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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

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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

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

5) 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

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6) 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

7) 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

8) 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

9) 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

10) 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

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

a) Yes b) No

12) 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