## ECE-320, Practice Quiz #7

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

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

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

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

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

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

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

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

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

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

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