EART160: Equations You Should Know (in addition to high school physics)

Gravity and impacts

Newton’s law \[ F = GMm/r^2 \] Surface gravity \[ g = GM/R^2 \]
Escape velocity \[ v = (2gR)^{1/2} \] Gravitational potential \[ U = -GM/r \]
Orbital period \[ GM = a^3 \omega^2 \]

Flexure and Stresses

Hooke’s law \[ \sigma = E\varepsilon \] Thermal expansion \[ \varepsilon = \alpha \Delta T \]
Flexural parameter \[ \alpha = \left[ \frac{ET_0^2}{3g(\rho_m - \rho_w)(1 - \nu^2)} \right] \]

Interiors

Hydrostatic assumption \[ dP = (-\rho g dz) \] Heat flow \[ F = k \frac{dT}{dz} \]
Specific heat capacity \[ E = mC_p \Delta T \] Rayleigh number \[ Ra = \frac{\rho g \alpha \Delta T d^3}{\kappa \eta} \]
Thermal diffusivity \[ \kappa = k/\rho C_p \] Diffusion timescale \[ t = d^2/\kappa \]

Atmospheres

Black-body radiation \[ F = \varepsilon \sigma T^4 \] Gas law \[ PV = P \mu/\rho = RT \]
Scale height \[ H = RT/g\mu \] Coriolis acceleration \[ a = 2v \omega \sin \theta \]