MAE 180
Orbital Mechanics (4 units)

Class/Laboratory Schedule: four hours of lecture, eight hours of outside preparation.
12 hours/week total

Course Coordinator(s): Aaron J. Rosengren, Zahra Sadeghizadeh

Textbooks/Materials:

1. Craig A. Kluever, Space Flight Dynamics, Wiley, 2018

Catalog Description: Students perform analyses based on mission requirements. Selected topics include astrodynamics, orbital motion, perturbations, coordinate systems and frames of reference, ground tracks and classification of common orbits, orbit determination, orbital maneuvers, station keeping, orbit injection and launch geometry, and interplanetary and lunar trajectories.

Course Type: Required

Course Objectives:

1. To teach students the basic principles of orbital mechanics with a comprehensive study of Earth-satellite orbits and some analysis of interplanetary trajectories.
2. To introduce students to the methods used to describe and determine an orbit, specify and predict position and velocity along an orbit, and maneuver in space.
3. To enable students to apply astrodynamics models to real satellites and spacecraft.
4. To encourage good problem-solving skills and written analysis.

Course Topics:

1. Two-body problem: conservation of angular momentum and energy.
2. Orbit as a function of time: Kepler's problem.
3. Orbital state representation, coordinate transformations, and ground tracks.
4. Orbit determination: Lagrange coefficients and Lambert's problem, Laplace's and Gauss's angles-only methods.
5. Non-Keplerian motion: planetary oblateness, third-body, and atmospheric-drag perturbations.
6. Impulsive maneuvers: single impulsive orbit maneuvers, Hohman and bi-elliptic

transfers, and phasing maneuvers.

7. Launch vehicle dynamics, orbit injection, rocket equation.
8. Patched-conic method, interplanetary transfers, gravity assists
9. Lunar trajectories, restricted three-body problem: Jacobi integral and zero-velocity curves.

Last Updated: 9th June 2025