

# Aerospace Engineering 3521: Flight Dynamics

Prof. Eric Feron

Quiz 6\*-

I certify that, in full accord with the Honor Code of the Georgia Institute of Technology, I have neither received assistance from nor given assistance to other students in taking this examination.

Signed: \_\_\_\_\_

Last Name (please print): \_\_\_\_\_

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**\*The exam is closed book. Please turn in the test along with your papers. Make sure your name is on every sheet that you turn in! Do not write on the back of any sheet you turn in!**

**Problem 1** [10pt]

All that is known about a particular closed orbit is that the major semi-axis  $a$  is 45,000km. Draw three distinct orbit shapes that have the same semi-axis. It is suggested you draw, carefully, these orbits using the scale 45,000km = 4.5cm. Draw your orbits around the same earth.



**Problem 2** [10pt] This problem explores very crudely what happens when more than two objects are in orbit around each other. For that purpose, consider Fig. 1 two Earths in orbit around each other. By using a rotating

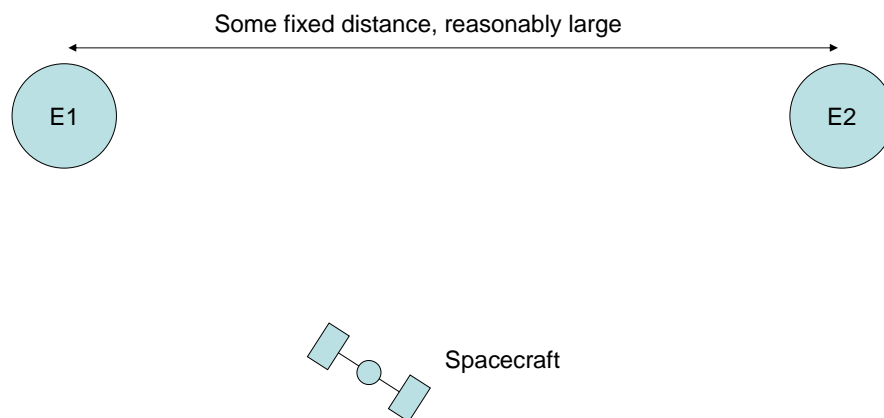


Figure 1: Two Earths and one spacecraft

reference frame, we can assume the two Earths (E1 and E2) are fixed. The Earths's circular orbits are slow enough that the reference frame can be considered Newtonian. A spacecraft is injected randomly in the vicinity of the two Earths, and we want to understand its motion.

1. [2.5pts] Assume the spacecraft is injected close to E1 (and therefore far from E2). Describe the trajectories that can be followed by the spacecraft.

2. [2.5pts] Consider now that the spacecraft is not very close to either E1 or E2. True or false: the trajectories (“orbits”) followed by the spacecraft are planar. Justify your answer.
3. [2.5pts] If your answer above is “false”, give precise conditions on the initial conditions (position, speed) of the spacecraft so that the resulting orbit is planar. If your answer above is “true”, go directly to Dr. Russell (if you can find him) and explain him your problem. You can also pick Drs. Braun, Tsiotras, Spencer, or Saleh.
4. [2.5pts] Based on your intuition, knowledge and hopefully some explanations, draw the example of a planar orbit that would go around both Earths.



