AOE 5235 – Orbital Mechanics – Spring 2007

Instructor: Dr. Hanspeter Schaub, Randolph Hall 228, 231-1413, schaub@vt.edu

Lectures: MW 2:30pm–3:45pm, WHIT 281

Office Hours: MW 9:30am–10:30am, R 1:30pm-2:30pm (or by appointment)

Final Exam: May 6, 2005, 7:45am–9:45pm, Randolph 206A

Text: - R. H. Battin, *An Introduction to the Mathematics and Methods of Astrodynamics*, AIAA Education Series, New York, 1999.
- H. Schaub and J. L. Junkins, *Analytical Mechanics of Space Systems*, AIAA Education Series, 2003. (please download the errata sheet from the web page http://homepage.mac.com/hanspeterschaub/work/books.html)

Course Web Page: on the VT blackboard system

Overview: Lagrange's equations of motion, two-body problem, conic sections, Kepler's laws, orbit determination. Multi-body problems and integrals of motion. Fundamentals of perturbation theory, variation of parameters, and Lagrange's planetary equations. Regularization and alternative formulations of equations of motion. AOE4134 is a prerequisite.

Goal: To introduce students to the fundamental theory of orbital mechanics.

Homework Policy: Each homework assignment is due on the specified due date and must be turned in at the beginning of the lecture. Normally, late homework will not be accepted. Some homework will require simple programs to be created. These can be done in Matlab, Maple, Mathematica, C, or Fortran. See instructor if not sure about the software package being used. If a homework has been graded incorrectly, you need to see me within 2 weeks of having the homework returned to you.

Exams: There will be a mid-term exam and one comprehensive final exam. If you have exam grading issues, you must see me within 2 weeks of having the exam returned to you. There will also be one course project which will require you to write a technical report.

Class Attendance: You are expected to attend class. If you need to miss a lecture, it is your responsibility to catch up on the material. Don't go to the instructor to catch up on missed material, speak with class mates and get the notes from them.

Make-Up Policy: There are no make-up homework assignments. If you miss the assignment, you get a zero for it. If you can't make an exam or a pressing reason, you need to contact the instructor *one week prior* to the exam date. If you can't take the exam for some emergency reason, you still need to notify the instructor prior to the exam. Without prior consent, there will be no make-up exams.

Grading Policy: A conventional ten-point system will be used for grading. If I feel it necessary, I will curve the exam scores to reflect the difficulty level of the problems assigned. Thus, your final assigned scores on each set of papers is your true grade and should be interpreted on a 100 point scale (i.e. A(90-100), B(80-89), C(70-79), D(60-69), F(below 60)). Subgrades of "+" and "-" will be assigned at instructors discression. The exam with your *highest* score will be weighted with an additional 5%. The percent worth of exams and class assignments are:

Homework/Quizzes – 25%
Project – 20%
Mid-Term – 25%
Final Exam – 25%
Mystery Points – 5%

Honor Code: The University Honor Code will be maintained. You are encouraged to discuss homework assignments with your instructor, teaching assistant, and classmates. However, all work submitted for a grade must reflect your own understanding of the material. You may not copy answers to homework problems and you may not assist others or seek assistance on exams.

Estimate of Topics Covered

Introduction Review of vector notation, basic particle kinematics, Vector Differentiation

2-Body Problem Learn about Kepler's laws, orbit equations of motion, orbit elements, Lagrange/Gibbs F and G solution, hypergeometric functions, Universal Solutions, hodographs.

3-Body Problem Search for invariant shapes of the general three-body problem. Specialize results for the circularly restricted 3-body problem.

Gravity Field Modeling Learn how to express the gravity field potential for bodies of arbitrary shape.

Special Perturbations Study Encke's Method, Lagrange's planetary equations, Gauss' variational equations, Poisson brackets, State Transition Matrix

Lambert's Problem Solve the orbital two-point boundary value problem.