

AE3521: Aircraft and Spacecraft Flight Dynamics, Spring 2004

Topics	Hrs	Assigned Sections
I. Aircraft Equations of Motion Review Coordinate Systems and Euler Transformations Derivatives in Rotating Frames Translational Equations Rotational Equations	6	1.6, 3.2-3.4, Nelson
II. Linearization Small Disturbance Theory Force and Moment Derivatives	8	3.5, 4.4, 5.4, pp193-195, 6.2 3.6, 3.7
III. Aircraft Static Stability Definitions Criteria for Static Stability Contributions of Wing and Tail The Neutral Point and Static Margin Longitudinal Control Directional Stability and Control Roll Stability and Roll Control	4	2.2 2.2 2.3 2.4 2.4 2.6-2.7 2.8-2.10
IV. Aircraft Longitudinal Dynamics Review of modal analysis Short Period and Phugoid Modes Modal Analysis Approximate Models Flying Qualities Frequency Response (optional)	3	Notes Notes Notes 4.5 4.7-4.9 Notes
V. Aircraft Lateral Dynamics Dutch Roll, Roll and Spiral Modes Modal Analysis Approximate Models Flying Qualities Frequency Response (optional)	3	Notes Notes 5.4.1-5.4.3 5.5-5.7 Notes
VI. Spacecraft Attitude Dynamics Euler's Equations Classical Euler Angles The Axisymmetric Case The General Case Quaternions	6	4.6-4.8, Wiesel 5.1-5.3 Notes

VII.	Spacecraft Attitude Control	18	
	Spinning Spacecraft		5.5
	Non-spinning Spacecraft		5.6
	Gravity-Gradient Satellite		5.8
	Dual-Spin Spacecraft		5.9
VIII.	Gyroscopic Instruments	6	6.1-6.7
	The Rate Gyro		
	The Integrating Gyro		
	Stable Platforms		
	Exams	5	
	Total	59	

Course Text Books:

Nelson, R.C., *Flight Stability and Automatic Control*, 2nd Edition, McGraw-Hill, 1998.
Wiesel, W.E., *Spaceflight Dynamics*, 2nd Edition, McGraw-Hill, 1997.

Others:

Aircraft

Blakelock, J.H., *Automatic Control of Aircraft and Missiles*, Wiley.
Etkin, B., Reid, L.D., *Dynamics of Flight*, John Wiley.
McRuer, D., et al, *Aircraft Dynamics and Automatic Control*, Princeton University Press.
Pamadi, B.N., *Performance, Stability, Dynamics, and Control of Airplanes*, AIAA Education Series.
Schmidt, L.V., *Introduction to Aircraft Flight Dynamics*, AIAA Education Series.
Zipfel, P.H., *Modeling and Simulation of Aerospace Vehicle Dynamics*, AIAA Education Series.

Spacecraft

Huges, P.C., *Spacecraft Attitude Dynamics*, Wiley.
Kane, et al, *Spacecraft Dynamics*, McGraw-Hill.
Kaplan, M.H., *Modern Spacecraft Dynamics and Control*, Wiley.
Thomson, W.T., *Introduction to Space Dynamics*, Wiley.

AE-3521 Aircraft and Spacecraft Flight Dynamics, Spring 04

Class Hours: M,W 9:35 – 10:55, F 10:05 – 10:55

Dr. Anthony J. Calise, Professor
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Office Hours: M 3:30-4:30, W 2:00-3:00. Pot luck in afternoons on M,W,F.

Dr. Eric N. Johnson, Lockheed Martin Assistant Professor of Avionics Integration
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Office Hours: M,W,F 1-2pm.

Quiz Dates: 45 minute Quizzes: 1/30, 2/25, 3/26, 4/16
Mini-Quizzes: 1/21, 2/09, 3/15, 4/05
3 Hour Comprehensive Final: 4/26 at 2:50pm

Makeup exams with prior permission only. 24 hour advanced notice required except for emergencies.

Homework: Assignments approximately once per week

Grades: 25% homework, 35% quizzes, 40% final, mini-quizzes extra credit (TBD)

Holidays: 1/19 (MLK), 3/8-3/12 (Spring Break)

Student's Responsibilities: Lecture material even if not in assigned reading
Assigned reading even if not covered in lecture
Prerequisite material from ae2020 and ae3520

Recommendations: Read the text before class
Ask lots of questions in class
Do as much of the assigned homework as possible

Course Objective: **Modeling of Aircraft and Spacecraft Dynamics**

Scope: This course introduces the student to basic elements of aircraft and spacecraft stability. Fundamental to this topic is developing an understanding of how aerodynamic and propulsive force and moment perturbations arise when aircraft and spacecraft are perturbed from an equilibrium flight condition, and the influence that these perturbations have on their dynamics. A primary issue is the stability of this motion, and understanding its modal properties in terms of the state variables. This understanding is an important precursor to the topic of aircraft and spacecraft flight control.