

Assignment No 1
(Hand-in by 10/12/24)

- The purpose of this assignment is to revise and develop the basic tools for future analysis of the orbit dynamics.
- Attach the *matlab* files or other code that you use.
- Prepare basic functions to be used in future assignments, like:
 - ❖ Transformation between coordinate systems.
 - ❖ Calculation of orbital elements from position and velocity vectors and vice versa.
 - ❖ Atmospheric density model.
 - ❖ Calculation of the sun direction.
 - ❖ Gauss Variational Matrix.
- Use graphs and illustrations.

A satellite orbits the Earth. Given:

- The position vector at the ascending node in ECI is $\mathbf{r}_{an}=[5000;8500;???] \text{ km}$.
- The velocity vector at the ascending node in ECI is $\mathbf{V}_{an}=[2.15;-2.05 ;???] \text{ km/s}$.
- The period is 7800 sec.

The above data were measured on January 1st.

Satellite data:

Mass 450kg, drag area 2 m^2 , drag coefficient 2.2, solar panel area 5 m^2 , solar reflectivity coefficient 1.

1. Find the orbital elements a, e, i, ω and Ω .
2. Perform simulation of the orbit based on the equations of motion in cartesian coordinates in ECI. Calculate the position and the velocity vectors versus time for one revolution, starting from the perigee. Consider the following perturbations:
 - Atmospheric drag.
 - Earth oblateness (J_2 term).
 - Solar radiation pressure (including the shadow effect).Required graphs: xyz 3-dimensional plot, osculating orbital elements.
3. A tangential positive velocity change of 10 m/sec was applied at the perigee. Find the new orbital elements immediately after the pulse.