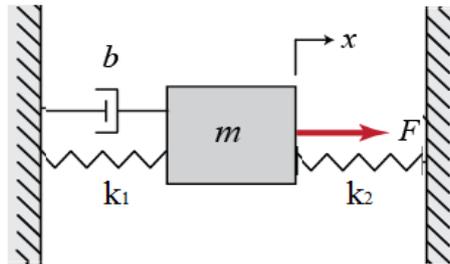


## EEE 352 LAB EXP #3

### Modeling and Simulation of a Mechanical System Using Matlab

#### 1. Preliminary Work

Consider the mathematical system given in Figure, where  $k_1$ ,  $k_2$  are spring constants,  $b$  is the viscous friction coefficient,  $m$  is the mass of object, and  $F$  is the external force applied on the object.



**1.1** Derive the differential equations for the system dynamics. Find the model of the system in Laplace domain. Obtain the transfer function between the applied force and displacement, where the initial position of the applied force and displacement is central (i.e.,  $x(t=0)=0$ ). Also find the transfer function between the initial position  $x_0$  and  $x$  for the case that  $F=0$ .

**1.2** Repeat 1.1 for zero damping, i.e. when  $b=0$ .

#### 2 Experimental Work

**2.1** Build the model for the system given above using Simulink. Use the numerical values as follows:  $m=0.5$  kg,  $k_1=k_2=4$  N/m,  $b=4$  Ns/m. Simulate the model and obtain and plot the displacement  $x$  for the following cases:

**2.1.1**  $F(t)=u(t)$ ,  $x_0=0$ .

**2.1.2**  $F(t)=\delta(t)$ ,  $x_0=0$ .

**2.1.3**  $F(t)=0$ ,  $x_0=1$ .

**2.2** Repeat the simulation in 2.1 for  $b=0$ .

#### 3 Results and Conclusion

Obtain the responses (displacement function) in the experimental work analytically, using the transfer functions derived in the preliminary work. Verify the results obtained.