AE 584 HELICOPTER DYNAMICS, STABILITY AND CONTROL
Fall 2014

Thursdays, 9:40-12:30, Room#125

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Course Description:

This course will introduce fundamentals of helicopter flight dynamics including aspects of modeling, simulation, stability and control of helicopters. Students will be introduced to rotor dynamics, calculations of rotor forces and moments. Rotor flapping, lag and torsional dynamics will be studied and analyzed. Sufficient tools will be provided to trim, and analyze the stability and handling quality aspects of helicopters. Homework problems will involve case-studies and will familiarize students with real-life engineering problems.

At the end of this course you should have a fundamental understanding of helicopter and rotor dynamics. Moreover, you should be able to generate basic simulation models and analyze its dynamic behavior, possibly provide flight controller solutions for desired handling quality performance.

Although the course will focus on a classic helicopter configuration, it will provide the necessary tools to analyze any aircraft with a rotor, including configurations like a tilt- rotor, auto-gyro, etc.

Course References:

1. Helicopter Theory, W. Johnson, Dover Publications, 1994.
2. Helicopter Flight Dynamics: The Theory and Application of Flying Qualities and Simulation Modeling, G.D. Padfield, AIAA Education Series, 1996.
3. Principles of Helicopter Aerodynamics, G. Leishman, Cambridge University Press, 2002
4. Helicopter Performance. Stability and Control, R. W. Prouty, Krieger Pub. Co., 2002.
5. Basic Helicopter Aerodynamics, J.Seddon, BSP Professional Books,1991

Syllabus:

1. Introduction, Basic Terminology
2. General Equations of Motion
3. Rotor Flap Dynamics
4. Rotor Wake and Inflow Dynamics
5. Coupled Flap-Lag-Torsion Dynamics
6. Rotor Dynamic Stability
7. Rotor Forces and Moments
8. Helicopter Linearized Equations of Motion
9. Helicopter Static and Dynamic Stability Characteristics
10. Handling Qualities and Flight Controllers for Helicopters

Grading: (+/-5%)

1 Midterm (13 Nov., 17:45)	30%
1 Project	20%
~3 HWs	15%
1 Final	35%

Pre-requisites:

This course is a graduate level class and although it does not have a pre-requisite, it requires a strong foundation in Dynamics, Flight Mechanics and System Dynamics.

AEE 446 Introduction to Helicopter Aerodynamics and Helicopter Design is a fundamental class in the introduction of helicopters and specifically the understanding of rotary wing aerodynamics. Therefore, although not required it is strongly recommended to take AE446 before taking this class to maximize your benefit. AE584 will complement the course AEE 446 and would serve as an extension and an advanced class in rotary wing analysis in graduate level.