastic Degrees of Freedom
  - Effect of Spinning Rotors
- Stability Derivatives
  - Longitudinal Derivatives
  - Lateral Derivatives
- Stability of Controls-Fixed Motion
  - Longitudinal Stick-Fixed
  - Lateral Stick-Fixed
- Stability of Controls-Free Motion
  - Longitudinal Controls-Free Motion
  - Lateral Controls-Free Motion
- Mathematical Tools
  - Small-Disturbance Theory
  - Linear System Theory
  - Laplace Transforms
  - Block Diagram Algebra
  - State-Space Formulation
- Actuation of Controls (Open Loop)
- Closed-Loop Control (Feedback Control)
- Every day “Rules of Thumb”