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ECE-320 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) $P^{-1} = \dfrac{1}{ad-bc}\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ b) $P^{-1} = \dfrac{1}{ad-bc}\begin{bmatrix} d & b \\ c & a \end{bmatrix}$ c) $P^{-1} = \dfrac{1}{ad+bc}\begin{bmatrix} d & b \\ c & a \end{bmatrix}$

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

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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

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11) Consider the following state variable model

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

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

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

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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

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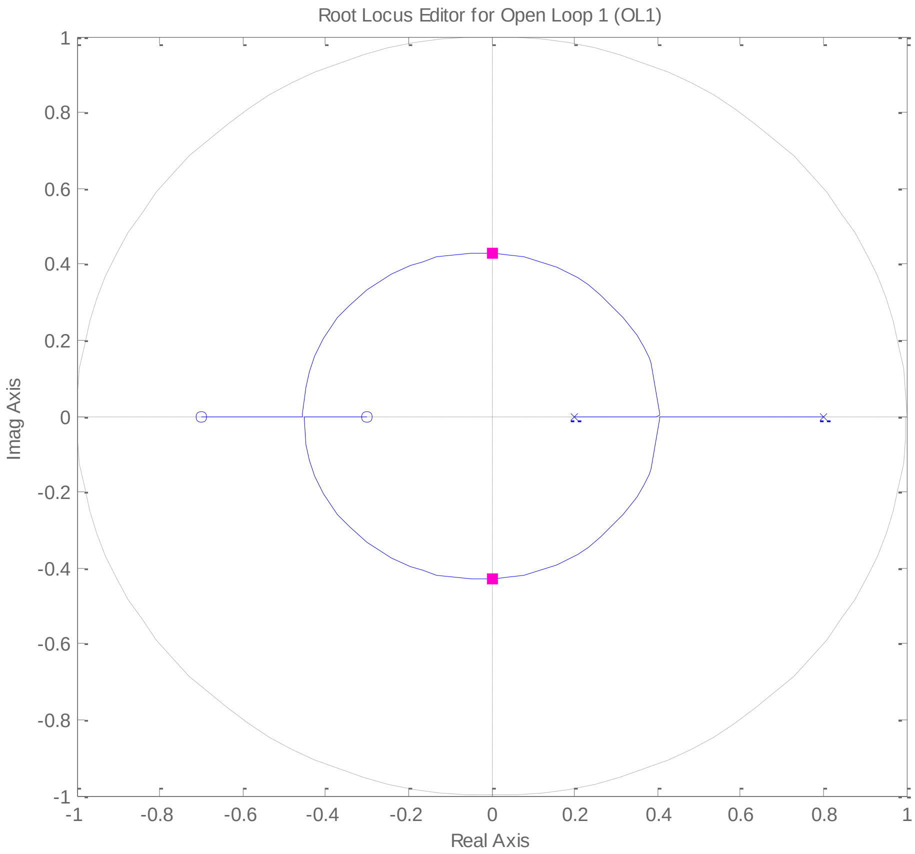
Problems 13 and 14 refer to the following root locus plot for a **discrete-time** system



13) Are there any values of *k* (the variable parameter) for which the system is stable?

a) yes b) no c) there is not enough information to answer

14) As *k* increases, the close loop poles of the system

a) move to the left b) move to the right c) do not move at all

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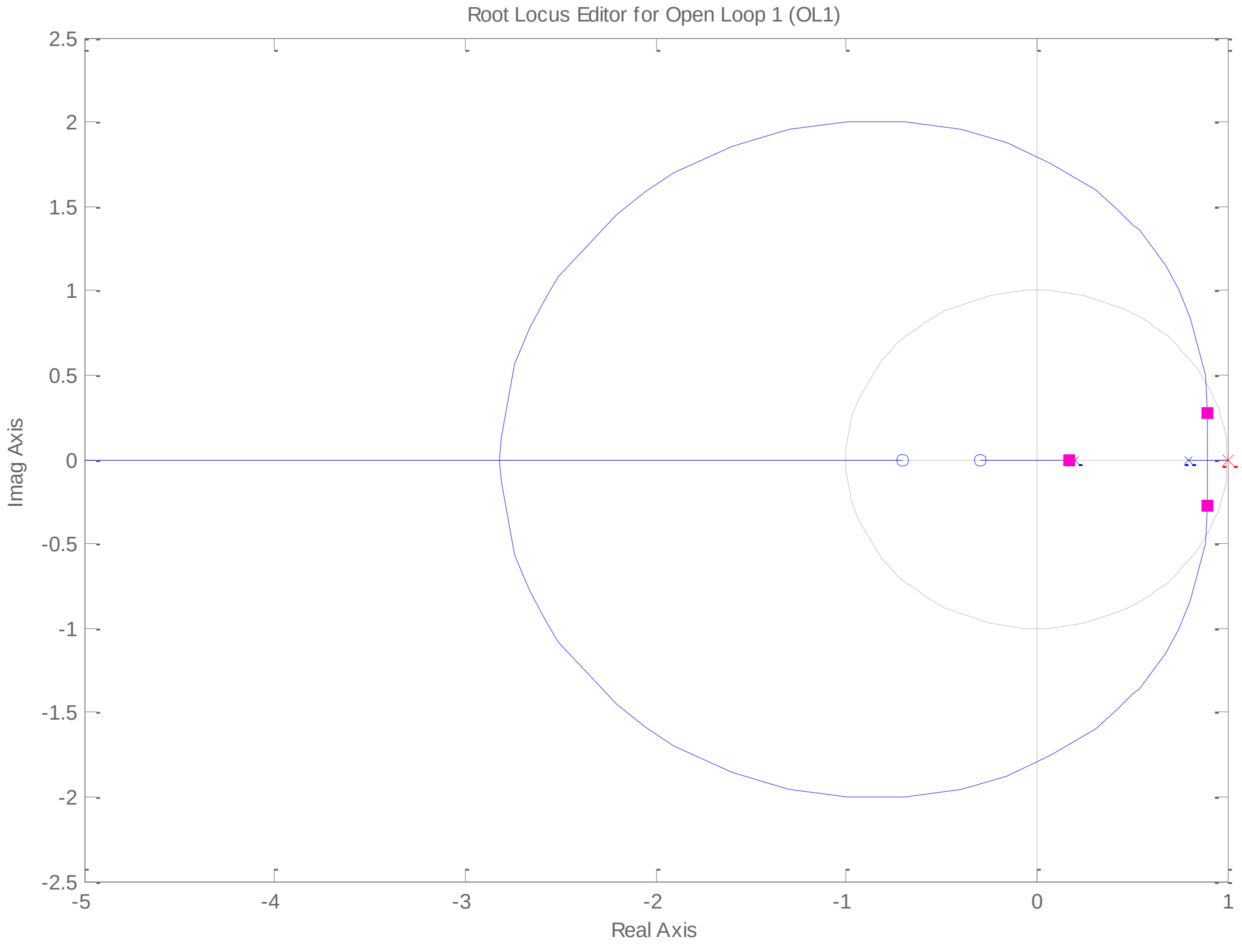
Problems 15-17 refer to the following root locus plot for a discrete-time system



15) With the closed loop pole locations shown in the figure, is the closed loop system stable?

a) yes b) no c) not enough information

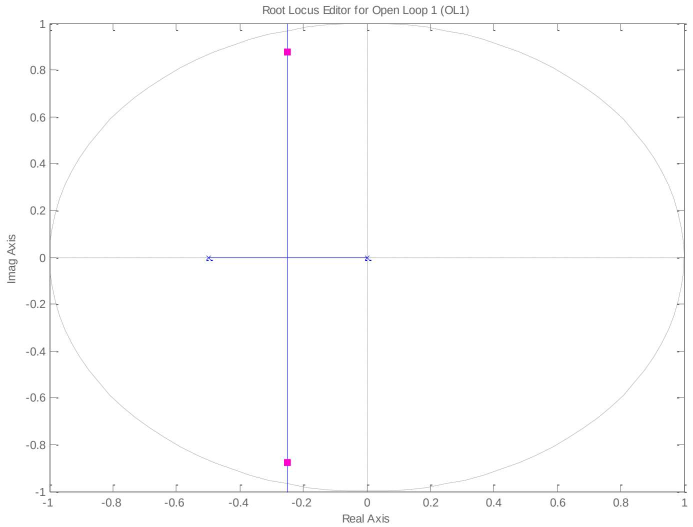
16) Is there any value of k for which the closed loop system is stable?

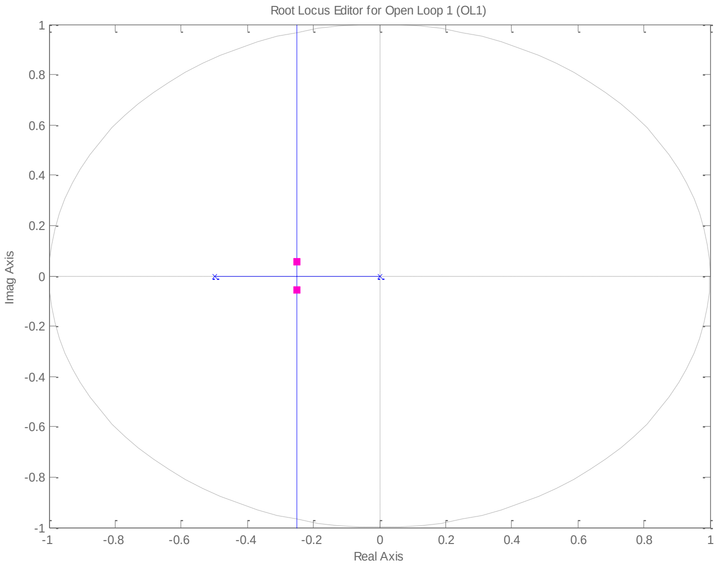
a) yes b) no c) not enough information

17) Is this a type one system?

a) yes b) no c) not enough information

Problems 18 and 19 refer to the following two root locus plot for a discrete-time system





18) For which system is the settling time likely to be smallest?

a) The system on thetop   b) the system on the bottom   c) the settling time will be the same

19) Is this a type 1 system?

a) yes   b) no   c) not enough information

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