Quiz #9 EE 360 Fall 2021 Name:_____

Open book and open notes

Show your work for credit and place boxes around your answers.

Consider an analog system described by the state equations,

$$\underbrace{\begin{bmatrix}\dot{q}_1(t)\\ \dot{q}_2(t)\end{bmatrix}}_{\dot{\boldsymbol{q}}(t)} = \underbrace{\begin{bmatrix}-3 & 1\\ -2 & 0\end{bmatrix}}_{\mathbf{A}} \underbrace{\begin{bmatrix}q_1(t)\\ q_2(t)\end{bmatrix}}_{\boldsymbol{q}(t)} + \underbrace{\begin{bmatrix}1\\ -3\end{bmatrix}}_{\mathbf{B}} x(t)$$

$$y(t) = \underbrace{\begin{bmatrix}1 & 0\end{bmatrix}}_{\mathbf{C}} \underbrace{\begin{bmatrix}q_1(t)\\ q_2(t)\end{bmatrix}}_{\boldsymbol{q}(t)}.$$

Where $x(t)$ is the system's input signal, and $y(t)$ is the system's output signal.

a) Using the vector matrix Laplace transform, show that

$$\mathbf{Y}(s) = [\mathbf{C}(s\mathbf{I} - \mathbf{A})^{-1}\mathbf{B} + \mathbf{D}]\mathbf{X}(s).$$

b) Using this formula, determine the system's impulse response, $h(t)$.

To solve this problem correctly, you will need to know that $\begin{bmatrix}a & b\\ c & d\end{bmatrix}^{-1} = \frac{1}{ad-bc}\begin{bmatrix}d & -b\\ -c & a\end{bmatrix}$