Fall 2007 AE 6353: Orbital Mechanics
Homework Assignment #8

Handout: November 30, 2007
Due: Dec 10, 2007

Be sure to use appropriate units. Show all of the important steps in your solution. Box or double-underline your final answers. Be sure to follow all of the format guidelines for homework as discussed in the course overview. Homework will be collected at the *beginning* of the lecture on the above date due. Late homework will not be accepted.

1) The value of the Jacobi integral at the Earth-Moon L_2 point is -1.59411. Ignore small terms in the expression for Jacobi's integral and
   a. Approximate the ΔV required to depart a 200-km circular low Earth orbit and arrive in the vicinity of the Earth-Moon L_2 point.
   b. Use the geometry of the L_4 point to determine the value of the Jacobi integral at this Earth-Moon location.
   c. Approximate the ΔV needed to depart the same LEO orbit and arrive in the vicinity of the Earth-Moon L_4 point.

2) Spacecraft A is in a circular orbit about the Earth with a radius of 9000 km. At time zero, spacecraft B is at a colinear radius of 9100 km ($y_0 = 0$) with an identical inertial velocity (magnitude and direction) as spacecraft A.
   a. Sketch the orbits of these two spacecraft denoting their relative position over time.
   b. Use the Euler-Hill equations to develop expressions for x(t), y(t) and z(t).
   c. Plot this relative motion {y(t) vs. x(t)}

3) The Space Station is in a circular orbit about the Earth with period of 88.8 minutes (radius of 6593.3 km). The Space Shuttle has a radius of 6643.3 km and is 0.8625 deg (100 km) ahead in its orbit about the Earth.
   a. What are the required initial values of $\dot{x}_0$ and $\dot{y}_0$ for the Shuttle to intercept the Station in 5 minutes?
   b. What are the required initial values of $\dot{x}_0$ and $\dot{y}_0$ for the Shuttle to intercept the Station in 22.2 minutes?
   c. For the 22.2 min intercept, sketch or plot the in-plane portion of this motion.

4) A spacecraft is initially in a circular orbit about the Earth. It experiences a constant, small drag deceleration along the orbital path, $f_y = -D$, while $f_x = f_z = 0$.
   a. Write the three equations which describe the perturbed motion of this spacecraft with respect to its Keplerian path (motion without drag).
   b. Solve these differential equations so that the x, y, and z components are expressed as a function of time in the E-H frame.
   c. Sketch or plot the in-plane portion of this motion.