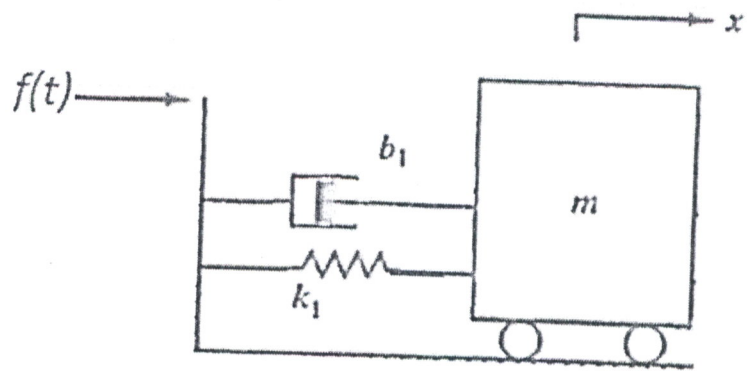
Faculty of Engineering	Philadelphia University	Mechanical Eng. Dep.
Course name: Automatic control	Second Quiz	Course number:620443
Instructor: Eng. Laith Batarseh	Sunday 17/4/2018	Allowed time: 10 minutes

Student Name: Typical Solution. **Student ID number:**

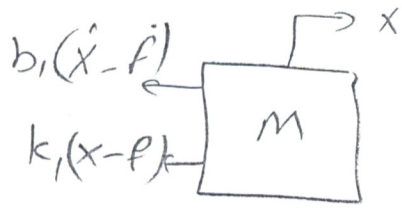
Consider the following mechanical system. Find the transfer function X(s)/F(s).

Solution:-



F.B.D :-

assume $x > f$.



Newton's 2nd law :-

$$\Sigma F = M\ddot{x}$$

$$M\ddot{x} = -b_1(\dot{x}-\dot{f}) - k_1(x-f) \Rightarrow M\ddot{x} = -b_1\dot{x} + b_1\dot{f} - k_1x + k_1f$$

$$\Rightarrow M\ddot{x} + b_1\dot{x} + k_1x = b_1\dot{f} + k_1f \quad ---(1)$$

Take Laplace for Eq (1) with I.C's = 0

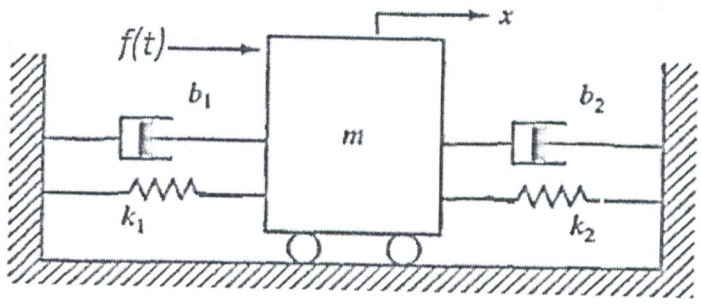
$$[Ms^2 + b_1s + k_1]\,X(s) = (b_1s + k_1)\,F(s)$$

$$\Rightarrow \frac{X(s)}{F(s)} = \frac{b_1s + k_1}{Ms^2 + b_1s + k_1}$$

	Philadelphia University	Mechanical Eng. Dep.
...omatic control	Second Quiz	Course number:620443
Instructor: Eng. Laith Batarseh	Sunday 17/4/2018	Allowed time: 10 minutes

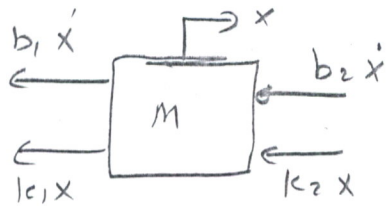
Student Name: Typical Solution. **Student ID number:**

Consider the following mechanical system. Find the transfer function X(s)/F(s).



Solution:-

F.B.D:-



Newton's 2nd Law:-

$$\Sigma F = M\ddot{x} \rightarrow m\ddot{x} = -b_1\dot{x} - k_1 x - b_2\dot{x} - k_2 x + f(t)$$

$$\Rightarrow m\ddot{x} + (b_1+b_2)\dot{x} + (k_1+k_2)x = f(t) \quad \text{--- (1)}$$

Take Laplace for Eq (1) with I.C's = 0

$$ms^2X(s) + (b_1+b_2)sX(s) + (k_1+k_2)X(s) = F(s)$$

$$\Rightarrow \frac{X(s)}{F(s)} = \frac{1}{ms^2 + (b_1+b_2)s + (k_1+k_2)}$$