Utah State University
Mechanical and Aerospace Engineering

PhD Qualifying Exam in Astrodynamics

FORMULAS

(1) $\mathbf{F} = m\mathbf{a}$ — Newton's Second Law

(2) $F_g = G\dfrac{m_1 m_2}{r^2}$ — Newton's Law of Gravitation

(3) $\ddot{\mathbf{r}} = -\dfrac{\mu}{r^3}\mathbf{r}$ — Two-Body Equation

(4) $\mathbf{h} = \mathbf{r} \times \mathbf{v}$ — Angular Momentum Vector

(5) $\mathbf{e} = \dfrac{\mathbf{v} \times \mathbf{h}}{\mu} - \dfrac{\mathbf{r}}{r}$ — Eccentricity Vector

(6) $r = \dfrac{h^2}{\mu}\dfrac{1}{1 + e\cos\theta}$ — Orbit Equation

(7) $\dfrac{v^2}{2} - \dfrac{\mu}{r} = -\dfrac{1}{2}\dfrac{\mu^2}{h^2}(1 - e^2) = \epsilon$ — Energy Equation

(8) $v_r = \dfrac{\mu}{h} e \sin\theta$ and $v_\perp = \dfrac{h}{r}$ — Speed Equations

(9) $e = \dfrac{r_a - r_p}{r_a + r_p}$ — One Eccentricity Formula

(10) $E - e\sin E = M_e = \dfrac{2\pi}{T}(t - t_p)$ — Kepler's Equation

(11) $\tan\dfrac{E}{2} = \sqrt{\dfrac{1-e}{1+e}}\tan\dfrac{\theta}{2}$ — E-θ Equation