ASEN5050 – Space Flight Dynamics - Fall 2015

Instructor	Dr. R. Steven Nerem (Office: ECNT319, Ph. 492-6721, Email: nerem@colorado.edu)
Class Time	TTH 11:00 – 12:15
Class Location	ECCS 1B28
Class Web Page	http://learn.colorado.edu/
Office Hours	TTH 9 – 10:30 AM, or by appointment, or by email
Class Assistant	Elena Trenholme (Elena.Trenholme@Colorado.EDU)
Required Text	*Fundamentals of Astrodynamics and Applications*, 4th Edition, 2013, by David A. Vallado
Grading	Take Home Mid-Term (25%) Take Home Final Exam (25%) Homework (30%) Research Project (20%) Late homework deducted 10 pts for each day late! ALL due dates for distance learning students are one week later. 90-100 = A, 80-89 = B, 70-79 = C, 60-69 = D, < 60 = F
Homework	Homework will be assigned on roughly a weekly basis. While the calculations can be done using whatever software you prefer, I highly recommend using Matlab. While you may discuss ideas and questions about the homework with other classmates, the homework solution must be your own.
Important Dates	October 15 – Take home midterm exam – due 10/22 November 24 – No Class – Fall Break November 26 – No Class - Thanksgiving December 10 – Last Day of Class, Take home final exam
Course Overview	In this course we will study the kinematics and dynamics of celestial bodies and artificial satellites moving under the influence of forces common to the space flight environment; most importantly bodies moving under the influence of gravity.

Other Notes:

(1) If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see Temporary Injuries guidelines under the Quick Links at the Disability Services website and discuss your needs with your professor.

(2) Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please discuss with me any conflicts you have so we can make alternative arrangements.
See campus policy regarding religious observances for full details.

(3) Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the student code.

(4) The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been discriminated against should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or the Office of Student Conduct and Conflict Resolution (OSC) at 303-492-5550. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be found at the OIEC website. The full policy on discrimination and harassment contains additional information.

(5) All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Additional information regarding the Honor Code policy can be found online and at the Honor Code Office.

Schedule

ASEN5050 – Space Flight Dynamics
(all dates subject to change)

Lecture:

1	August 25	Introduction to Space Flight Dynamics
2	August 27	Two-Body Problem 1
3	September 1	Two-Body Problem 2
4	September 3	Two-Body Problem 3
5	September 8	Orbital Elements
6	September 10	Coordinate System
7	September 15	Time Systems
8	September 17	Orbit Maneuvers 1
9	September 22	Orbit Maneuvers 2
	September 24	STK Lab 1
10	September 29	Orbit Maneuvers 3 / Groundtracks
11	October 1	Lambert's Problem
12	October 6	CW Equations
13	October 8	Perturbations 1
14	October 13	Perturbations 2
15	October 15	Perturbations 3, Take home mid-term exam
	October 20	STK Lab 2
16	October 22	Perturbations 4
17	October 27	Perturbations 5
18	October 29	Repeat Groundtracks and Tides
19	November 3	Initial Orbit Determination
20	November 5	Orbits and the Global Positioning System 1
21	November 10	Orbits and the Global Positioning System 2
	November 12	STK Lab 3
22	November 17	Interplanetary 1
23	November 19	Interplanetary 2
	November 24	No class – Fall Break
	November 26	No class - Thanksgiving
24	December 1	Interplanetary 3
	December 3	STK Lab 4
25	December 8	Restricted 3-Body Problem
26	December 10	Review, Take home final exam

Syllabus
ASEN5050 – Space Flight Dynamics

Introduction - Applications of Astrodynamics

Chapter 1 - Equations of Motion
- A. Newton's Laws (Force of Gravity - Point Mass and Spheres)
- B. Two-Body Equations of Motion
- C. Energy and Angular Momentum Integrals of Motion
- D. Characteristics of Conic Motion - Perigee, Apogee, etc.
- E. Classical Orbit Elements
- F. Position, Velocity --> Orbit Elements
- G. Orbit Elements --> Position, Velocity

Chapter 2 - The Orbit as a Function of Time
- A. The Anomalies
- B. Keplers Equation
- C. Solution of Keplers Equation
- D. Satellite Ground Tracks

Chapter 3 - Fundamentals of Coordinate Systems and Time
- A. Coordinate Systems (astronomical, Earth-fixed, etc.)
- B. Measurement of Time
- C. The Shape of the Earth

Chapter 6 - Orbit Maneuvers
- A. Coplanar Transfers
- B. Hohmann Transfer and Rendezvous
- C. Relative Motion
- D. Non-Coplanar Transfers
- E. CW Equations (Hill's Equations)

Chapters 8 and 9 - Perturbations
- A. The N-Body Problem
- B. The Restricted 3-Body Problem
- C. Perturbation Methods
- D. The Earth's Gravity Field and the Effects of Oblateness
- E. Atmospheric Drag and Solar Radiation Pressure

Chapters 7 and 10 – Orbit Determination
- A. Initial Orbit Determination
- B. Least Squares

Chapter 11 – Mission Analysis
- A. Special Orbits
- B. Global Positioning System

Chapter 12 – Interplanetary Mission Analysis

A. Patched Conics
B. Porkchop Plots
C. Interplanetary Orbits