THE UNIVERSITY OF TEXAS AT AUSTIN
Department of Aerospace Engineering and Engineering Mechanics

ASE 367K – FLIGHT DYNAMICS
Spring 2011

SYLLABUS

Unique Number: 13450

Instructor: David G. Hull
WRW 408C, 471-4908, dghull@mail.utexas.edu

Time: MWF 11-12

Location: WRW 102

Teaching Assistant: Alan Campbell

Web Page: courses.ae.utexas.edu/ase367k

Catalog Description:
Equations of motion for rigid aircraft; aircraft performance, weight and balance, static stability and control, and dynamic stability; design implications.

Course Objectives:
This course is intended to give the student an understanding of the basic principles of atmospheric flight mechanics and what role they play in aircraft design.

Prerequisites:
ASE 320 and ASE 330M

Knowledge, Skills, and Abilities Students Should Have Before Entering This Course:
Differential equations
Vector analysis
Dynamics
Subsonic aerodynamics (lift and drag) of airfoils and wings

Knowledge, Skills, and Abilities Students Gain from this Course (Learning Outcomes):
Derive equations of motion (three DOF, flat earth, spherical earth)
Model aerodynamic forces and moments of subsonic airplanes, incompressible and compressible
Understand the derivation and use of formulas for distance factor, distance, rate of climb, time to climb, neutral point, dynamic response and stability, etc.
Understand the relationship between atmospheric flight mechanics and airplane design

Impact On Subsequent Courses In Curriculum:
This course is a prerequisite for the airplane design course. It (flight mechanics) is motivated by a discussion of the commercial and military mission profiles for airplane sizing, and a major part of the course is devoted to the derivation of the equations to be used in each mission segment for the calculation of distance, time, and fuel consumed. Hence,

once the conceptual design has been performed and the configuration of an airplane is known, the student should be able to compute the performance of the airplane.

Relationship of Course to Program Outcomes:
This course contributes to the following ABET Criterion 3 outcomes and those specific to the EAC accredited program.

AEROSPACE ENGINEERING PROGRAM OUTCOMES

	a. An ability to apply knowledge of mathematics, science, and engineering.
	b. An ability to design and conduct experiments, as well as to analyze and interpret data.
	c. An 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. An ability to function on multidisciplinary teams.
x	e. An ability to identify, formulate, and solve engineering problems.
	f. An understanding of professional and ethical responsibility.
	g. An ability to communicate effectively.
	h. The 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. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET Program Criteria Achieved:
Program criteria are unique to each degree program and are to be compiled from the program criteria given for each degree program and listed in table format below. The faculty should check which of the program criteria are achieved in the course.

AEROSPACE ENGINEERING PROGRAM CRITERIA

	Programs must demonstrate that graduates have A. knowledge of:	
	1. Aeronautical engineering:	
	x	a. Aerodynamics
		b. Aerospace materials
		c. Structures
		d. Propulsion
	x	e. Flight mechanics
	x	f. Stability and control.
	2. Astronautical engineering;	
		a. Orbital mechanics
		b. Space environment
		c. Attitude determination and control
		d. Telecommunications
		e. Space structures
		f. Rocket propulsion
	3. Of some topics from the area not emphasized	
	B. Design Competence which includes integration of aeronautical or astronautical topics	

Note: This course teaches fundamental math and engineering skills that do not cover aerospace engineering criteria

Topics:
Each topic listed below has a Criteria 2000 Outcome of e
1. Introduction to flight mechanics and aircraft design (2 classes)
2. Equations of motion for flight in a vertical plane (4 classes)
3. Modeling the aircraft drag polar; thrust and specific fuel consumption (7 classes)
4. Quasi-steady flight: distance, time, and fuel consumed during cruise and climb (10 classes)
5. Nonsteady flight: take-off and landing, and specific excess power (6 classes)
6. Static longitudinal stability and control: equations of motion, aerodynamics, trim conditions, stability, aerodynamic control, effect of cg location (8 classes)
7. Dynamic longitudinal stability and control: linearized equations of motion, aerodynamics, response to an elevator input and to a vertical gust, stability characteristics of the response, and effect of cg location (4 classes) (A,F,M)
8. Review, tests, and recaps (6 classes)

Professionalism Topics:
Throughout the course the topics being discussed are related to the history of aircraft development. Examples include the reason for the elliptical wing on the Spitfire, the reason for the gull wing on the Corsair, the reason for the flat surface on the F-16 to which the wing is attached, the dynamic stability characteristics of the Wright Flyer, etc. These are also design related topics.

Design Assignments:
This course is the aircraft performance, stability, and control course which most directly prepares the student for the aircraft capstone design course. Topics covered in the first part of the course help the student identify the parameters which affect takeoff, climb, cruise, descent, turn, and landing performance as well as specific excess power. Topics covered in the second part of the course include a detailed look at static longitudinal stability, with special emphasis on cg location for static stability, and an overview of dynamic longitudinal stability and response to an elevator deflection and to a vertical gust .

Laboratory Assignments:
None

Computer:
Most of the computer exercises have been placed in the lab associated with the class (ASE 167M). Some assignments require computation and plotting.

Text:
Hull, D.G., "Fundamentals of airplane flight mechanics", Springer, 2007

Class Format:
Three hours of lecture per week for one semester

Class Schedule:
See Topics

Class Outline:
See Topics

Grading:
Weekly homework 10%
First quiz 25%
Second quiz 25%
Final exam 40%

Homework Policy:
Homework is used to enhance the student's understanding of the course material. At least one assignment will be given each week, and it will be due on Friday. The homework counts 10% of the course grade. This is equivalent to one letter grade.

Examinations:
One-hour exams will be given at approximately one-third and two-thirds of the semester. Each exam will count 25% of the grade. The final exam will count 40% of the grade.

Attendance:
Regular attendance is expected.

Office Hours:
MWF 10-11

Important Dates:
Last day to drop course without academic penalty – September 22

Special Notes:
The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the Cockrell School of Engineering Director of Students with Disabilities at 471-4321.

Evaluation:
The course/instructor evaluation will be conducted during the scheduled time.

Prepared by:
Prof. David G. Hull
August 4, 2010

MAJOR AREAS OF ATMOSPHERIC FLIGHT MECHANICS

1. Trajectory Analysis (Performance)

2. Stability and Control

3. Airplane Sizing

4. Simulation

5. Flight testing