

AE 3521 Aircraft and Spacecraft Flight Dynamics (4-0-4)

Catalog Data: AE 3521: Aircraft and Spacecraft Flight Dynamics. Credit 4 (4-0-4). AE 3020, AE 3520, or consent of the School. Three-dimensional rigid body dynamics, aircraft and spacecraft equations of motion, principles of static stability and control, dynamic stability of uncontrolled motion, gyroscopic instruments.

Textbook:

Bernard Etkin and Lloyd D. Reid, *Dynamics of Flight, Stability and Control*, Third Edition, John Wiley & Sons, Inc., 1995.
W.E. Wiesel, *Space Flight Dynamics*, 2nd Edition, McGraw-Hill, 1997

Reference:

Nelson, *Flight Stability and Automatic Control.*, McGraw-Hill Book Company.
Thomson, *Introduction to Space Dynamics*, Dover Publications, Inc.

Coordinator: J.V.R. Prasad, Associate Professor of A.E.

Educational objectives: This course is designed to give juniors in aerospace engineering a foundational understanding of dynamics and stability of aerospace vehicles.

Prerequisites by Topic:

1. Fundamentals of aerodynamics.
2. Introduction to boundary layer concepts.
3. Vibrations and system dynamics.
4. Linear system analysis using Laplace transforms.
5. Differential equations with linear algebra.
6. Matrix treatment of linear systems, characteristic roots.

Topics:

1. Introduction: stability, control and equilibrium, axes and notation. (2 classes)
2. General equations of motion: derivation of rigid body equations of motion, vehicle kinematics. (5 classes)
3. Spacecraft attitude dynamics: torque-free rigid body equations. (6 classes)
4. Gyroscopic instruments: basic, rate and integrating gyros, inertial platform. (5 classes)
5. Spacecraft stability and control: spin and gravity gradient stabilization, thrusters, momentum and reaction wheels, attitude control (19 classes)
6. Aircraft dynamics: equations of motion, small disturbance theory and stability derivatives. (7 classes)
7. Aircraft static stability and control: longitudinal static stability and control, directional static stability and control, roll stability and control. (5 classes)
8. Aircraft dynamic stability: longitudinal modes, longitudinal approximations, lateral modes, lateral approximations. (6 classes)
9. Tests & Instructor's option (5 classes)

Computer Usage:

Homework assignments using MATLAB

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