Homework Assignment 6: Lambert's Problem and IOD

ENAE 404: Space Flight Dynamics

For derivations or other pen-and-paper problems, please present your work neatly and box answers (5 points will be based on the professionalism of your submission). For problems requiring coding, attach your code. Submit this assignment as a single file on Gradescope.

1. (15 points code, 16 points solution) Write a code to solve Lambert's problem. Given the following initial and final positions and the time of flight, calculate the initial and final velocity vectors, the eccentricity and the radius of periapsis of the transfer orbit. Assume the orbits are about Earth.

	Case 1	Case 2
Initial Position (km)	[8000, 0, 0]	[0.5, 0.6, 0.7] R_E
Final Position (km)	[7000, 7000, 0]	[0, -1, 0] R_E
Time of Flight (sec)	3600	16135
Type	short way	long way

2. Use your 2BP numerical propagator to verify that your Lambert's solver is working correctly. For Case 2 above:
   - (3pts) calculate the vector difference between final position given in the problem statement and that calculated using your 2BP code,
   - (3pts) calculate the vector difference between final velocity calculated in your Lambert's solver and that calculated using your 2BP code,
   - (6pts) plot the the transfer trajectory with markers at the initial and final states (labeled). Use the 'axis equal' command to scale your axes.
3. (10 points) For the transfer orbit described by Case 1 above, calculate the total ΔV of the transfer, assuming that initial and final orbits are circular.
4. (15 points) Use the Gibbs method to calculate the velocity of the spacecraft at time t_2 given the following position vectors taken at 3 epochs (epoch=time), assuming that the spacecraft is orbiting Earth. Discuss how you could verify that your answer is correct, using what you have learned in the class so far.

Table 1: Positions for Initial Orbit Determination.

	t_1	t_2	t_3
x (km)	-6.97949190E+03	-6.96633930E+03	-6.94996267E+03
y (km)	2.08846535E+02	2.67474976E+02	3.25979638E+02
z (km)	-5.73801140E+02	-7.34881458E+02	-8.95621695E+02