Fall 2012

AERSP 309 ASTRONAUTICS

Instructor:	Graduate TA:	Undergraduate Teaching Intern
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Office Hours: 1:00-3:00 TR or by appt.	Office Hours: MW 12:15-2:15 or by appt. Weekly help session: Monday evening TBD	

Course website: ANGEL (angel.psu.edu or cms.psu.edu)
Video and audio files for all lectures will be posted on www.aero.psu.edu/aersp309

Course Outcomes: After completing this course, students will be able to
   1.) use three-dimensional kinematics to describe relative orientations of different coordinate systems and their rates of change, and apply these to problems in aerospace vehicle motion,
   2.) apply basic principles of three-dimensional dynamics to solve problems in orbital mechanics, rigid body motion, and satellite attitude dynamics,
   3.) apply the rocket equation to estimate propellant masses needed for orbital maneuvers and transfers,
   4.) apply principles of radiative heat transfer to estimate the internal temperature of a satellite, and
   5.) demonstrate a rudimentary working knowledge of the space environment and its interactions with spacecraft.

Required Textbook: Wiesel, W.E., *Spaceflight Dynamics*, 3rd edition, Aphelion Press, 2010.

Grading:
Test #1	25%	Wed., Oct. 3	8:15-10:15PM	358 & 360 Willard
Test #2	25%	Wed., Nov. 14	8:15-10:15PM	121 Sparks
Final Exam	25%	date and time TBD		
Quizzes	13%	weekly (on ANGEL)		
Homework	12%	weekly		

Grading Scheme	Minimum score
A	93
A-	90
B+	87
B	83
B-	80
C+	77
C	70
D	60
F	0

Homework policy: Unless otherwise announced, homework will be due at the beginning of class each Friday. Late submissions will be penalized 10% of the earned score for each late day (weekends count as one day). You may submit late homework for a grade up until the beginning of class on the following Friday. Please write neatly, leaving room for us to put comments and corrections. Staple the homework assignment page to the front of your work.

Quizzes: Weekly quizzes on ANGEL, accessible from 11am Wed until 9am Fri. These are open-book, open-notes, and their purpose is to encourage you to read the book and review your notes. The lowest quiz score will be dropped. We will remind you about the quiz each week, but forgetting to take the quiz is not an excuse for a makeup.

<p style="text-align:center">Topics</p>

1. 3-D kinematics
   - direction cosine matrices
   - vector components in different coordinate systems
   - Euler angles
   - angular rate (rotation rate) vector
   - velocity and acceleration in different reference frames
2. 3-D particle dynamics
   - Newton's laws of particle motion
   - energy
   - angular momentum
   - systems of particles
3. Two-body orbital mechanics
   - Newton's law of universal gravitation
   - orbit equation
   - conic sections and orbit terminology
   - Kepler's equation (predicting future position)
   - classical orbital elements
   - representations of satellite position and velocity
4. Orbital maneuvers and transfers
   - impulsive maneuvers
   - Hohmann transfers
   - simple inclination changes
   - relative motion between spacecraft
5. Rigid-body dynamics
   - angular momentum and energy
   - inertia matrix
   - principal-axis system
   - Euler's equations of rigid-body motion
   - torque-free motion
   - effects of external torques
6. Rocket performance
   - rocket equation
   - specific impulse
   - estimating propellant requirements for a mission
   - survey of propulsion technology
7. Space environment
   - standard atmosphere
   - simple radiative heat-transfer analysis
   - Van Allen belts
   - meteors and debris hazards

<u>Additional references</u> (on reserve in Engineering Library unless otherwise noted)

1. Newton, I., *Philosophiae Naturalis Principia Mathematica* (various early editions are held in the Special Collections vault in Pattee Library and may be viewed upon request).
2. Bate, R.R., Mueller, D.D., and White, J.E., *Fundamentals of Astrodynamics*, Dover Publications, New York, 1971. Call number: TL1050.B33
3. Greenwood, D., *Principles of Dynamics*, Prentice-Hall, Englewood Cliffs, NJ, 1988. Call number: QA845.G83 1988
4. Chobotov, V., *Spacecraft Attitude Dynamics and Control*, Krieger, Malabar, FL, 1991. Call number: TL1050.C48 1991

<u>Accessibility:</u>

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at http://equity.psu.edu/ods/.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at http://equity.psu.edu/ods/guidelines/documentation-guidelines). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.