Exercise Session 3

Problem 1 Multiple Choice Questions

A) We perform a rendezvous with the ISS which orbits the Earth in a circular LEO at 400 km altitude. During the approach, the chaser (Space Shuttle) is in an elliptical orbit in the same plane as the ISS with an apogee at 400 km and a perigee at 370 km, behind the ISS. On each successive apogee crossing, will the Shuttle get closer to the ISS or further away ? By how many kilometers ? (Give your answer as measured on the orbit of the ISS).

(1) Closer	(1) -282 km	(4) -4.3 km
(2) Further away	(2) 282 km	(5) 141 km
	(3) 7.7 km	(6) -152 km

B) In order to circularize its orbit to reach the ISS, the Space Shuttle will have to do different maneuvers. During rendezvous, a maneuver is performed at apogee which raises the perigee by 10 km. What is the Δv needed for this maneuver ?

(1) 0.22 m/s
(2) 1.43 m/s
(3) 2.86 m/s
(4) 0.32 km/s.
(5) 7.11 km/s

C) CHEOPS should be launched in 2019. This exoplanet observation satellite, which is partly designed at EPFL, will be in a Sun-Synchronous orbit with an inclination of 98.6° to avoid long eclipses and therefore avoid carrying many heavy batteries. To achieve this minimization of eclipses strategy, what are the local mean solar times when the satellite crosses the equator ?

(1) Noon/midnight
(2) 3 pm / 9 pm
(3) 6 am / 6 pm (Sunrise/Sunset)
(4) 10 am / 4 pm
(5) it does not matter

D) We want to inject a GPS satellite from a circular parking orbit at 230 km altitude to a final circular orbit at 20000 km altitude, using a Hohmann transfer without orbital plane change. What are the amounts of the two maneuvers Δv_1 and Δv_2 ?

(1) 2.1, 3.7 km/s
(2) 1.4, 1.1 km/s
(3) 1.4, 2.1 km/s
(4) 2.1, 1.4 km/s
(5) 4.7, 4.4 km/s

Problem 2 Chaser and Target

For each of the configurations and initial conditions (i) listed below, draw the trajectory of the chaser (thick line orbit, elliptical orbit semi-major axis **a**) vs. target (thin line orbit, circular orbit radius **r**) on the relative motion XZ plot. In all cases the direction of motion is counter clockwise, for the chaser as well as for the target.