ASEN 5050 Space Flight Mechanics
T Th 13:00-14:15 in AERO 111

Instructor: Daniel Scheeres, scheeres@colorado.edu
AERO 454
Office Hours T Th 14:15-15:00

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Office Hours
M 11:00-12:30
W 15:00-16:30

Introduction to astrodynamics at the graduate level. 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 3700), graduate standing, or permission of the instructor.

Coursepack:
Selected excerpts from "Orbital Motion in Strongly Perturbed Environments," selected papers and notes will be distributed.

Textbook:
A.E. Roy, Orbital Motion 4th edition, Institute of Physics Publishing, 2005.
This text is available for download on the CU Library page.

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
J.E. Prussing and B.A. Conway, Orbital Mechanics, 2nd Ed., Oxford University Press, 2012.
J.M.A. Danby, Fundamentals of Celestial Mechanics, 2nd Ed., Willmann-Bell, 1992.

Computing:
Use of Matlab/Python (or other computer languages) in homework.

Homework Communications:
Homework and computational homework problems should be written as informal reports. They should be submitted as a single, combined PDF file. All HW will be due at midnight on Wednesday of the appropriate week. There will be, on average, 1 assignment every 2 weeks.

Grading:

HW problems:	20%
Computational problems:	20%
Mid-term exam (date TBD, early/mid November):	30%
Final exam (Tuesday, December 9, 4:30-7:00 PM):	30%

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:

Orbital mechanics (AE Roy: Chapter 4)
- 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 (AE Roy: Chapter 12)
- Impulsive maneuvers
- Lambert's theorem
- 3-D Targeting
- Fuel optimal considerations

Orbit perturbation formulations (AE Roy: Chapters 7 and 8)
- Variation of constants
- Lagrange's Equations
- Gauss' Equations
- Mean elements and averaging

Orbit perturbation analysis (AE Roy: Chapter 11)
- Effect of non-spherical gravity fields
- Low-thrust trajectories
- Atmospheric drag
- Tidal and third body effects

Restricted 3-body problem with applications (AE Roy: Chapter 5)
- Derivation of equations of motion
- Jacobi Integral, Zero-Velocity Curves, and Lagrange Points
- Hill approximation
- Numerical computation and analysis of orbits