Selected HW #4 Answers

1. $$(J + mR^2)\dot{\omega} + bl^2\omega cos^2(\theta) = FR$$
$$\omega_{BW} = \frac{bl^2}{J + mR^2}$$

2. $$m\dot{v} + (2Dv_o)v = F(t) + Dv_o^2 = u(t)$$
$$\frac{|v|}{|u|} = G(\omega) = \frac{1}{\sqrt{(m\omega)^2 + (2Dv_o)^2}}$$
$$\emptyset(\omega) = -tan^{-1}\left(\frac{m\omega}{2Dv_o}\right)$$

3. $$\left(\frac{J}{R^2} + m\right)\ddot{x} + \frac{b}{R^2}\dot{x} = F$$
$$\omega_{BW} = \frac{b}{J + mR^2}$$

4 $$\left(J_2 + J_1\left(\frac{R_2}{R_1}\right)^2\right)\ddot{\theta}_2 + \left(b_2 + b_1\left(\frac{R_2}{R_1}\right)^2\right)\dot{\theta}_2 = -\frac{R_2}{R_1}\tau$$

Note the negative sign on the right had side is due to the sign convention assigned (however sign convention DOES NOT change the signs on the left hand side of the EOM)

$$\dot{\theta}(t) = Ae^{\frac{-b_{eff}}{J_{eff}}t} + \tau_o\left(\frac{1}{\sqrt{(J_{eff}\omega)^2 + (b_{eff})^2}}\right)\sin\left(\omega t - tan^{-1}\left(\frac{J_{eff}\omega}{b}\right)\right)$$

$$\theta(t) = A\left(\frac{-J_{eff}}{b_{eff}}\right)e^{\frac{-b_{eff}}{J_{eff}}t} - \tau_o\left(\frac{1}{\omega\sqrt{(J_{eff}\omega)^2 + (b_{eff})^2}}\right)\cos\left(\omega t - tan^{-1}\left(\frac{J_{eff}\omega}{b}\right)\right)$$