MAE 2: Introduction to Aerospace Engineering
Assignment 2
Due 10/16

1. (10) Suppose we would like a satellite to be in circular orbit above the Earth, with an orbit period of 6 hours. What should the orbit radius be? (Recall that $Gm_{\text{Earth}} = \mu_{\text{Earth}} = 398603.2 \text{ km}^3/\text{sec}^2$.)

2. (10) Suppose instead, that we would like a spacecraft to be in circular orbit above Mars, with an orbit period of 6 hours. What should the orbit radius be? (The gravitational constant for Mars is $Gm_{\text{Mars}} = \mu_{\text{Mars}} = 42828.29 \text{ km}^3/\text{sec}^2$.)

3. (10) Sketch a groundtrack for a satellite in a circular Earth orbit, with orbit plane inclined at $\pi/3 \text{ rad}$ relative to the equatorial plane, and with an orbit radius of 20270 km, over a period of one day. (Recall that $Gm_{\text{Earth}} = \mu_{\text{Earth}} = 398603.2 \text{ km}^3/\text{sec}^2$, and that a sidereal day is 86164.0 sec.)

4. (5) A person is at latitude $-30$ degrees, longitude 45 degrees. What is the person’s ECEF position? (Use a spherical Earth model with radius 6378 km.)

5. (5) A person’s ECEF position is ($-359.6, -1667.8, 6145.6$) km. What are the person’s latitude/longitude coordinates (assuming the same spherical Earth model as above).

6. (10) Suppose a satellite is at position $(10000, 8000, -2000)$ km in ECEF. Suppose an observer is at latitude, $\theta = \pi/6 \text{ rad}$, longitude, $\lambda = \pi/3 \text{ rad}$. What is the position of the vehicle in a coordinate system centered at the observer, with axes parallel to the ECEF axes. (Assume a spherical Earth of radius 6378 km.)

Some study problems. NOT TO BE HANDED IN.

1. Sketch the relationship between orbit period and orbit radius (for circular orbits around Earth). Sketch the relationship between satellite speed and orbit radius (for circular orbits around Earth).
2. Suppose a satellite is at a position of \((8000, 4000, 2000)\) km in the observer-centered coordinate system of Problem 6 above. What is its position in a local East-North-Up (ENU) system? Also, what is the angle between the local up direction and the vector from the local origin toward the satellite? Is it above the horizon?