$$\frac{\Theta_L}{V_{in}} = \frac{\left(\frac{K_g K_m}{J R_m}\right)}{s\left(s + \frac{K_g^2 K_m^2}{J R_m}\right)} \quad \ldots \text{ (eqn. 13 in lab document)}$$

Solve for V_{in}:

$$V_{in} = \Theta_L \frac{s\left(s + \frac{K_g^2 K_m^2}{J R_m}\right)}{\left(\frac{K_g K_m}{J R_m}\right)}$$

Set equal to eqn. 16 (Laplace transform of eqn. 15):

$$\Theta_L \frac{s\left(s + \frac{K_g^2 K_m^2}{J R_m}\right)}{\left(\frac{K_g K_m}{J R_m}\right)} = K_p\left(\Theta_D - \Theta_L\right) - s K_d \Theta_L$$

Pull Θ_L terms to one side:

$$\Theta_L\left[\frac{s\left(s + \frac{K_g^2 K_m^2}{J R_m}\right)}{\left(\frac{K_g K_m}{J R_m}\right)} + K_p + s K_d\right] = K_p \Theta_D$$

Rearrange:

$$\frac{\Theta_L}{\Theta_D} = \frac{K_p}{s^2\left(\frac{J R_m}{K_g K_m}\right) + s K_g K_m + K_p + s K_d}$$

Multiply through by $\frac{K_g K_m}{K_g K_m}$:

$$\frac{\Theta_L}{\Theta_D} = \frac{K_p K_g K_m}{s^2 J R_m + s K_g^2 K_m^2 + K_p K_g K_m + s K_d K_g K_m}$$

Multiply through by $\frac{1/J R_m}{1/J R_m}$:

$$\frac{\Theta_L}{\Theta_D} = \frac{\left(\frac{K_p K_g K_m}{J R_m}\right)}{s^2 + s\left(\frac{K_g^2 K_m^2}{J R_m}\right) + \left(\frac{K_p K_g K_m}{J R_m}\right) + s\left(\frac{K_d K_g K_m}{J R_m}\right)}$$

Rearrange in Transfer Function form:

$$\boxed{\frac{\Theta_L}{\Theta_D} = \frac{\left(\frac{K_p K_g K_m}{J R_m}\right)}{s^2 + s\left(\frac{K_g^2 K_m^2}{J R_m} + \frac{K_d K_g K_m}{J R_m}\right) + \left(\frac{K_p K_g K_m}{J R_m}\right)}}$$