EAS 4510

HW 1

Spring 2016

1-2 February 2016

What Allowed During Examination/HW

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 exam/hw, and that includes me and TAs!**

Any violations of the exam/hw 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/hw:

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 TESTS**: your test must be HANDWRITTEN, no software, no scans, etc., your own handwriting ONLY. If anything else appears other than your own handwriting, the test 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., have 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. Tests without name on each page, and/or without UFID and signature at the bottom of this page, will not be graded, i.e., they will count as a 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 (only for HW)

On your exam/hw 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/hw.

Signature: **Date:**

University of Florida ID:

Total points: 100

The following requires you to turn in working Matlab file/s that we can run. Those files should output the required quantities/plots. Upload your Matlab files and additional scanned papers (e.g.: previous page signed) on CANVAS, within 24hrs of the time this hw is released.

A spacecraft orbiting Earth has the following position and velocity in the ECI-fixed coordinate system at initial time:

$\mathbf{r_0}$ = [8000; 0; 6000]; km

$\mathbf{v_0}$ = [0; 8.5; 0]; km/s

A) Compute the following using Matlab (**each question 5 points → 30 points**)
   1. Orbit's angular momentum.
   2. Orbit's eccentricity vector – what kind of orbit is it?
   3. Distance from Earth's center at perigee.
   4. Distance from Earth's center at apogee.
   5. Semi major axis.
   6. Orbital period.

B) Use Matlab's ODE45 to integrate the equations of motion for 1 orbital period, with a maximum time step of 10 seconds (OPTIONS = odeset('Maxstep', 10)). Plot the trajectory in ECI, using a red line, of width 2. [**20 points**]

C) Using the parametric solution for the 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 a default line width. Make sure it matches the trajectory of point B [**30 points**]

D) Compute the velocity the spacecraft should have at perigee to be in a circular orbit. Plot that circular orbit with a blue line of width 2, on the same figure (you choose the appropriate method to create the points of the circular trajectory) [**10 points**]

E) Compute the velocity the spacecraft should have at apogee to be in a circular orbit. Plot that circular orbit with a green line of width 2, on the same figure (you choose the appropriate method to create the points of the circular trajectory) [**10 points**]

EXTRA CREDIT [**5 points**]

Assuming that onboard thrusters have the ability to instantaneously change the velocity of the spacecraft, without changing its position, what are the velocity corrections (**ΔV**) required to circularize the initial orbit at perigee and at apogee?