EAS 4510
Astrodynamics
Spring 2017

Homework 1
February 2017

What is Allowed During Examinations and Homework

You may use any books, your personal notes, or electronic aid, provided that you find the material on your own without having it provided to you by anyone else (either implicitly or explicitly). **You may not, under any circumstances, communicate with anyone about this assignment, and that includes me and the TAs!** Any violations of these rules will result in further action on my part in a manner consistent with the academic honesty policy of the University of Florida. The academic honesty policy can be found at the Student Conduct and Conflict Resolution website:
https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/

Guidelines for Solutions

Communication is an extremely important part of demonstrating that you understand the material. To this end, the following guidelines are in effect for all problems on the examination/homework:

1. Your handwriting must be neat. I will not try to decipher sloppy handwriting and will assume that something is incorrect if I am unable to read your handwriting.
2. **ONLY FOR IN-CLASS EXAMS:** Your exam must be HANDWRITTEN, no software, no scans, etc., your own handwriting ONLY. If anything else appears other than your own handwriting, the exam will be evaluated at 0 (zero).
3. You must be crystal clear with every step of your solution. in other words, any step in a derivation or statement you write must be unambiguous (i.e., there must be one and only one meaning). IF it is ambiguous as to what you mean in a step, then I will assume the step is incorrect.
4. Exams without a name on each page, and/or without a UFID and signature at the bottom of this page, will not be graded (i.e., they will receive a score of 0 (zero)).

In short, please write your solutions in an orderly fashion so that somebody else can make sense of what you are doing and saying. Finally, credit will be given only if a relevant concept is applied properly, and no credit will be given for an incorrectly applied concept even if the final answer is correct.

University of Florida Honor Code

On your examination/homework you must state and sign the University of Florida honor pledge as follows:

On my honor, I have neither given nor received unauthorized aid in doing this examination/homework.

Signature: **Date:**

University of Florida ID:

Homework 1

Due February 2, 2017 by 11:59pm

Total points: 100

The following requires you to turn in working MATLAB file(s) that we can run without error. Files should output all required quantities and/or plots. Upload your MATLAB files and additional scanned papers (e.g.: previous page signed) on Canvas, within the deadline.

1. Given perigee ($r_p = 10000$ km) and apogee ($r_a = 30000$ km) distances, find the following:

   a) eccentricity, e **(3 Points)**

   b) semi-major axis, a **(3 Points)**

   c) orbital period, T **(3 Points)**

   d) velocity at perigee, v_p **(3 Points)**

   e) velocity at apogee, v_a **(3 Points)**

   f) specific angular momentum at perigee, h_p **(2 Points)**

   g) specific angular momentum at apogee, h_a **(2 Points)**

   How does h_p compare to h_a? **(1 Point)**

2. Use MATLAB's ode45 function to integrate the equations of motion for one orbital period using a maximum time step of 10 seconds (hint: use "options = odeset('Maxstep',10)"). Plot the trajectory of a satellite (in *ECI*) using a red line of width 2. Use the following initial conditions: **(20 Points)**

$$\mathbf{r} = \begin{bmatrix} r_p \\ 0 \\ 0 \end{bmatrix} \qquad \mathbf{v} = \begin{bmatrix} 0 \\ v_p \\ 0 \end{bmatrix}$$

3. Using the parametric solution for Keplerian orbits (parameter = θ) obtain the position vector every 1 degree of true anomaly. Plot, on the same figure above, the obtained trajectory, in black, with default line width. Does the trajectory match that from Problem 2? **(20 Points)**

4. Repeat Problem 2, modifying the initial conditions to plot a circular equatorial orbit (in the x-y plane) with the same semi-major axis as Problem 2. Plot this orbit over one orbital period using a blue line of width 2. **(20 Points)**

5. What is the minimum velocity required for the satellite in Problem 4 to escape the Earth's orbit given its same initial position? Plot this orbit over the same time span as Problem 4 using a green line of width 2. What type of orbit is this? **(20 Points)**

Extra Credit:
Find the difference in orbital specific energies ($\Delta\varepsilon$) between the spacecraft in Problem 4 and spacecraft in Problem 5. **(5 Points)**