EE/Ae 157a

Homework #1

Due Date: October 21, 2019

Problem 1.

Calculate the altitude of geostationary orbits for Mercury, Venus, Mars, Jupiter and Saturn. The rotation periods of these planets are 58.7 Earth-days, 243 Earth-days, 24 hr 37 min, 9 hr 51 min, and 10 hr 14 min, respective1y. A geostationary orbit has an inclination of zero and a period equal to the rotation period of the planet.

Problem 2.

Let us assume that an Earth orbiting sensor in sun-synchronous circular orbit requires daily repeat (*i.e.* 1 solar day). Calculate the lowest three orbits which allow such a repeat coverage. Calculate the lowest three orbits for repeats every two solar days ($N = 2$) and every three solar days ($N = 3$).

Problem 3.

A radar mission is designed to fly on the space shuttle with the aim of mapping as much of the Earth as possible in 10 days. Given the size and mass of the radar payload, the inclination of the orbit is 57°, and the altitude range is 200 km to 250 km. Calculate the altitude of an orbit in this range that would repeat in approximately 10 siderial days, taking orbit precession into account. Calculate the separation between orbit tracks along the equator.

Problem 4.

The first client of your satellite company wants a measurement of the surface of the earth between 60 degrees north and 60 degrees south every three solar days, *i.e.* the orbit needs to be sun-synchronous. The instrument can cover a field of view equal to 30 degrees. For cost reasons, you decide that you can only fly the instrument between 400 km and 800 km altitudes.

- Calculate the possible orbits altitudes that would satisfy the 3-day repeat requirement.
- Compare the instrument swath width to the required swath to achieve global coverage for each orbit. Can any of these orbits provide global coverage with a single satellite?
- If the orbits cannot provide global coverage with a single satellite, how many satellites would you need to provide the global coverage?