AE 3310 – Introduction to Aerospace Vehicle Performance (3-0-3)

Catalog Data: AE 3310 - Introduction to Aerospace Vehicle Performance: Performance analysis of fixed-wing aircraft, rotorcraft, and spacecraft. Equations of motion, evaluation of forces, and performance calculations. Steady and accelerated flight performance.

Prerequisites:

AE 2020 – Low-Speed Aerodynamics.

MATH 2403 – Differential Equations

Textbook: Anderson, J. D., *Aircraft Performance and Design*, WCB/McGraw-Hill, Boston, 1999.

Coordinator: J. R. Cruz, Visiting Professor

Learning Objectives: This course introduces the students to the solution of performance problems for fixed-wing aircraft, rotorcraft, and spacecraft. Emphasis is placed on the approach used to pose and solve performance problems: setting up the equations of motion, evaluating the appropriate forces, and solving for the desired performance parameters. Students are introduced to standard performance problems for all three types of aerospace vehicles (e.g., airplane range, rotorcraft hover performance, spacecraft orbital maneuvering), and the relationship between key vehicle parameters and performance (e.g., how is range affected by an airplane's lift-to-drag ratio and specific fuel consumption?). Students use numerical methods learned in previous classes (e.g., numerical integration of ordinary differential equations) to solve performance problems for which closed-form solutions do not exist. This course prepares the students for the senior-level aerospace vehicle design sequences.

Expected Outcomes: Students will be able to pose and solve performance problems by setting up the equations of motion, evaluating the appropriate forces, and solving for the desired performance parameter. Students will understand, and be able to solve, standard performance problems.

Topics:

<u>Part I – Preliminaries (2 hrs)</u>

1. Aerospace Vehicle Performance – Definitions
2. Aerospace Vehicle Performance as a Requirement
3. Flight Regimes – Mach Number and Reynolds Number
4. Standard (and non-Standard) Atmospheres

Part II – Fixed Wing Aircraft Performance (24 hrs)

5. Forces of Flight and Equations of Motion
6. Aerodynamics and the Drag Polar
7. Propulsion Systems
8. Aircraft Mass Estimation
9. Airplane Performance in Steady Flight
10. Airplane Performance in Accelerated Flight
11. Instrumentation and Flight Testing

Part III – Rotorcraft Performance (6 hrs)

12. Rotorcraft Configurations and Capabilities
13. Actuator Disk Theory – Vertical Flight
14. Actuator Disk Theory – Forward Flight
15. Rotorcraft Power Required
16. Elements of Rotorcraft Performance

Part IV – Space Vehicle Performance (6 hrs)

17. Orbital Mechanics
18. Rocket Engines and Launch Vehicles

Note: 7 hours have been allocated for non-lecture content such as test reviews, tests, and discussion of homework and test problems.

Last Revision: May 2007