ECE-320, Practice Quiz #5

1) For the 2x2 matrix $P = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, the inverse of this matrix, P^{-1}, is which of the following:

a) $P^{-1} = \frac{1}{ad-bc}\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ b) $P^{-1} = \frac{1}{ad-bc}\begin{bmatrix} d & b \\ c & a \end{bmatrix}$ c) $P^{-1} = \frac{1}{ad-bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

d) $P^{-1} = \frac{1}{ad+bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ e) $P^{-1} = \frac{1}{ad+bc}\begin{bmatrix} d & b \\ c & a \end{bmatrix}$ f) none of these

2) For the following state variable model

$$\dot{q}(t) = \begin{bmatrix} 1 & 0 \\ 1 & 2 \end{bmatrix} q(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$
$$y(t) = [1 \quad 2]q(t)$$

The poles of the system are at

a) -1 and -3 b) -2 and -2 c) 1 and 3 d) 0 and 1 e) 1 and 2

3) For the following state variable model

$$\dot{q}(t) = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} q(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$
$$y(t) = [1 \quad 2] q(t)$$

The poles of the system are at

a) -1 and -2   b) -1 and -1   c) 1 and 3   d) 0 and 1   e) 1 and 2

4) For the following state variable model

$$\dot{q}(t) = \begin{bmatrix} -1 & -1 \\ 1 & -3 \end{bmatrix} q(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$
$$y(t) = [1 \quad 2] q(t)$$

The poles of the system are at

a) -1 and -3   b) -2 and -2   c) 1 and 3   d) 0 and 1   e) -1 and -2

5) Consider the following state variable model

$$\dot{q}(t) = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix} q(t) + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 3 & 0 \end{bmatrix} q(t)$$

Assume state variable feedback of the form $u(t) = G_{pf} r(t) - Kq(t)$ The closed loop transfer function for this system is which of the following?

a) $G(s) = \dfrac{-6G_{pf}}{s(s-1+2k_2)+2k_1-1}$ b) $G(s) = \dfrac{6G_{pf}}{s(s-1+2k_2)+2k_1-1}$

c) $G(s) = \dfrac{6G_{pf}}{s(s-1+2k_2)-2k_1+1}$ d) $G(s) = \dfrac{-6G_{pf}}{s(s-1+2k_2)-2k_1+1}$

6) Consider the following state variable model

$$\dot{q}(t) = \begin{bmatrix} -1 & 2 \\ 0 & 1 \end{bmatrix} q(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$$
$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} q(t)$$

Assume state variable feedback of the form $u(t) = G_{pf} r(t) - Kq(t)$ Is the closed loop transfer function for this system equal to

$$G(s) = \frac{G_{pf}}{s + 1 + k_1}$$

a) yes b) no

7) A system with state variable feedback has the closed loop transfer function

$$G(s) = \frac{8G_{pf}}{s^2 + (k_1 + 12)s + (k_1 + k_2 + 20)}$$

Is this system ***controllable***?

a) Yes b) No c) impossible to determine

8) A system with state variable feedback has the closed loop transfer function

$$G(s) = \frac{G_{pf}}{s^2 + (k_1 - 1)s + (k_2 + 2)}$$

Is the system controllable?

a) Yes b) No c) impossible to determine

9) A system with state variable feedback has the closed loop transfer function

$$G(s) = \frac{G_{pf}}{(s - k_1 k_2)^2}$$

Is the system controllable?

a) Yes b) No c) impossible to determine

10) Consider a plant that is unstable but is a controllable system. Is it possible to use state variable feedback to make this system stable?

a) Yes b) No

Answers: 1-c, 2-e, 3-b, 4-b, 5-b, 6-a, 7-a, 8-a, 9-b, 10-a