ASTE 580 (Orbital Mechanics I) - Fall 2020

Course Syllabus

Instructor: Dr. Ryan Park
Class Location: Online
Time: Wednesday, 6:40-9:20 PM
E-Mail: Ryan.S.Park@jpl.nasa.gov
Please include "ASTE580" in the subject.
Course Website: https://courses.uscden.net
Teaching Assistant: TBD
Office Hours/Location/Phone Number: TBD

Required Text

Battin, R.H., *An Introduction to the Mathematics and Methods of Astrodynamics, Revised Edition*, AIAA Education Series, New York, 1999.

Prerequisites

Graduate standing in engineering or science
Proficient in programming (e.g., MATLAB, PYTHON)
ASTE 480 (Spacecraft Dynamics)

Course Objective

Orbital mechanics is the basis for spacecraft mission design and is a key component of spacecraft engineering and operations. The basic principles of orbits and astrodynamics inform the designer with options for selecting orbits, maneuvers, and mission profiles that impact the eventual spacecraft design. Understanding orbit perturbations, trajectories, and maneuver needs guides the mission planner with selecting optimal orbit maintenance, rendezvous, and transfers to accomplish the ultimate goals of the mission. This information will then be used by the spacecraft and subsystem engineers to ensure that the spacecraft design can satisfy those requirements and achieve mission success. Once a spacecraft is on orbit, orbital mechanics is the foundation for tracking, orbit determination, and computing orbit corrections.

The goal of this course is to provide the student with an understanding of the basic theory, practices, and applications of orbit mechanics. It combines the foundational principles of algebra, geometry, and physics to describe the motion of objects to, in, and from space.

At the end of the course, the student should have mastered the basic principles of an object in orbit around a central body, effects of other forces on objects in orbit, and the means for changing orbits. These fundamentals will enable the student to learn and master almost any orbit analysis related problem that they will encounter during their professional lives.

Course Topics

This course covers standard concepts and methods applicable to practical and realistic astrodynamics problems. Topics include: the two-body problem, Keplerian orbits, the N-body problem, transfer orbits, planetary equations of motion, and numerical integration. Other topics as time permits.

Grading

- Homework (total of 7): 35%
- Midterm: 30%
- Final: 35%

Weekly schedule

Note: All homework assignments must be submitted by 6:40 pm on the due date (for both DEN and on-campus students). All homework assignments must be submitted via the course website as a single file (please submit as PDF). **Late submission will not be accepted.**

- Lecture 01 (08/26):
- Lecture 02 (09/02):
- Lecture 03 (09/09): Homework 1 due
- Lecture 04 (09/16): Homework 2 due
- Lecture 05 (09/23):

- Lecture 06 (09/30): Homework 3 due
- Lecture 07 (10/07): Homework 4 due
- Lecture 08 (10/14): Midterm exam
- Lecture 09 (10/21):
- Lecture 10 (10/28): Homework 5 due
- Lecture 11 (11/04): Homework 6 due
- Lecture 12 (11/11):
- Lecture 13 (11/18): Homework 7 due

Exams

- Midterm: October 07, 2020 (Wed), 7 pm - 9 pm, online
- Final: December TBD (between Dec. 2-9), 2020, 7 pm - 9 pm, online

References

- Bate, R.R., Muller, D.D., White, J.E., *Fundamentals of Astrodynamics*, Dover Publications, New York, 1971.
- Danby, J.M.A., *Fundamentals of Celestial Mechanics*, Willmann-Bell, Inc., 2003.
- Montenbruck, O., Gill, E., *Satellite Orbits*, Springer, New York, 2001.
- 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.