Course Syllabus

First graduate-level astrodynamics class that includes two-body orbital mechanics, orbit determination, orbit prediction, orbital maneuvers, lunar and interplanetary trajectories, orbital rendezvous and space navigation.

1. Course Introduction (1 hr.)

2. Orbital Mechanics (4 hrs.)
   - 2.1 Newton's law of gravitation and the N-body problem
   - 2.2 Two-body problem
   - 2.3 Conic sections
   - 2.4 Elliptical, circular, Parabolic and hyperbolic orbit properties

3. Orbit Determination (10 hrs.)
   - 3.1 Coordinate systems and transformations
   - 3.2 Classical orbital elements
   - 3.3 Orbital elements to and from position and velocity
   - 3.4 The measurement of time
   - 3.5 Orbit determination from three observations (Gibbs method)
   - 3.6 Ground tracks
   - 3.7 Oblateness effects on low-altitude orbits
   - 3.8 Sun-synchronous, eclipsing and Molynia orbits

4. Orbital Maneuvers (2 hrs.)
   - 4.1 Orbital transfer and energy changes
   - 4.2 Orbital plane change

5. Kepler's Problem: Time of Flight (4 hrs.)
   - 5.1 Kepler's time of flight problem; Mean and eccentric anomaly
   - 5.2 Universal variables
   - 5.3 Universal variable formulation of Kepler's time of flight problem

6. Gauss' Problem: Intercept & Rendezvous (4 hrs.)
   - 6.1 Gauss' problem

6.4 Practical Applications of Gauss' problem: Mission Design, Rendezvous/Intercept

7. Interplanetary & Lunar Trajectories (11 hrs.)

7.1 Phase angle and synodic period
7.2 Patched conic approximation for interplanetary transfer
7.3 Gravity assist trajectories
7.4 The Earth-Moon system and simple lunar transfers
7.5 General lunar transfers and the patched conic approximation
7.6 Lunar free-return trajectories
7.7 The restricted 3-body problem as applied to lunar transfer

8. Special Topics (5 hrs.)

8.1 Orbital rendezvous
8.2 Space navigation

*4 hours reserved for in-class midterms and 2 days lost to semester breaks