Syllabus

ENGR 4820: Advanced Topics--Aerospace Flight Dynamics
Winter 2015

University of Denver
Mechanical and Materials Engineering Department

Meets: Lockheed-Martin, 5:00-8:20 T
(4.0 Credit hours), Satisfies Graduate Course Credit

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Course Description:
This course covers flight dynamics related to both atmospheric and space flight. A review of aerodynamic principles is followed by an overview of atmospheric flight dynamics and space flight dynamics. In the atmospheric domain topics associated with aircraft performance, and re-entry vehicle performance will be covered. In the space domain fundamental orbital mechanics are covered. The approach toward these topics is from a practical perspective in which analysis and design are intertwined.

Prerequisites: Graduate Level Standing

Textbooks:
Tewari, A., Atmospheric and Space Flight Dynamics: Modeling and Simulation with MATLAB and Simulink, Birkhauser Boston, 2007. ISBN#: 978-0-8176-4437-6.

Course Learning Objectives: The student should be able to

- Apply basic/constitutive principles fluids mechanics such as the Bernoulli and Euler equations for Aeronautics applications
- Explain flow regimes (viscous/non-viscous; compressible/incompressible aerodynamics) and to estimate viscous and thermal effects for Aeronautics applications
- Compute lift/drag of simple configurations
- Derive and apply general equations of motion for flight to determine aircraft performance in steady gliding, horizontal and climbing flight
- Derive aircraft performance diagram and flight envelope, in relation to aircraft morphology, lift-drag polar and engine performance
- Derive and apply the general equations of orbital mechanics for determining satellite ground tracks.
- Understand general rocket propulsion

Approximate Course Schedule and Topics:

Week	Lectures	Approximate Topics Covered and Sequence
Aerospace Flight Dynamics		
1	1	Fundamental Aerodynamics Equations (Bernoulli and Euler)
2	2	Compressible Flow in Aerodynamics and Propulsion
3	3	Laminar and Turbulent Flow in Aerodynamics
4	4	Airfoils and Finite Wing Theory
5	5	Aircraft Flight Dynamics
6	6	Aircraft Horizontal Flight
7	7	Climbing and Descending Flight/Flight Envelope
8	8	Satellite Orbits
9	9	Orbital Maneuvers
10	10	Rocket Propulsion

The topics are covered in primarily a slide set that will be available to students and from Chapters 3, 4, 5, and Chapters 8-12 in the required textbook.

Grading

Homework 40%
Projects 60%

***Homework*:** 4-5 problems will be assigned from the required textbooks and or given out in a handout and will be due at the beginning of class on the due dates--these will be assigned approximately weekly. The homework should be done in the required format which was shown on the first day of class. These problems are meant for you to hone your analytical skills and broaden your conceptual knowledge of Aerospace Flight Dynamics concepts.

In-Class "Homework": There will be some in-class participatory exercises that will count towards your homework grade. These types of exercises might include watching videos on a topic and filling out a viewing guide as well completing analytical problems relevant to the most recent material. These will be typically graded such that legitimate attempts and participation will give you most of the credit. These exercise will help me gage your progress and understanding of the topics along with encouraging you to attend and participate in class. These in-class assignments can be made-up if there is a legitimate reason for missing class.

Projects: Three projects will be assigned to help you synthesize your understanding of Aerospace Space Flight Dynamic topics and its practical applications to everyday engineering practice. These projects will require a level of analysis beyond what is required in the homework, and will likely involve using computational tools such as Matlab or equivalent, MS Excel, and CFD tools. The projects will be due approximately every 3 weeks.