AE 4803 – Configuration Aerodynamics and Flight Performance

HOURS: 2-0-2

CATALOG DESCRIPTION:

Applied aerodynamics methods for aircraft performance assessment. Numerical simulation of canonical flight maneuvers. Regulatory requirements involving flight performance.

PREREQUISITES:

AE 3030, AE 3330

TEXTBOOKS:

Required:	None
Recommended:	Lan, C-T.E., and Roskam, J., *Airplane Aerodynamics and Performance*, DAR Corporation, 2016

COURSE OBJECTIVES:

To learn the theoretical, numerical, and semi-empirical methods for applied aerodynamics and flight performance that are commonly employed in engineering practice for aircraft design and operations.

LEARNING OUTCOMES:

Students will be able to:

1. Apply computational aerodynamics tools such as airfoil viscous flow codes, vortex lattice codes, panel methods, supersonic wave drag codes, and understand when the various tools are applicable
2. Apply semi-empirical aerodynamics methods such as wetted area build-ups and high-lift system performance charts and understand in which contexts the various methods are applicable
3. Develop and use aerodynamic databases, e.g. drag polars and lift curves, for different types of aircraft in different flight conditions
4. Use propulsion performance databases (“decks”) in the simulation of flight performance
5. Apply numerical ODE solvers to simulate takeoff, landing, cruise, pull-up, level turn, and other 2- to 3-DOF flight maneuvers
6. Generate and interpret flight envelope plots with contours for specific excess power and determine minimum time-to-altitude and time-to-energy flight paths
7. Integrate fuel burn in cruise with realistic air traffic control allowances for speed and altitude changes
8. Determine operating conditions (cruise Mach and altitude) for maximizing specific range or specific endurance
9. Evaluate and verify flight performance of aircraft designs relative to requirements in the U.S. Federal Aviation Regulations (FARs)
10. Estimate battery electric aircraft range and endurance performance with consideration of appropriate margins of safety in terms of battery state of charge, life, and health

GRADING:

Individual Mini-Projects:	6 @ 12% each
Group Project:	28%

The <u>mini-projects</u> require considerable and competent computer programming (MATLAB recommended) and the appropriate use of numerical aerodynamics tools. The mini-project assignment reports must be typed and professionally formatted and require high-quality engineering graphics and thoughtful discussions to convey findings. The <u>group project</u> will consist of reverse-engineering a historical airplane’s aerodynamics and performance, using methods learned in the class.

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 ADAPTS office (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. A particular policy is that computer codes written by students will be compared using plagiarism detection software. 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	Lecture Hours
I.	**Drag Prediction**	**6**
II.	**Propeller Aerodynamics and Performance**	**2**
III.	**Cruise Flight**	**4**
IV.	**Specific Excess Power and Energy Maneuverability Theory**	**3**
V.	**High Angle-of-Attack Aerodynamics**	**1.5**
VI.	**Turn Performance and V-n Diagrams**	**1.5**
VII.	**Pull-Up Performance and Loops**	**2**
VIII.	**High-Lift System Aerodynamics**	**2**
IX.	**Takeoff and Landing Performance**	**3**
X.	**Electric Flight**	**4**
	Total	**29**