1 **Revision.** Find Eigenvalues and Eigenvectors for the following matrices.

a) \[ A = \begin{pmatrix} -3 & 1 \\ 2 & -2 \end{pmatrix} \]

b) \[ B = \begin{pmatrix} 3 & 6 \\ 1 & 2 \end{pmatrix} \]

c) \[ C = \begin{pmatrix} 0 & -5 \\ 1 & -4 \end{pmatrix} \]

d) \[ D = \begin{pmatrix} -3 & 0 \\ 2 & -2 \end{pmatrix} \]

What are the eigenvalues of a matrix with a zero on the off diagonal, i.e., of the form \[ A = \begin{pmatrix} a & 0 \\ c & d \end{pmatrix} \] or \[ A = \begin{pmatrix} a & b \\ 0 & d \end{pmatrix} \]?

2 **Solve the following initial value problems (IVP),**

for real solutions \( y(t) = \begin{pmatrix} y_1(t) \\ y_2(t) \end{pmatrix} \).

a) \( \dot{y} = Ay \), with \( A \) as in part 1a) and \( y(0) = \begin{pmatrix} 0 \\ 3 \end{pmatrix} \)

b) \( \dot{y} = By \), with \( B \) as in part 1b), and \( y(0) = \begin{pmatrix} 5 \\ 0 \end{pmatrix} \)

c) \( \dot{y} = Cy \), with \( C \) as in part 1c), and \( y(0) = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \)

d) \( \dot{y} = Dy \), with \( D \) as in part 1d), and \( y(0) = \begin{pmatrix} 0 \\ 3 \end{pmatrix} \)

3 **Take a Mass-Spring-Damper System**

\[ m\ddot{x} = -kx - c\dot{x}, \]

with mass 1, spring constant \( k = 6 \) and damping constant \( c = 10 \).

a) Find the General Solution for \( x(t) \) by the old method.

b) Use the matrix method, letting \( y_1(t) = x(t) \) and \( y_2(t) = \dot{x}(t) \) and find the General solution for \( y(t) = \begin{pmatrix} y_1(t) \\ y_2(t) \end{pmatrix} \).

c) Solve the initial value problem for the Mass-Spring-Damper with \( x(0) = 1 \) and \( \dot{x}(0) = 0 \), in matrix form.

4 **Kreyszig (8th Edition)** K3.1 p158 no. 2, 6, 7, 10. and K3.3 p169 no. 5, 8, 12, 16*. 