AE5540 – SPACE FLIGHT DYNAMICS

Assignment No. 4 – 100 points

(Orbit Maneuvers & Interplanetary Trajectory Design)

Due: 18 March 2017

11 March 2017

1. The space station “FREEDOM” and spacecraft A and B are all in the same circular orbit of 350 Km altitude. Spacecraft A is 600 Km behind the space station and spacecraft B is 600 km ahead of the space station (c. f. Figure given below). Now, both spacecraft A and B perform a phasing maneuver at the same instant in order to dock at the space station in one revolution of their phasing orbits exactly.
2. Calculate the period of phasing orbits for each spacecraft to reach the space station.
3. Calculate the total and for each spacecraft. **20 Points**



1. With a single maneuver, the earth orbit of a satellite is to be changed from a 15000 Km radius circular orbit to a collinear ellipse with a perigee radius of 6878 Km and apogee radius of 22000 Km. (c. f. Figure below)
2. Calculate the single that is required to be given and the change in flight path angle required for this operation.
3. What is the minimum total required if the entire operation is carried out using Hohmann transfer? Compare and comment.

**20 Points**



1. Calculate the total required for a Hohmann transfer from Mars to Jupiter. Calculate the synodic period of Jupiter relative to Mars. Calculate the Sphere of Influence (SOI) of Jupiter. Suppose a spacecraft approaches Jupiter in a Hohmann Transfer ellipse from Earth. If the spacecraft flies by Jupiter by 200000 Km determine the imparted by Jupiter’ gravity on the spacecraft. Use data from Appendix-A of Curtis book. **20 Points**
2. Design a patched conic mission to Venus. Compute the total needed to go from a 400-Km circular Earth parking orbit to a 1000-Km circular orbit about Venus. Assume a Hohmann transfer for circular, coplanar orbits for Earth and Venus. What are the departure and arrival velocities (the velocities at periapsis and apoapsis on the transfer). What is the total and the time of flight? Use the following values for constants.

**20 Points**

|  |  |
| --- | --- |
|  | 132,712,440,018 |
|  | 398,600 |
|  | 324,900 |
|  | 149,600,000 Km |
|  | 108,200,000 Km |
|  | 6378.1363 Km |
|  | 6052 Km |

1. Given the following information about earth gravity assist:

=

=

398,600

The vectors are given in ecliptic co-ordinate system. Determine the spacecraft’s closest approach distance to earth ‘ and the deflection angle of the spacecraft ‘δ’ due to this encounter. **20 Points**



Hint: Realize and at SOI are parallel to asymptotes and this should fix ‘. Then the solution is apparent.