BIRZEIT UNIVERSITY
Physics Department

PHYS233: Astronomy

Useful constants and formulas:

For Earth: $M_{Earth} = 5.972 \times 10^{24}$ kg, if spherical approximation: R = 6370 km
If ellipsoid: a = 6378137 m, b = 6356752 m,

For Sun: $M_{\odot} = 1.989\times10^{30}$ kg, $R_{\odot} = 6.96\times10^{8}$ m, $L_{\odot} = 3.9\times10^{26}$ W.

$G = 6.673\times10^{-11}$ m^3 kg^{-1} s^{-2}, 1AU = 1.49597870×10^{11} m, 1amu is 1.6604×10^{-27} kg.

For calculating shortest distance between two points (φ_1, λ_1) and (φ_2, λ_2) on Earth's surface

$\cos \Psi = \sin\varphi_1 \sin\varphi_2 + \cos\varphi_1 \cos\varphi_2 \cos(\lambda_1 - \lambda_2)$.

Distance = RΨ, where Ψ is in radians and R is the radius of Earth. R = 6370 km.

$\cos A \cos B \pm \sin A \sin B = \cos(A \mp B)$

$\Theta = h + \alpha$, escape velocity: $v_e^2 = \frac{2G(m_1+m_2)}{R}$

Conversion between Horizontal system to equatorial system:

$\sin A \cos a = \sin h \cos\delta$ $\cos A \cos a = \cos h \cos\delta \sin\phi - \sin\delta \cos\phi$

$\sin a = \cos h \cos\delta \cos\phi + \sin\delta \sin\phi$

Conversion between Equatorial system to ecliptic system:

$\sin\lambda \cos\beta = \sin\delta \sin\varepsilon + \cos\delta \cos\varepsilon \sin\alpha$ $\cos\lambda \cos\beta = \cos\delta \cos\alpha$

$\sin\beta = \sin\delta \cos\varepsilon - \cos\delta \sin\varepsilon \sin\alpha$ $\varepsilon = 23°26'$

Kepler's third law: $P^2 = \frac{4\pi^2}{G(m_{1+m_2})} a^3$ synodical period: $\frac{1}{P_{1,2}} = \frac{1}{P_1} - \frac{1}{P_2}$

$\frac{1}{2} v^2 - \frac{\mu}{r} = h$, $h = -\frac{\mu}{2a}$ for ellipse