Rotary Mechanical Systems Modeling

Linear Mechanical Elements: Rotary and translational

The solution process is similar to that for translational mechanical systems, so you can refer to the mechanical modeling handout for information setting up models. Here are the rotational mechanical elements.

Description	Trans Mech	Rotary mech	units
Damper (a.k.a. Dashpot or Linear Friction)	$f = \pm \boldsymbol{B}(v_1 \pm v_2)$	$\tau = \pm \boldsymbol{B_r}(\omega_1 \pm \omega_2)$	B_r: Nm/(rad/s) ω: rad/s τ: Nm
Power dissipation in Damper	$P = fv = f^2 \frac{\mathbf{1}}{\boldsymbol{B}} = v^2 \boldsymbol{B}$	$P = \omega^2 \boldsymbol{B_r} = \tau^2 / \boldsymbol{B_r}$	W
Spring	$f = \pm \mathbf{K}(x_1 \pm x_2)$	$\tau = \pm K_r(\theta_1 \pm \theta_2)$	K_r: Nm/rad
Energy stored in spring	$E = \frac{1}{2}\mathbf{K}(\Delta x)^2$ or $E = \frac{1}{2}\frac{\mathbf{1}}{\mathbf{K}} f^2$	$E = \frac{1}{2}\frac{\mathbf{1}}{\mathbf{K}_r}\tau^2 = \frac{1}{2}K_r(\Delta\theta)^2$	J (joules)
Mass	$f = \boldsymbol{M}\frac{dv}{dt}$ or $\frac{dv}{dt} = f / \mathbf{M}$, where *f* is the sum of all forces, each taken with the appropriate sign.	$\frac{d\omega}{dt} = \frac{\tau}{\mathbf{J}}$	J: kg m^2
Energy stored in mass	$E = ½\boldsymbol{M}v^2$	$E = ½\boldsymbol{J}\omega^2$	J (joules)