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AE 771A
Quiz - 6

Q.1- Orbit Eccentricity, $e = 0.7$

$\mu = 398600.4 \text{ km}^3/\text{sec}^2$

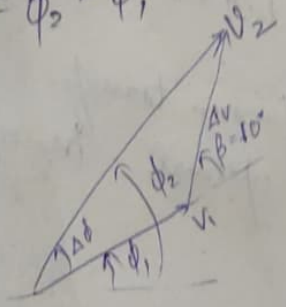
where $r_1 = 6900 \text{ km}$ and $v_1 = 7.4 \text{ km/sec}$,

$\Delta v = 500 \text{ m/s}$ applied at

$\beta = 60^\circ$ from initial velocity direction

No change in orbital plane.

$\Delta\phi = \phi_2 - \phi_1$



Using geometry,

$v_1 + \Delta v \cos\beta = v_2 \cos\Delta\phi$

$\Delta v \sin\beta = v_2 \sin\Delta\phi$

$$\tan\Delta\phi = \frac{\Delta v \sin\beta}{v_1 + \Delta v \cos\beta}$$

$$\tan\Delta\phi = \frac{(0.5)\sin 60^\circ}{7.4 + (0.5)\cos 60^\circ}$$

$\tan\Delta\phi = 0.0516$

$\Delta\phi \cong 3.2395^\circ$

$$v_2 = \frac{\Delta v \sin\beta}{\sin\Delta\phi}$$

$v_2 = 7.66 \text{ km/sec}$

$$\epsilon = \frac{v_2^2}{2} - \frac{\mu}{r_1} = \frac{-\mu}{2a}$$

$$-\frac{v_2^2}{\mu} + \frac{2}{r_1} = \frac{1}{a}$$

$$\frac{-(7.66)^2}{398600.4} + \frac{2}{6900} = \frac{1}{a}$$

$$a = 7010.1153 \text{ km}$$

$$h = r_1 v_2 = (6900)(7.66)$$

$$h = 52854 \text{ km}^2/\text{sec}$$

$$p = \frac{h^2}{\mu} \cong 7008.386 \text{ km}$$

$$e = \sqrt{1 - \frac{p}{a}} = 0.015$$

2. Earth to Mars

$\mu = 1.3271 \times 10^{11}\ km^3/s^2$

$r_1 = 1\ AV$

$r_2 = 1.524\ AV$

Smallest velocity impulse required for sending a spacecraft from one circular orbit to another circular orbit ⇒ Hofmann Transfer

Semi major axis of transfer obit.

$$a = \frac{r_1 + r_2}{2} = \frac{2.524}{2} = 1.262\ AV$$

first impulse $\Delta V_1 = \sqrt{\frac{2\mu}{r_1} - \frac{\mu}{a}} - \sqrt{\frac{\mu}{r_1}}$

$= 32.7292 - 29.7833$

$= 2.94589\ km/sec$

Second Impulse

$$\Delta V_2 = \sqrt{\frac{\mu}{r_2}} - \sqrt{\frac{2\mu}{r_2} - \frac{\mu}{a}}$$

$= 24.12573 - 21.4758$

$= 2.64986\ km/sec$

Total Impulse $= \Delta V_1 + \Delta V_2 = 5.59575\ km/sec$