ENG ME 406 Dynamics of Space Vehicles

2008 - 2009 Catalog Data:
ENG ME 406 Dynamics of Space Vehicles Prereq: ENG ME 302. Orbital mechanics of particles, earth satellite trajectories. Rocket propulsion and atmospheric reentry dynamics. Gravitational and electro-magnetic fields of the earth. Effects of the space environment on vehicle performance. Rigid body dynamics and vehicle attitude control. Interplanetary trajectories and mission planning. 4 cr.

Class/Lab Schedule: 4 lecture hours per week

Textbook(s) and/or Other Required Material: W.E. Wiesel, Spaceflight Dynamics, 2nd Ed., McGraw-Hill, 1997

Coordinator: Raymond J. Nagem, Associate Professor of Mechanical Engineering

Prerequisites by Topic:
1. Particle dynamics
2. Elementary rigid body dynamics
3. Gravitational and electromagnetic field equations
4. Matrices, systems of ordinary differential equations

Goals:
This course is designed to give aerospace engineering majors an introduction to the issues and analysis techniques associated with space flight dynamics. Students are expected to apply the fundamental principles of mechanics to particle and rigid body models of space vehicles.

Course Learning Outcomes:
As an outcome of completing this course, students will:

i. Be able to apply the equations of Newtonian dynamics to earth satellite motion
ii. Understand the complete solution of the two-body problem of Newtonian gravitation
iii. Be able to apply the equations of Newtonian dynamics to problems of three-dimensional rigid body motion
iv. Understand the principles of gyroscopic motion and gyroscopic instruments
v. Understand the principles of rocket motion and the dynamical basis of rocket design
vi. Be able to apply the equations of Newtonian dynamics to the restricted three-body problem of Newtonian gravitation

Course Learning Outcomes mapped to Program Outcomes:
(For Program Outcomes, please see attached page or Department Web Site)

Program:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Course:	i, iv, v				ii, iv			i,v	iv, vi	i	vi	i, ii, v		
Emphasis:	4	1	1	1	4	1	1	2	2	2	2	4	1	1

Topics (time spent in weeks):
1. Kinematics of particle motion (1)
2. Rotation matrices, angular velocity (1)
3. Two-body gravitational problem (2)
4. Earth satellite operations (1)
5. Momentum principles for rigid bodies (1)
6. Attitude dynamics and control (2)
7. Gyroscopic instruments (2)
8. Rocket dynamics (2)
9. Three-body gravitational problem (1)
10. Interplanetary orbits (1)

Contribution of Course to Meeting the Professional Component:
Engineering Topics: 100%

Status of Continuous Improvement Review of this Course:
Prepared by: Raymond J. Nagem **Date:** April 10, 2009