Syllabus
AERO 489/689

Course Title – Helicopter Aerodynamics
Credit Hours- 3
Semester – Fall 2017

Instructor Information

Name	David Coleman (teaching fellow), and Dr. Moble Benedict
Telephone number	540-247-2807, 979-458-2705
Email address	dcaero14@tamu.edu, benedict@tamu.edu
Office hours	Tuesday, Thursday 2pm-4pm
Office location	746A HRBB

Textbook and/or Resource Material

Required Textbook: Principles of Helicopter Aerodynamics (2nd edition) – J. Gordon Leishman.
Optional Textbook: Rotorcraft Aeromechanics – Wayne Johnson.

Course Description and Prerequisites

Course Description: Hovering theory, hovering and vertical flight performance, factors affecting hovering and vertical flight performance, autorotation in vertical descent, concepts of blade motion and control, aerodynamics of forward flight, forward flight performance, operational envelope, and introduction to conceptual design of helicopters.

Prerequisites: AERO 301 Theoretical Aerodynamics, AERO 310 Aircraft Dynamics, AERO 220 Introduction to Aerospace Computation**.**

Learning Outcomes

At the end of this course students, will be able to:

1. Use momentum theory to understand the interdependence of some of the basic parameters such as thrust coefficient, power coefficient, disk loading, power loading and figure of merit.
2. Use blade element momentum theory to predict the thrust and power of a rotor in axial flight (hover, climb, decent) and forward flight. Understand how the parameters such as rotor solidity, number of blades, blade twist and planform taper affect rotor performance.
3. Understand the dynamics of a rotating, flapping-pitching blade in forward flight and swashplate-based control. Derive expressions for flapping dynamics of a rigid blade with aerodynamic forces included.
4. Predict the flight envelope of a helicopter in terms of maximum endurance, speed, range, climb rate, density altitude and autorotation capability.
5. Perform conceptual design of the helicopter depending on the mission.

Grading Policies

Homework Policy:

- Homework is collected at the beginning of class on the due date.
- Staple/clip the homework pages together.
- Late assignments will not be accepted, except for University approved excused absences.

Major Exams:

- Closed book and closed notes.
- Student will not be able to pass the class if he/she fails to pass the final.
- No makeup exams will be given, except for University approved excused absences.

Method of Evaluation (undergraduate):

1.	Homework	50%
2.	Mid-term Examination	20%
3.	Final Examination	30%
	Total	100%

Method of Evaluation (graduate):

1.	Homework	45%
2.	Mid-term Examination	15%
3.	Final Examination	25%
4.	Final Project	15%
	Total	100%

Grading Scale

Standard Letter Grading Scale:
A = 85-100
B = 70-84
C = 55-69
D = 40-54
F = <40

Course Topics, Calendar of Activities, Major Assignment Dates

Week	**Topic**
1-3	Momentum theory in axial flight (hover, climb, decent)
4,5	Momentum Theory in Forward Flight
6	Blade Momentum Theory
7,8	Blade Element Momentum Theory, **mid-term exam**
9,10	Dynamics of a Rotating Blade
11,12	Helicopter Performance
13,14	Conceptual Design of Helicopters
15	**Final Exam / Project**

Other Pertinent Course Information

Attendance Policy:

- Students are expected to attend class. Only university excused absences will be accepted.
- See http://student-rules.tamu.edu/rule07 regarding attendance and Excused Absences.

Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus, or call 979-845-1637. For additional information, visit http://disability.tamu.edu.

Academic Integrity
For additional information please visit: http://aggiehonor.tamu.edu

"An Aggie does not lie, cheat, or steal, or tolerate those who do."

ABET Outcomes

Contribution to Professional Component:

1. Provides foundation in aerodynamics of a helicopter rotor.
2. Provides understanding of helicopter performance.

Relationship to Program Outcomes:

Objectives	Assessment Method	ABET Outcome
Use momentum theory to understand the interdependence of parameters such as thrust/power coefficients, disk loading, power loading and figure of merit.	Homework, Mid-term Examination, Final Examination/Project.	3 (a), 3(e)
Use blade element momentum theory to predict the thrust and power of a rotor in axial flight and forward flight.	Homework, Mid-term Examination, Final Examination/Project.	3 (a), 3(e)
Understand the dynamics of a rotating, flapping-pitching blade in forward flight and swashplate-based control.	Homework, Mid-term Examination, Final Examination/Project.	3 (a), 3(e)
Calculate the operational envelope of a helicopter.	Homework, Mid-term Examination, Final Examination/Project.	3 (a), 3(e)

Relationship of Course to ABET Student Outcomes

a. Ability to apply knowledge of mathematics, science and engineering
b. Ability to design and construct experiments, as well as to analyze and interpret data
c. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. Ability to function on multi-disciplinary teams
e. Ability to identify, formulate and solve engineering problems
f. understanding of professional and ethical responsibility
g. Ability to communicate effectively
h. Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. Recognition of the need for, and an ability to engage in life-long learning
j. Knowledge of contemporary issues
k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice

PC1. Knowledge of Aerodynamics
PC2. Knowledge of aerospace materials, structures, or space structures
PC3. Knowledge of propulsion
PC4. Knowledge of flight mechanics, stability and control, and/or spacecraft attitude control
PC5. Knowledge of orbital mechanics and/or space environment

Learning Outcome	**Assessment Method**	**ABET Outcome**
Specific learning outcome from your course	How you will assess this (exam, homework, etc.)	Particular a-k or PC1-5 outcome