The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus

Course Prefix and Number: AERO 4351
Course Title: Orbit and Attitude Dynamics
Credit Hours: 3

Prerequisite Courses:
AERO3343: System Modelling and Control with a D or better, and
MATH2326: Differential Equations with a C or better.

Course Description:

This course provides an overview of orbital mechanics (astrodynamics) and attitude dynamics. Two body Keplerian problems, three dimensional orbits, orbital maneuvers, restricted three body problems, spacecraft reference frames, attitude stabilization, pointing laws, disturbance torques, and spin stabilization are studied. Active spacecraft attitude control hardware is analyzed for performance and implementation. Interplanetary orbits, orbital perturbations, and formation flying are also introduced at a fundamental level.

Learning Outcomes:

- Understand and predict spacecraft motion and attitude
- Apply spacecraft reference frames and pointing laws for orbit motion and attitude control
- Analyze and simulate orbit maneuvers, attitude control, and stabilization
- Evaluate performance of active control hardware

Required Materials: All required materials will be provided.

Recommended Textbook: Anton H.J. Ruiter, Christopher J. Damaren, and James R. Forbes (2013) *Spacecraft Dynamics and Control, An Introduction,* John Wiley and Sons, Inc., United Kingdom

Course Schedule:

Week 1	Rigid Body Dynamics	Kinematics review, dynamics of single particles, dynamics of systems, inertial matrix
Weeks 2-3	Keplerian Two-Body Problem	Keplerian orbital elements, coordinate systems, circular orbits, elliptical orbits, parabolic orbits,
Weeks 4-5	Orbit Maneuvers	Orbit determination, Hohmann transfers, plane change maneuvers
Week 6	Interplanetary Trajectories	Planetary Flyby, planetary capture, sphere of influence
Weeks 7	Orbit Perturbations	Special and general orbit perturbations
Week 8	Formation Flying	Relative in-plane and out-of-plane motion, relative orbits
Week 9-10	Three Body Problem	Equation of motion, Lagrangian points, Jacobi's integral
Week 11-12	Disturbance Torques	Magnetic, solar, aerodynamic, gravity-gradient
Weeks 12-13	Attitude Stabilization	Open and closed loop feedback control, spin stabilization, gravity-gradient stabilization
Weeks 14-15	Active Attitude Control	Attitude sensors, attitude actuators, control law implementation