$$\vec{\omega}_{AVE} = \frac{\Delta\vec{\theta}}{\Delta t} \quad \vec{\alpha}_{AVE} = \frac{\Delta\vec{\omega}}{\Delta t} \quad \vec{\theta}_f = \vec{\theta}_i + \vec{\omega}_i \Delta t + \frac{1}{2}\vec{\alpha}(\Delta t)^2 \quad \vec{\omega}_f = \vec{\omega}_i + \vec{\alpha}\Delta t \quad {\omega_f}^2 = {\omega_i}^2 \pm 2\alpha\Delta\theta \quad \vec{\omega}_{AVE} = \frac{\vec{\omega}_f + \vec{\omega}_i}{2}$$

$$\vec{\omega}(t) = \frac{d\vec{\theta}(t)}{dt} \quad \vec{\alpha}(t) = \frac{d\vec{\omega}(t)}{dt} \quad \vec{\omega}(t) = \int \vec{\alpha}(t)dt \quad \vec{\theta}(t) = \int \vec{\omega}(t)dt \quad s = r\theta \quad v_t = r\omega \quad a_t = r\alpha \quad a_r = \frac{v^2}{r} = \omega^2 r$$

$$\vec{\tau} = \vec{r} \times \vec{F} \qquad I = \int r^2 dm \qquad I = I_{CM} + Md^2 \qquad \sum \vec{\tau} = I\vec{\alpha} \qquad K_{ROT} = \frac{1}{2} I\omega^2$$

$$W_{ROT} = \vec{\tau} \cdot \Delta\vec{\theta} \qquad W_{ROT} = \int \vec{\tau} \cdot d\vec{\theta} \qquad P_{ROT} = \vec{\tau} \cdot \vec{\omega} \quad \vec{L} = I\vec{\omega} \qquad \vec{L} = \vec{r} \times \vec{p} \qquad \sum \vec{\tau} = \frac{d\vec{L}}{dt}$$

$$F_g = \frac{GMm}{r^2} \qquad G = 6.67x10^{-11} Nm^2/kg^2 \qquad U_g = -\frac{GMm}{r}$$

$$\vec{F}_S = -k\vec{x} \qquad \vec{x}(t) = A\cos(\omega t + \phi_o) = a\sin(\omega t) + b\cos(\omega t) \quad \omega = \sqrt{\frac{k}{m}} \qquad U_S = \frac{1}{2}kx^2 \qquad \omega = 2\pi f \qquad T = \frac{1}{f}$$

$$\sin\theta \cong \tan\theta \cong \theta \qquad \omega = \sqrt{\frac{g}{L}} \qquad \vec{F}_D = -b\vec{v} \qquad \vec{x}(t) = Ae^{-\alpha t}\cos(\omega' t) \qquad \alpha = \frac{b}{2m} \qquad \omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$$

$$\rho = \frac{m}{V} \qquad P = \frac{F}{A} = \frac{E}{V} \qquad A_1 v_1 = A_2 v_2 \qquad P_1 + \frac{1}{2}\rho {v_1}^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho {v_2}^2 + \rho g y_2$$

$$v = \lambda f = \frac{\omega}{k} \qquad I = \frac{P}{a} \qquad v = (331 + 0.6T_C) \qquad \beta = 10\log_{10}(\frac{I}{I_O}) \qquad I_O = 1.00x10^{-12} W/m^2 \qquad f' = f\frac{(v \pm v_O)}{(v \mp v_S)}$$

$$\Delta r = m\lambda \qquad \Delta r = (m + \frac{1}{2})\lambda \qquad m \in \{0,1,2,3,\ldots\} \qquad f_{beat} = |f_1 - f_2|$$

$$\lambda_m = \frac{2L}{m} \qquad f_m = \frac{mv}{2L} \qquad m \in \{1,2,3,\ldots\} \qquad \lambda_m = \frac{4L}{m} \qquad f_m = \frac{mv}{4L} \qquad m \in \{1,3,5,\ldots\}$$

$$\Delta r = d\sin\theta_m \qquad a\sin\theta_p = p\lambda \qquad a\sin\theta_p = (p + \frac{1}{2})\lambda \qquad \theta_1 = \frac{1.22\lambda}{D} \qquad \theta_i = \theta_R \qquad n = \frac{c}{v}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \qquad M = -\frac{d_i}{d_o} = \frac{h_i}{h_o} \qquad n_1\sin\theta_1 = n_2\sin\theta_2 \qquad \theta_c = \sin^{-1}(\frac{n_2}{n_1}) \qquad M = -\frac{f_o}{f_e}$$