ASEN 5052-001, 5052-001B Analytical Astrodynamics

TTh, 10:05-11:20, AERO 111

Instructor: Daniel Scheeres, scheeres@colorado.edu
AERO 454
Office Hours TBD

Introduction to astrodynamics with an emphasis on analytical approaches — alternative to ASEN 5050. General solution of the 2-body problem. Orbital trajectories, transfers, targeting, and time of flight. Orbit perturbations and averaging analysis. Restricted 3-body problem.

Pre-requisite: Undergraduate orbital mechanics course (equivalent to ASEN 3200) or permission of the instructor.

Coursepack:

Selected excerpts from “Orbital Motion in Strongly Perturbed Environments" will be distributed, selected papers will be distributed.

Textbooks:

A.E. Roy, Orbital Motion 4th edition, Institute of Physics Publishing, 2005.

Additional Reference Books:

D.J. Scheeres. “Orbital Motion in Strongly Perturbed Environments: Applications to Asteroid, Comet and Planetary Satellite Orbiters,” Springer-Praxis Books in Astronautical Engineering. 2012. ISBN 978-3-642-03255-4, e-ISBN 978-3-642-03256-1, DOI 10.1007/978-3-642-03256-1

Grading:

HW problems:	25%
Computational problems:	25%
Mid-term exam:	25%
Final exam:	25%

Topics:

Principles of orbital mechanics.
Orbital trajectories, transfers, time of flight.
Trajectory propagation and targeting.
Orbit perturbation formulation and analysis.
Restricted 3-body problem with applications.

Syllabus (Scheeres):

Orbital mechanics
- Formulation of two-body, three-body and n-body problems
- The two-body problem solution
- Elliptical and circular orbits
- Parabolic and hyperbolic trajectories
- 3-D trajectories and orbit elements
- Time of flight and orbit propagation

Orbital transfers
- Impulsive maneuvers
- Lambert's theorem
- 3-D Targeting
- Fuel optimal considerations

Orbit perturbation formulations
- Variation of constants
- Lagrange's Equations
- Gauss' Equations
- Mean elements and averaging

Orbit perturbation analysis
- Effect of non-spherical gravity fields
- Low-thrust trajectories
- Atmospheric drag
- Tidal and third body effects

Restricted 3-body problem with applications
- Derivation of equations of motion
- Jacobi Integral, Zero-Velocity Curves, and Lagrange Points
- Hill approximation
- Numerical computation and analysis of orbits!

In-Class vs Remote course access:

The following items detail my plans for delivering lectures and office hours, accommodating any restrictions that may arise from the current pandemic crisis. If the campus transitions to a more restrictive stage, the course has been designed to be able

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