AE 4532 – Spacecraft Flight Dynamics

HOURS: 3-0-3

CATALOG DESCRIPTION:
Cover fundamental material in orbit and attitude dynamics. Investigate orbits, rendezvous / intercept maneuvers, interplanetary transfers, attitude coordinates, attitude stability, attitude control, and attitude estimation.

PREREQUISITES:
AE 3530 System Dynamics and Vibrations
AE 3330 Introduction to Aerospace Vehicle Performance

COURSE OBJECTIVES:
1. Formulation and Numerical Solution of Flight Dynamics Equations of Motion
2. Understanding of Static and Dynamic Stability of Aerospace Systems
3. Familiarity with Space Mission Design (Intercept, Rendezvous, Interplanetary & Lunar Transfers, Gravity Assist, Formation / Constellation Design)
4. Formulation of relative motion dynamics
5. Introduced to GNSS systems
6. Introduced to Atmospheric Entry
7. Understanding of Kinematics and Dynamics of a 3D Rigid Body
8. Introduced to attitude determination and control instruments & techniques

LEARNING OUTCOMES:
1. Generate kinematics and dynamics solutions to problems
2. Mission/trajectory design
3. Spacecraft attitude system design
4. Applied programming in MATLAB
5. Constructing simulations in SIMULINK

TOPICAL OUTLINE:	HOURS
Introduction	1
Vectors, reference frames, and kinematics	1
Review of Newton's law of gravitation, N-body problem, two-body problem	1
Kepler's Equation and Time-of-Flight	2
Gauss' Problem: Intercept & Rendezvous Mission Design (p-iteration)	5
Interplanetary and Lunar Transfers (Patched Conics, Gravity assist, Free-return)	5
Relative Motion	2
GNSS Overview	2
Spacecraft Constellation and Formation Overview	2
	Subtotal: 21
Attitude parameterizations	2
Attitude Kinematics	1
Attitude Dynamics	3
Attitude Stability (spin, dual-spin, 3-axis, gravity gradient)	4
Attitude control mechanisms	4
Attitude control of spinning and non-spinning spacecraft, yo-yo	2
Spacecraft attitude control design	2
Attitude sensors (rate gyros, sun sensors, star trackers, magnetometers)	3
	Subtotal: 21
Midterm Exam and Quizzes (3 / +0)	3
	Subtotal: 3
	Cumulative Total: 45