Due Thu. April 1, 2010, in class.

1. Problems 4, 7, 8, Section 3.5, pp. 122–124.

2. Transform the following higher-order equations into a system of first order, and write the system in matrix form \( x' = Ax \)
   
   (a) \( u'' + \frac{1}{2}u' + 2u = 3 \sin t \)
   
   (b) \( t^2 u'' + tu' + (t^2 - \frac{1}{4})u = 0 \)

3. Write the system of equations for the two mass-spring system with two masses, 
   
   \[
   \begin{align*}
   m_1 x_1'' &= -(k_1 + k_2)x_1 + k_2 x_2 \\
   m_2 x_2'' &= k_2 x_1 - (k_2 + k_3)x_2
   \end{align*}
   \]
   
   in the form of a first order system \( x' = Ax \).

4. Systems of first order equations can sometimes be transformed into a single equation of higher order. Consider the system
   
   \[
   \begin{align*}
   x_1' &= -2x_1 + x_2 \\
   x_2' &= x_1 - 2x_2.
   \end{align*}
   \]

   (a) Solve the first equation for \( x_2 \) and substitute into the second equation, thereby obtaining a second order equation for \( x_1 \). Solve this equation for \( x_1 \) and then determine \( x_2 \) also.

   (b) Find the solution for the given system that also satisfies the initial conditions \( x_1(0) = 2, \ x_2(0) = 3 \).

   (c) Sketch the curve, for \( t \geq 0 \), given parametrically by the expressions for \( x_1(t) \) and \( x_2(t) \) obtained in part (b).

5. Same as problem 4 for the system
   
   \[
   \begin{align*}
   x_1' &= 2x_2, \quad x_1(0) = 3 \\
   x_2' &= -2x_1, \quad x_2(0) = 4.
   \end{align*}
   \]

6. Problems 4 (a) (d) (h), 5, 6, 12, Section 5.3, pp. 196–198.