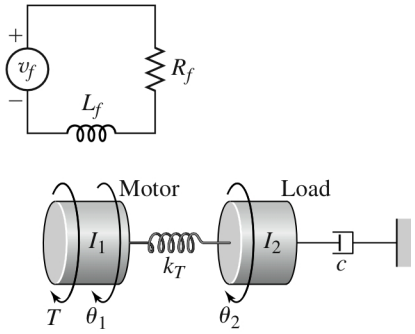
System Dynamics Final, Fall 2015

1. Obtain the transfer function $\Theta_2(s)/V_f(s)$ for the system shown below.



2. For the system below:

   (a) Draw a block diagram for the following system.

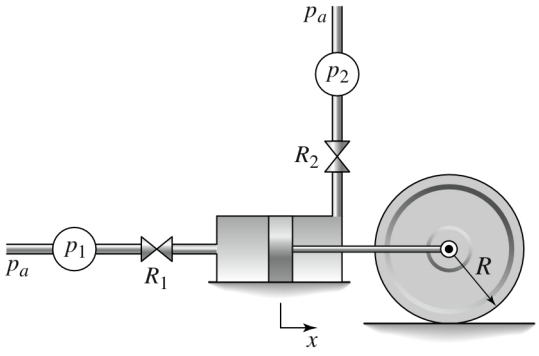
   (b) Is the system stable and why or how could you demonstrate this?

$$\begin{aligned} 2\ddot{x} + 6\dot{x} - 3x + y &= f_1(t) \\ 12\ddot{y} - y + 3x &= f_2(t) \end{aligned}$$

3. A piston of area A is connected to the axle of the cylinder with mass m and inertia I about its center.

   (a) Develop a dynamic model of the axle's translation with pressures p_1 and p_2 as inputs.

   (b) Write the governing equations in state-space form with x and the pressure on the left side of the cylinder as outputs.



$F(s)$	$F(t)$
$sX(s) - x(0)$	$\dot{x}(t)$
$s^2X(s) - sx(0) - v(0)$	$\ddot{x}(t)$
$\frac{a}{s^2+a^2}$	$\sin(at)$
$\frac{s}{s^2+a^2}$	$\cos(at)$
1	$\delta(t)$
$\frac{1}{s}$	$u(t)$
$\frac{1}{s^2}$	t
$\frac{1}{s-a}$	e^{at}
$\frac{1}{s^n}$	$\frac{t^{n-1}}{(n-1)!}$