EE 792 - Summer 2017 Quiz #1

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$$\frac{5}{4}$$
$$9$$

1) Derive a state-space model of the system given by the following differential equation:

$$\ddot{y} + 7\dot{y} + 12y = u$$

2) Find the transfer function of the system given by the following state-space model

$$\dot{x} = \begin{bmatrix} -2 & 0 \\ 0 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & -1 \end{bmatrix} x$$

1) $\ddot{y} + 7\dot{y} + 12y = u$

$\dot{x}_2 + 7x_2 + 12x_1 = u$

$A = \begin{bmatrix} 0 & 1 \\ -12 & -7 \end{bmatrix}$

$x_1 = y$

$x_2 = \dot{y}$

$\dot{x}_1 = \dot{y} = x_2$

$\ddot{y} = \dot{x}_2$

$B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

$C = \begin{bmatrix} 1 & 0 \end{bmatrix}$

$\dot{x} = Ax + Bu$

$y = Cx$

$\det[SI - A]$

$\dot{x} = \begin{bmatrix} 0 & 1 \\ -12 & -7 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$

A is square matrix

$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$ 5

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EE-792 **Quiz-1** **Summer-17**

Last Name: MAHAVADIA $\frac{10}{10}$ **First Name** KHYATI

1. What is the determinant of the following matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 5 & 6 & 0 \\ 4 & 3 & 0 \end{bmatrix}$

   a. -9
   b. 9
   c. 21
   d. -15

$= 3(0) - 2(0) + 1(15-24)$

$= -9$

2. What is the cofactor of '5' the following matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 5 & 6 & 0 \\ 4 & 3 & 0 \end{bmatrix}$

$\begin{bmatrix} + & - & + \\ - & + & - \\ + & - & + \end{bmatrix}$

   a. -3
   b. 3
   c. -15
   d. 15

$0 - 3 = -(-3)$

3. What is the trace of the following matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 5 & 6 & 0 \\ 4 & 3 & 0 \end{bmatrix}$

   a. 0
   b. 2
   c. 1
   d. 3

4. Find the inverse of A if $A = \begin{bmatrix} 2 & 0 \\ 4 & 1 \end{bmatrix}$

   a. $A^{-1} = \begin{bmatrix} 2 & 0 \\ 4 & 1 \end{bmatrix}$
   b. $A^{-1} = \begin{bmatrix} 0 & 2 \\ 1 & 4 \end{bmatrix}$
   c. $A^{-1} = \begin{bmatrix} 0.5 & 0 \\ -2 & 1 \end{bmatrix}$
   d. $A^{-1} = \begin{bmatrix} 1 & 0 \\ -4 & 2 \end{bmatrix}$

$= \frac{1}{2-0} \begin{bmatrix} 1 & 0 \\ -4 & 2 \end{bmatrix}$

$= \frac{1}{2} \begin{bmatrix} 1 & 0 \\ -4 & 2 \end{bmatrix}$

$= \begin{bmatrix} 1/2 & 0 \\ -2 & 1 \end{bmatrix}$

5. Find the Transpose of matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 5 & 6 & 0 \\ 4 & 3 & 0 \end{bmatrix}$

   a. $A^T = \begin{bmatrix} 3 & 2 & 1 \\ 5 & 6 & 0 \\ 4 & 3 & 0 \end{bmatrix}$ b. $A^T = \begin{bmatrix} 3 & 5 & 4 \\ 2 & 6 & 3 \\ 1 & 0 & 0 \end{bmatrix}$ c. $A^T = \begin{bmatrix} 5 & 6 & 0 \\ 3 & 2 & 1 \\ 4 & 3 & 0 \end{bmatrix}$ d. $A^T = \begin{bmatrix} 1 & 3 & 2 \\ 0 & 5 & 6 \\ 0 & 4 & 3 \end{bmatrix}$

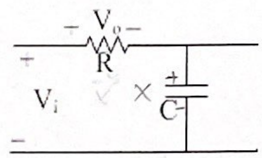
$A^T = \begin{bmatrix} 3 & 5 & 4 \\ 2 & 6 & 3 \\ 1 & 0 & 0 \end{bmatrix}$

Please show your work for partial credit.
Each question worth 4 points; this quiz worth 1 % of your final grade.

EE-792 9/10 Quiz-2 H798K433 Summer-17

Last Name: MAHAVADIA First Name KHYATI

1. Write the state equation for the given circuit



2/2

a. $\dot{X} = \frac{1}{RC}V_i - \frac{1}{RC}X$

b. $\dot{X} = \frac{1}{R}V_i - \frac{1}{R}X$

c. $V_0 = V_i - X_1$

d. $\dot{X} = V_i - X$

$\dot{x} = \frac{1}{C}x$

$x = C\dot{x}$

$u = V_i = RX + X$
$= RC\dot{x} + x$

$\therefore \dot{x} = V_i/RC - \frac{X}{RC}$

2. Which of the following statement is **FALSE**

2/2

a. Number of state variables depends upon the number of energy storage elements

b. Single input and single output system will have only one state variable

c. State variable is nothing but current and voltage

d. Input of the circuit can be either voltage or current

3. which one of the following function represent the spring mass system

1/2

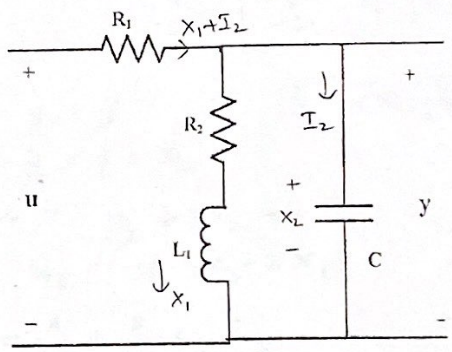
a. $F = m\ddot{y} + c\dot{y} + ky$

b. $F = m\ddot{y} + k\dot{y} + cy$

c. $F = m\ddot{y}$

d. $F = m\ddot{y} + k\dot{y}$

4. write the first loop equation for given circuit



2/2

a. $U = R_1(X_1 + I_2) + R_2X_1 + L_1\dot{X}_1$

b. $U = R_1(X_1) + R_2X_1 + L_1\dot{X}_1$

c. $U = R_1(X_1) + R_2X_1 + \dot{X}_1$

d. $U = R_1(X_1 + I_2) + X_1$

$U = R_1(X_1 + I_2) + R_2X_1 + L_1\dot{X}_1$

5. Write the output equation for the given circuit

2/2

a. $y = X_2$

b. $y = R_2X_1 + L_1\dot{X}_1$

c. $y = R_2X_1 + L_1X_1$

d. $y = R_2X_1 + L_1\dot{X}_1 + X_2$

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EE-792 10/10 Quiz-3 Summer-17

Last Name: MAHAVADIA First Name KHYATI

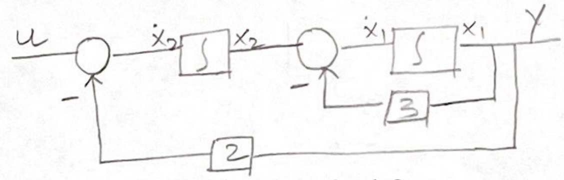
1. In controllable canonical form which of the following statement is **TRUE**
   a. All state variables depends upon the input
   b. All state variables depends upon the output
   c. Only one state variable depends upon the input ✓
   d. Only one state variable depends upon the output

2/2

2. $\ddot{y} + 3\dot{y} + 2y = u$; write the state equation by using observer canonical form
   a. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$
   b. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-3 & -2\\ 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$
   c. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-3 & 1\\ -2 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 0\end{bmatrix}u$
   d. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-3 & 1\\ -2 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$ ✓

$\ddot{y} = u - 3\dot{y} - 2y$

$y = \iint u - 3\int y - 2\iint y$



$\dot{x}_1 = x_2 - \cancel{3x_1}$

$\dot{x}_2 = u - 2x_1$

2/2

3. $\ddot{y} + 3\dot{y} + 2y = u$; write the state equation by using controllable canonical form
   a. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$ ✓
   b. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-3 & -2\\ 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$
   c. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-3 & 1\\ -2 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 0\end{bmatrix}u$
   d. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-3 & 1\\ -2 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$

$\begin{matrix}\dot{x}_1\\ \dot{x}_2\end{matrix} = \begin{bmatrix}-3 & 1\\ -2 & 0\end{bmatrix}$ $u = \begin{bmatrix}0\\ 1\end{bmatrix}$

$x_1 = y$ $\ddot{y} = \ddot{x}_1 = \dot{x}_2$

$\dot{x}_1 = \dot{y} = x_2$

$u = \dot{x}_2 + 3x_2 + 2x_1$

$\dot{x}_2 = u - 3x_2 - 2x_1$

2/2

4. Find 'C' in the following function $F_{(s)} = \frac{1}{(s+2)(s+1)^2} = \frac{A}{S+2} + \frac{B}{S+1} + \frac{C}{(s+1)^2}$
   a. 1 ✓
   b. -1
   c. -2
   d. 2

$A(s+1)(s+1)^2 + B(s+2)(s+1)^2 + C(s+2)(s+1) = 1$

substituting
$s=-2$
$s=1$

$C=1$

2/2

5. The denominator of the transfer function is called
   a. Characteristic equation
   b. Characteristic polynomial ✓
   c. Eigenvalues of the vectors
   d. Poles of the given system

2/2

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