Topics/Concepts
Kepler’s laws, orbital angular momentum and energy, semi-major axis, mean motion
Tidal potential, tidal bulge, Roche limit, Love numbers
Phase lag, $Q$, tidal torque

Equations
\[ n^2 = \frac{GM}{a^3} \quad E = -\frac{GMm}{2a} \quad L = mna^2 \sqrt{1 - e^2} \]

Tidal potential \[ V = -\frac{GM}{a^3} R^2 P_2 (\cos \phi) = -H g P_2 (\cos \phi) \] Equbm. tide \[ H = \frac{M}{m} \left( \frac{R}{a} \right)^3 \]

Tidal lag \[ \sin(2\phi) \approx \frac{1}{Q} \] Tidal torque (non-synchronous) \[ \frac{3}{2} k_2 m^2 G \frac{R_p^5}{a^6} \frac{1}{Q} \]

Numbers
\[ G = 6.67 \times 10^{-11} \text{ m}^3 \text{s}^{-2} \text{kg}^{-1} \quad Q_{\text{solid}} \sim 10^2 \quad Q_{\text{gas}} \sim 10^5 \]

Homogeneous, fluid body: $h_2 = 5/2$, $k_2 = 3/2$

References