Advanced Manoeuvre Problems – 1

Problem No. 01

Consider an **elliptic** orbit with perigee of **400 km** altitude and apogee of **6000 k**m altitude. Calculate **ΔV** & ϕ required to change **ω** by 60^o. (R_E = 6378 km, $\mu = 3.986\times10^{14}$).

Solution No. 01

Argument of **perigee** change solution is as given **below**.

$$\alpha = 60^{\circ}; \quad \delta = 30^{\circ}; \quad r_p = 6,778km; \quad r_a = 12,378km$$

$$a = 9,578km; \quad V = 8,717.8m/s; \quad e = 0.292$$

$$\cos^2\phi = \frac{\left[1+e\cos\delta\right]^2}{\left[1+e^2+2e\cos\delta\right]} = 0.9866; \quad \cos\phi = 0.9933$$

$$\phi = 6.65^{\circ}; \quad \Delta V = 2V\sin\phi = 2,019.1m/s$$

Problem No. 02

Initial orbit is **defined as, $a_1 = 5R_E$ & $e_1 = 0.7$.** The final orbit is to be $a_2 = 10R_E$ & $e_2 = 0.3$. Determine β_2, ΔV, & γ. Also determine propellant **required** if m_0 is **1000 kg** & I_{sp} is **200s.**

$$R_E = 6378km; \quad \mu = 3.986 \times 10^{14} m^3 / s^2$$

Solution No. 02

Single impulse orbit change manoeuvre **solution** is as follows.

$$V_{a1} = 1.485 km/s; \quad V_2 = 2.9078 km/s, \quad \beta_2 = 15.23^o$$
$$\Delta V = 1.526 km/s; \quad \gamma = 30.87^o; \quad m_{prop} = 540.1 kg$$