

**ECE-320 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

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

$$y(t) = [1 \quad 2]q(t)$$

The poles of the system are at

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

3) For the following state variable model

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

$$y(t) = [1 \quad 2]q(t)$$

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) Is the following system **controllable**?

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

a) Yes b) No c) impossible to determine

5) Is the following system **controllable**?

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

a) Yes b) No c) impossible to determine

6) A system with state variable feedback has the following 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

7) 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

8) Is it possible for a system with state variable feedback to change the zeros of the plant (other than by pole-zero cancellation) ?

a) Yes b) No

9) Is it possible for a system with state variable feedback to introduce zeros into the closed loop system?

a) Yes b) No

10) If a plant has  $n$  poles, then a system with state variable feedback with no pole-zero cancellations will have

a) more than  $n$  poles b) less than  $n$  poles c)  $n$  poles d) it is not possible to tell

11) Consider the following state variable model

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

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

12) 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

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

a) yes b) no

Name \_\_\_\_\_ Mailbox \_\_\_\_\_

**13)** Write an expression for the magnitude of the following function

$$S(j\omega) = \frac{a + j\omega b + c}{d + j\omega e + j\omega f}$$