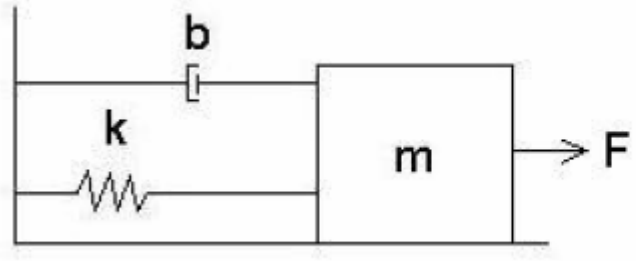
Homework: Simulink

Using the mass-spring-damper system shown below, answer questions 1-5.



x : position of mass
$\dot{x}$: velocity of mass
$\ddot{x}$: acceleration of mass
F : applied force
m : mass
b : damping coefficient
k : spring constant

For questions 3-5, use the following values (the force, F, is assumed constant):

$F = 3\ N$ $\quad$ $m = 5\ kg$

$b = 2\ Ns/m$ $\quad$ $k = 5\ N/m$

1. Derive the system's equation of motion in terms of the highest order term (i.e. $\ddot{x} = \ldots$).

2. Derive the state space model from the equation of motion found above. *Hint: F should be the system input*

3. Create a Simulink model of the equation derived in question (1) using two *integrator blocks*. Include screen shots of your model as well as a graph of the block's position over time.

4. Create another Simulink model based on your state space model in question (2) using the *state space* block. Include screen shots of your model (use the block properties option to display your state space matrices) as well as a graph of the block's position over time. Verify your graph matches that in question (3).

5. Based on the graph in question (3) or (4), where does the block finally stabilize (i.e. x=?)? Prove this theoretically.