Total points: 100 (10 pts per question – unless indicated otherwise, the question is right or wrong, i.e. 10 or 0)

Questions:

1. What are longitude and latitude of a Geo-stationary satellite that operates in the Greenwich, UK's meridian? (consider only Keplerian gravitational force) **[10 pts]** **0 and 0 (degrees)**

2. A spacecraft is orbiting with an inclination of 50 degrees. What do you expect its maximum latitude to be? **[10 pts]** **50 degrees**

3. Without calculations, using geometrical considerations, provide the orbital parameters, except for *a*, of a spacecraft possessing, at time 0, the following state vector $\boldsymbol{r_0}$ = [10000; 10000; 0] km $\boldsymbol{v_0}$ = [0; 0; $\sqrt{2}\sqrt{\frac{\mu}{r_0}}$] km/s . **[10 pts] – [If you engage in calculations and find them correctly, only 5 points.]** **HINT: start drawing in 3D…** **Drawing r and v in ECI (3 axes) one can see that they are at 90 deg., so, that is either apogee or perigee. The velocity given is the parabolic one, so, it is the perigee. So, the true anomaly is 0 deg. and eccentricity is 1. Angular momentum is normal to r and v, normal to z, and inclination is then 90 deg.. The given r is on the xy plane, one can see the RAAN immediately, and given x equals y, it is 45 degrees. Finally, it is immediate to see that being the perigee on the xy plane, the argument of perigee is 0 deg..**

4. A rigid body undergoes a 121 Euler Angles rotation sequence with the following angles: 10 deg, 0 deg, 10 deg. What would be the difference in final orientation of the same body if, instead, it went through a 121 sequence with angles 20 deg, 0 deg, 0 deg? **[10 pts]** **no difference**

5. A rigid body undergoes a 321 Euler Angles rotation sequence with the following angles: 10 deg, 90 deg, 10 deg. Is it equivalent to 20 deg, 90 deg, 20 deg? **[10 pts]** **yes, equivalent**

6. On a hyperbolic orbit, the kinetic energy's magnitude is always greater than the potential energy's magnitude: true or false? **[10 pts]** **true**

7. A Sun-synchronous orbit has its RAAN at 0 degrees at Summer solstice. What is it going to be at Autumnal Equinox? **[10 pts]** **Look at the book's image where they show seasons on ecliptic plane. A Sun-synch faces the Sun at all times, so, after ¼ of a year**

the RAAN will have to be 90 degrees.

8. Compute the total ΔV on a Hohmann transfer from a Earth's circular orbit or radius 10,000 km to another circular of radius 15,000 km **[10 pts]** **run matlab file I provided**

9. Compute the total ΔV on a Bi-elliptical transfer from a Earth's circular orbit or radius 10,000 km to another circular of radius 15,000 km, with intermediate radius being 20,000 km **[10 pts]** **run matlab file I provided**

10. In a two-impulse maneuver from a circular orbit to a higher energy elliptical orbit, what is the best strategy? **[10 pts]** **end at apogee of outer ellipse**