MAE180A Spacecraft Guidance, Navigation, and Mission Design
Assignment 4
Due 5pm, Friday, 8 Nov.

Note: You must show all your work in order to get credit!

Problems to hand in (Not all problems may be graded.)

Partial list of problems. More will be added.

1. (10 points) Let a spacecraft be in elliptical orbit around Mars. Let
the orbital elements (with angles relative to a Mars–centered inertial
system) be

\[ a = 8000 \text{ km}, \quad e = 0.25, \quad i = \frac{\pi}{3} \text{ radians}, \]
\[ \Omega = \frac{4\pi}{3} \text{ radians}, \quad \omega = \frac{\pi}{4} \text{ radians and } \tau = 1\text{AM PST (Earth time)}, \]

where we recall that \( \tau \) is the time of periapsis passage. What is the
position of the vehicle (in the Mars–centered inertial system) at 9AM
PST that same morning? Note that \( \mu_{\text{Mars}} = Gm_{\text{Mars}} \simeq 42,828 \frac{\text{km}^3}{\text{sec}^2} \).

You must include all your rotation matrices in the solution for full
credit.

2. (5 points) Suppose that an object is located at \((8000, -4000, 3000) \text{ km}\)
in the ECI coordinate system. What is the location of that object
in the orbit plane (i.e., perifocal) coordinate system corresponding to
angles \( \Omega = -\pi/4, \ i = \pi/4 \) and \( \omega = \pi \)?

3. (10 points) Suppose that an object is located at \((8000, -4000, 3000) \text{ km}\)
in the ECI coordinate system at 1AM PST. Suppose the ECI and ECEF
coordinate systems were aligned at midnight. What is the location of
that object in the ECEF system (at 1AM PST)?