AE 4071 – Rotorcraft Aeromechanics

HOURS: 3-0-3

CATALOG DESCRIPTION:
Basic rotor aerodynamics and dynamics, helicopter performance and trim, introduction to helicopter stability, control and vibration.

PREREQUISITES:
AE3030 and AE3530

TEXTBOOKS:
Course Notes
References:
1. Gordon Leishman: Principles of Helicopter Aerodynamics, Cambridge Aerospace Series.
2. Stepniewski & Keys: Rotarywing Aerodynamics, Dover Publications.
3. Bramwell, Done and Balmford: Helicopter Dynamics, Elsevier.
4. Wayne Johnson: Helicopter Theory, Dover Publications.

COURSE OBJECTIVES:
Provide students with a basic understanding of helicopter aerodynamics, dynamics, performance and trim, and an introduction to helicopter stability, control and vibration.

LEARNING OUTCOMES:
Students will be able to:
1. Model rotor as an actuator disk
2. Develop simplified rotor inflow models in axial flight
3. Formulate and analyze rigid blade flapping dynamics
4. Formulate rotor aerodynamic forces and moments
5. Carry out helicopter simplified performance analysis
6. Formulate and solve helicopter trim equations
7. Analyze rotor damping and controllability
8. Understand introductory aspects of helicopter stability and control
9. Understand introductory aspects of helicopter vibration

LEARNING ACCOMMODATIONS:
If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services. (http://disabilityservices.gatech.edu).

ACADEMIC INTEGRITY:
Academic dishonesty is not tolerated. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. Plagiarism includes reproducing the words or visual/graphical expressions of others without clear attribution and citation. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code, available online at http://osi.gatech.edu/content/honor-code.

TOPICAL OUTLINE

Topic	Hours
1. Introduction and basic terminology	3
2. Aerodynamics of rotors in hover and axial flight	9
-Momentum theory	
-Blade element theory	
-Combined axial momentum and blade element theory	
-Inflow modeling in axial flight	
-Inflow modeling in forward flight	
3. Simplified performance analysis	6
-Hover and horizontal flight	
-Ascending and descending flight	
-Energy methods	
4. Physical concepts of blade motion and control	6
-Flapping, lead-lag and feathering	
-Collective and cyclic controls	
-Steady state flapping motion to control inputs	
-Steady state flapping motion to body angular rates	
5. Simplified trim analysis	6
-Rotor forces and moments	
-Force and moment balance	
-Trim solution	
6. Introduction to stability, control and vibration	9
- Pitch, roll and yaw damping	
- Control power and control sensitivity	
- Static stability	
- Dynamic modes in hover	
- Vibration and methods for vibration control	
Exams	3
Total	**42**