Noe Lepez Da Silva Duarte

AE 4361 – Assignment 3

1) a)

$$P = 2\pi\sqrt{\frac{a^3}{\mu}}$$

$$\sqrt[3]{\left(\frac{P}{2\pi}\right)^2 \times \mu} = a$$

$$\text{a} = \sqrt[3]{\left(\frac{12 \times 3600}{2\pi}\right)^2 \times 3.986 \times 10^5} = \boldsymbol{26610km}$$

b)

$$\text{r}_\text{p} = \text{a}(1 - \text{e})$$

$$e = -\frac{r_p}{a} + 1 = 0.549$$

Using the provided 'Kepler_solver' code with t = 9*3600 = 32400s, e=0.549, M0 = 0, a=26610km

E= 4.2269 rad

$$r = a(1 - e\,cos\,E) = 26610(1 - 0.549\,cos\,4.2269) = \boldsymbol{33427km}$$

c)

$$V = \sqrt{\mu\left(\frac{2}{r} - \frac{1}{a}\right)} = \sqrt{3.986 \times 10^5 \times \left(\frac{2}{33427} - \frac{1}{26610}\right)} = \boldsymbol{2.978km/s}$$

d)

$$tan\frac{\nu}{2} = \sqrt{\frac{1+e}{1-e}}tan\frac{E}{2} = \sqrt{\frac{1+0.549}{1-0.549}}tan\frac{4.2269}{2} = -3.073$$

$$\nu = 2\,arctan\,{-3.073} = -2.51rad$$

$$h = \sqrt{\mu a(1-e^2)} = 86080.6$$

$$\gamma = asin\left(\frac{\mu}{hv}\left(1 + ecos(v)\right)\right) = 1.047rad$$

$$V_r = V \times \cos\gamma = 2.978 \times sin2.51 = \boldsymbol{1.49km/s}$$

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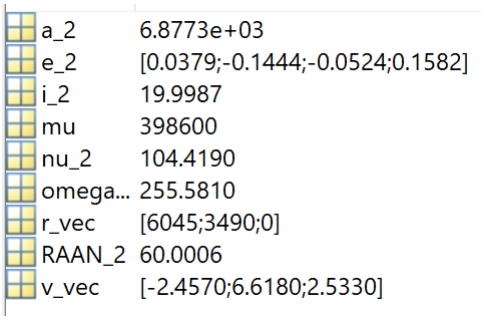
2)

Semi-major axis (a) *km*	**6877.3**
Eccentricity (e)	**0.1582 or [0.0379, -0.1444, -0.0524]^T**
Inclination (i) *deg*	**20.000**
Right ascension of ascending node (Ω) *deg*	**30.000**
Argument of perigee (ω) *deg*	**255.581**
True Anomaly (υ) *deg*	**104.419**

See “AE4361 HW3” starting at Q2 comment at the end of document for code.

Workspace variables for Q2:



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3)

a) $\vec{r}_{\text{Vanguard}-1} = \begin{bmatrix} 6.7758 \\ 0.3813 \\ 2.0544 \end{bmatrix} \times 10^6 \text{m}$

b) $\vec{r}_{\text{Hubble}} = \begin{bmatrix} -5.5368 \\ -3.8525 \\ -1.4916 \end{bmatrix} \times 10^6 \text{m}$

c) $\vec{r}_{\text{Molniya comms sat}} = \begin{bmatrix} 0.6497 \\ 1.3425 \\ 3.0208 \end{bmatrix} \times 10^7 \text{m}$

d) $\vec{r}_{\text{Starlink 3327}} = \begin{bmatrix} -3.7498 \\ 2.3053 \\ 5.0795 \end{bmatrix} \times 10^6 \text{m}$

See code and function on next pages.