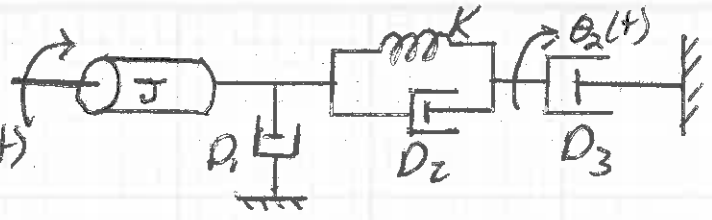
#33



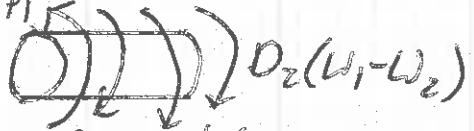
$J = 1\ kg\cdot m^2$

$D_1 = D_2 = D_3 = 1\ \frac{N\text{-}m}{rad/s}$

$K = 1\ N\text{-}m/rad$

Find θ_2 / T

Diagram for inertia J



Summation of Moments

$J\dot{\omega}_1 = T(t) - D_1\omega_1 - D_2(\omega_1-\omega_2) - K(\theta_1-\theta_2)$

Rearrange

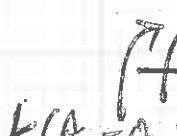
$J\dot{\omega}_1 + (D_1+D_2)\omega_1 + K\theta_1 = T(t) + D_2\omega_2 + K\theta_2$

Substitute values, use $\omega_1 = \dot{\theta}_1$, $\omega_2 = \dot{\theta}_2$

$\ddot{\theta}_1 + 2\dot{\theta}_1 + \theta_1 = T(t) + \dot{\theta}_2 + \theta_2$

Laplace transform $(s^2+2s+1)\Theta_1 = T(s) + (s+1)\Theta_2$

Diagram for point between dampers 2 & 3



Summation of Moments

$D_3\dot{\theta}_2 = D_2(\dot{\theta}_1-\dot{\theta}_2) + K(\theta_1-\theta_2)$

rearrange $(D_2+D_3)\dot{\theta}_2 + K\theta_2 = D_2\dot{\theta}_1 + K\theta_1$

Substitute values & transform: $(2s+1)\Theta_2 = (s+1)\Theta_1$

substitute for Θ_1

$(s^2+2s+1)(s+1)\cdot\Theta_2/(s+1) = T(s) + (s+1)\Theta_2$

Rearrange $[(s^2+2s+1)(2s+1) - (s+1)^2]\Theta_2 = (s+1)T(s)$

Simplify & Cancel $[(s+1)^2(2s+1-1)]\Theta_2 = (s+1)T(s)$

$(s+1)\cdot 2s\,\Theta_2 = T$

$$\boxed{\Theta_2/T = \frac{1}{2s(s+1)}}$$