AAE 412 **SPACE SYSTEMS ENGINEERING**

Properties of Conic Sections

All orbits:

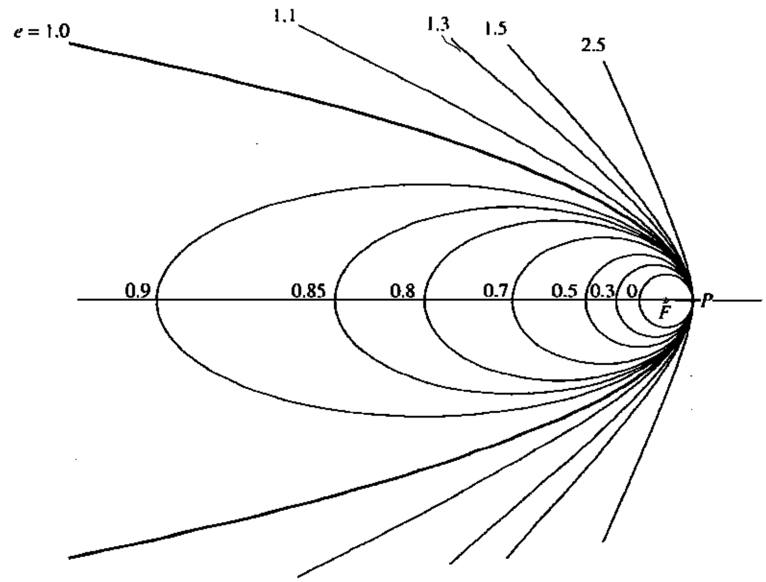
$$h = rv_\perp$$

$$r = \frac{h^2}{\mu}\,\frac{1}{1 + e\cos\theta}$$

$$v_r = \frac{\mu}{h} e \sin\theta$$

$$\tan\gamma = \frac{v_r}{v_\perp}$$

$$v = \sqrt{v_r^2 + v_\perp^2}$$



Elliptic orbits $0 \le e < 1$

$$a = \frac{r_p + r_a}{2} = \frac{h^2}{\mu}\,\frac{1}{1 - e^2}$$

$$\frac{v^2}{2} - \frac{\mu}{r} = -\frac{\mu}{2a}$$

$$T = \frac{2\pi}{\sqrt{\mu}} a^{3/2}$$

$$e = \frac{r_a - r_p}{r_a + r_p}$$

Parabolic orbits $e = 1$

$$\frac{v^2}{2} - \frac{\mu}{r} = 0$$

Hyperbolic orbits $e > 1$

$$\theta_\infty = \cos^{-1}\left(-\frac{1}{e}\right)$$

$$\delta = 2\sin^{-1}\left(\frac{1}{e}\right)$$

$$a = \frac{h^2}{\mu}\,\frac{1}{e^2 - 1}$$

$$\Delta = a\sqrt{e^2 - 1}$$

$$\frac{v^2}{2} - \frac{\mu}{r} = \frac{\mu}{2a}$$

Note: v_r is the radial component of the velocity vector and $v_\perp$ is the transverse (locally horizontal) component.