SESA2024 Astronautics
Chapter 11: Remote Sensing Spacecraft - Problem Sheet

For each of the missions described below, identify suitable values for the following parameters:

- Semi-major axis;
- Eccentricity;
- Inclination;
- Number of days and number of orbits before the ground track repeats;
- Orbit control cycle (time and number of orbits between orbit boosts)
- Delta-V and propellant mass required for orbit control over the mission lifetime; and
- Uncompressed data rate for the instrument

1. A civilian remote sensing satellite in low Earth orbit carrying a multispectral imager of 19,500 pixels for each of its three separate waveband channels. The instrument has a field of view of 45.95° and uses 8-bit data quantisation. We require a similar ground resolution to other, government satellites (e.g. Landsat, SPOT: 20 - 30 m ground resolution), a design lifetime of about three years and the ability to revisit ground targets as frequently as possible. Take the cross-sectional area of the satellite to be 1 m^2 and the total/wet mass to be 150 kg.

2. A military surveillance satellite at around 275 km altitude carrying a panchromatic, visible waveband imager of 20,000 pixels, with a ground resolution of around 1 m. The instrument has a field of view of 4.165° and uses 7-bit data quantisation. Take the cross-sectional area of the satellite to be 10 m^2 and the total/wet mass to be 1000 kg.

You may use $C_D = 2.2$ and atmospheric mass density values from the Table below (use the closest value). For other values, please refer to your notes as needed.

Altitude (km)	Atmospheric mass density (kg/m^3)	Altitude (km)	Atmospheric mass density (kg/m^3)
280	2.83E-11	**600**	7.05E-14
300	1.80E-11	**620**	5.18E-14
320	1.17E-11	**640**	3.86E-14
340	7.71E-12	**660**	2.90E-14
360	5.15E-12	**680**	2.22E-14
380	3.47E-12	**700**	1.73E-14
400	2.36E-12	**720**	1.37E-14
420	1.61E-12	**740**	1.10E-14
440	1.11E-12	**760**	9.02E-15
460	7.71E-13	**780**	7.50E-15
480	5.37E-13	**800**	6.34E-15
500	3.76E-13	**820**	5.45E-15
520	2.65E-13	**840**	4.73E-15
540	1.88E-13	**860**	4.16E-15
560	1.35E-13	**880**	3.69E-15
580	9.68E-14	**900**	3.30E-15