

## MAE 5070: Dynamics of Flight Vehicles

**Designation as a 'Required' or 'Elective' course:** Elective

**Course (catalog) description:** Spring. 3 credits. Offered alternate years.

Introduction to stability and control of atmospheric-flight vehicles. Review of aerodynamic forces and methods for analysis of linear systems. Static stability and control. Small disturbance equations of unsteady motion. Dynamic stability of longitudinal and lateral-directional motions; transient response. At the level of Flight Stability and Automatic Control by Nelson.

**Prerequisite(s):** M&AE 3050 (Introduction to Aeronautics), M&AE 3230 (Introductory Fluid Mechanics) and M&AE 3260 (System Dynamics) concurrently or permission of instructor.

**Textbook(s) and/or other required material:**

*Flight Stability and Automatic Control*, Robert C. Nelson, McGraw-Hill, Second Edition, 1998.

**Course learning outcomes:**

Upon completion of this course, students should be able to:

1. Understand the nature of aerodynamic forces and moments (aerodynamic stability derivatives) in determining the motions of a flight vehicle (MAE/ABET outcomes a, c, and e);
2. Understand the various terms in the equations of motion and the simplifications arising from assumptions of small disturbances from equilibrium flight and from the bi-lateral symmetry of most aircraft (MAE/ABET outcomes a);
3. Be able to identify, formulate and solve engineering problems in aircraft flight dynamics (MAE/ABET outcomes a, e and k);
4. Understand the principal constraints imposed on aircraft design by stability and controllability requirements (MAE/ABET outcomes c, e and j).

**Topics covered:**

- ◆ Definitions, Coordinate Systems, Dimensions and Units.
- ◆ Aerodynamic Background
- ◆ Static Stability and Control
- ◆ Equations of Motion
- ◆ Dynamical Systems Background
- ◆ Longitudinal Dynamics
- ◆ Lateral/Directional Dynamics
- ◆ Nonlinear Dynamics

**Class/laboratory schedule, i. e., number of sessions each week and duration of each session:**  
Two 75-minute lectures each week.

**Contribution of course to meeting MAE/ABET curriculum requirements:** This course partially fulfills the requirement to complete three upper level M&AE courses as a Field Approved Elective. It can be used to partially fulfill the requirement to complete two upper level

courses within the Aerospace or Vehicle Engineering concentrations or it can be used to fulfill the Technical Elective requirement.

**Relationship of course to program outcomes:** This course meets MAE/ABET Outcomes a, c, e, j, and k.

**Outcome Assessment:** Each student's knowledge of fundamental principles is assessed by performance on quizzes, mid-term and final examinations, and on homework exercises. Each student's competence in problem identification and formulation is assessed by performance on assigned homework exercises and on mid-term and final examination questions. Student's suggestions for improvements in the course, obtained from comments on Course Evaluation Forms, also will be considered.

**Person(s) who prepared this description and date of preparation:**

D. A. Caughey

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