ASTE 581 (Orbital Mechanics II) - Spring 2023

Course Syllabus

Instructor: Dr. Ryan Park
Class Location / Time: Online, Wednesday, 6:40-9:20 PM
E-Mail: Ryan.S.Park@jpl.nasa.gov, **Please include "ASTE581" in the subject.**
Course Website: https://courses.uscden.net
Teaching Assistant: TDB

Office Hours/Location/Phone Number: TBD

Required Text

There is no required textbook for this class.

Prerequisites

ASTE 580 (Orbital Mechanics I)

Course Description

This course covers advanced concepts and methods applicable to practical and realistic astrodynamics problems. Topics include: review of 2-body problem, Hamiltonian and Lagrangian dynamics, linear dynamics, N-body problem, 3-body problem, Halo orbits, Hills equations, periodic orbits, stability analysis, orbit uncertainty propagation, basics of estimation, Monte-Carlo simulation, and basics of optimal control theory. Other topics as time permits.

Grading

- Homework: 35%
- Project progress report: 5%
- Final project presentation: 20%
- Final project report: 40%

Final Project

- There are no exams in this class.
- There is a final project in this class: a report and a presentation.
- The project topic must be related to astrodynamics, e.g., mission design, maneuver design, navigation, etc.
- The final project report (including programs) is due on the last day of the class. The report must be typed and written concisely. Font size of 10 or 11 is preferred.
- The final project presentation will be scheduled during the last two lectures (15 minutes each).

Some Sample Final Project Topics

- Earth-Mars transfer trajectory with various perturbing forces (e.g., SRP, multi body)
- Formation of lunar relaying satellites
- Halo orbit about the Lagrange points and maintenance
- Multiple asteroid flybys for optimal data coverage
- GEO satellite maintenance
- Passive inclination control for GEO satellites
- Multi-Body Dynamics simulation
- Aerocapture or aerobraking
- Asteroid rendezvous and orbit maintenance

- Multi-body integrator with low-thrust
- Satellite tour problem
- Symplectic integrator
- Very low-Earth orbit design
- Mercury solar sail

Homework Assignments

Note: all assignments are due at 6:40 pm PST on the due date (for both DEN and on-campus students). Late homework will **not** be accepted.

Weekly Schedule

- Week 01 (01/11)
- Week 02 (01/18):
- Week 03 (01/25): Homework 1 due, Project topic due
- Week 04 (02/01)
- Week 05 (02/08): Homework 2 due
- Week 06 (02/15)
- Week 07 (02/22): Homework 3 due
- Week 08 (03/01): Project progress report due
- Week 09 (03/08): Homework 4 due
- Week 10 (03/15): No class (Spring Break)
- Week 11 (03/22):
- Week 12 (03/29): Homework 5 due
- Week 13 (04/05):
- Week 14 (04/12): Homework 6 due

- Week 15 (04/19): Final project presentation 1
- Week 16 (04/26): Final project presentation 2, Final project report due

Recommended References

- Montenbruck, O., Gill, E., *Satellite Orbits*, Springer, New York, 2001.
- Bate, R.R., Muller, D.D., White, J.E., *Fundamentals of Astrodynamics*, Dover Publications, New York, 1971.
- Battin, R.H., *An Introduction to the Mathematics and Methods of Astrodynamics*, AIAA Education Series, New York, 1987.
- Danby, J.M.A., *Fundamentals of Celestial Mechanics*, Willmann-Bell, Inc., 2003.
- Kaula, W., *Theory of Satellite Geodesy Applications of Satellites to Geodesy*, Dover, New York, 2000.
- Prussing, J.E., Conway, B.A., *Orbital Mechanics*, Oxford University Press, Inc., New York, 1993.
- Roy, A.E., *Orbital Motion*, Institute of Physics Publishing, 1998.
- Vallado, D.A., *Fundamentals of Astrodynamics and Applications*, McGraw-Hill, New York, 1997.