Fall 2013

AERSP 309 ASTRONAUTICS

Instructor:	Graduate TA:
Robert G. Melton 229 Hammond Bldg. rgmelton@psu.edu Office Hours: 1:00-3:00 TR or by appt.	Brad Sottile 234 Hammond Bldg. bjs5332@psu.edu Office Hours: TBD or by appt. Weekly help session: Time and location TBD

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

Student 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. 2	8:15-10:15PM	101 Thomas
	Test #2	25%	Wed., Nov. 6	8:15-10:15PM	119 Osmond
	Final Exam	25%	date and time TBD		
	Quizzes	25%	(weekly, in class)		

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

Practice Problems: Practice problems will be assigned each week, but not collected or graded. It is critical that you work all of the practice problems; this is the only way that you can really learn the material in the course. Solutions for the problems will be posted after the weekly quiz.

Quizzes: Weekly 10-minute quizzes (on Fridays). These will be based upon the practice problems. The lowest quiz score from the semester will be dropped.

What is Academic & Professional Integrity?

Integrity, to a great degree, is a matter of intent. A person of integrity intends to act consistently according to his/her beliefs and values, and such actions constitute ethical behavior. We recognize common values[1] that are critical to the success of our academic community: honesty, trust, fairness, respect, and responsibility. At various times during the semester, we will discuss these values as they pertain both to you and me. We'll also talk about how they are related to professional codes of ethics (a copy of the American Institute of Aeronautics and Astronautics Code of Ethics is attached). It is important that you positively assert your commitment to integrity and ethical behavior both within and outside the classroom. On each quiz, test and exam in this course, you will be required to write out and sign the following statement: "I have completed this work with integrity."

What are Penn State's Standards for Academic Integrity?

"Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

"Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others."

(Penn State University Faculty Senate Policy No. 49-20: www.psu.edu/ufs/policies/separate_policy/49-20.htm)

What is Penn State's Policy for Handling Violations of Academic Integrity Standards?

Our professional integrity compels us not only to monitor our own behaviors but to protect the integrity of the course by not standing by and letting others cheat and get away with it. So, I encourage you to intervene with a student you know to be cheating (you can talk to them or talk to me, anonymously or otherwise) and I will always intervene when I become aware of integrity violations. I will do this by reducing the student's grade for the quiz, test or exam, as well as following Penn State's procedures for reporting violations, Penn State Academic and Administrative Policy G-9 (www.psu.edu/dept/oue/aappm/G-9.html).

Accessibility:

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.

[1] An excellent collection of writings on these values is available from the International Center for Academic Integrity (www.academicintegrity.org).

AERSP 309 Topics

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

Additional references (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