Unit 10 - Week 8

Assignment 8

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-09-25, 23:59 IST.

1) For the system $\dot{x} = Ax + Bu$; $y = Cx$, the state feedback control input for tracking problem is given by $u = -Kx + \bar{N}r$, where r is the reference or command input and $\bar{N}$ is a constant. For step input, zero steady state tracking error will be achieved if *1 point*

- $\bar{N} = \frac{-1}{C(A-BK)^{-1}B}$
- $\bar{N} = \frac{1}{C(A-BK)^{-1}B}$
- $\bar{N} = \frac{-1}{C(A-BK)B}$
- $\bar{N} = \frac{1}{C(A-BK)B}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\bar{N} = \frac{-1}{C(A-BK)^{-1}B}$

2) In designing minimum order observer, the state vector x can be partitioned into two parts, x_a (measurable part) and x_b (un-measurable part). The partitioned state and output equations are given by *1 point*

$$\begin{bmatrix} \dot{x}_a \\ \dot{x}_b \end{bmatrix} = \begin{bmatrix} A_{aa} & A_{ab} \\ A_{ba} & A_{bb} \end{bmatrix} \begin{bmatrix} x_a \\ x_b \end{bmatrix} + \begin{bmatrix} B_a \\ B_b \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_a \\ x_b \end{bmatrix}$$

The estimated value of x_b is $\tilde{x}_b$, the estimation error is $e = x_b - \tilde{x}_b$, and K_e is the state observer gain matrix. The error equation for the minimum order observer is given by

- $\dot{e} = (A_{bb} - K_e A_{ba})\, e$
- $\dot{e} = (A_{aa} - K_e A_{bb})\, e$
- $\dot{e} = (A_{bb} - K_e A_{ab})\, e$
- $\dot{e} = (A_{ab} - K_e A_{bb})\, e$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\dot{e} = (A_{bb} - K_e A_{ab})\, e$

3) For a system with transfer function $G(s) = \frac{1}{s(s+1)}$, the state feedback control input for stabilization and tracking is given by $u = -Kx + \bar{N}r$. The closed loop poles are at $s = -1 \pm j2$. The values of K and $\bar{N}$ are calculated as *1 point*

- $K = \begin{bmatrix} 5 & 1 \end{bmatrix}, \quad \bar{N} = 1$
- $K = \begin{bmatrix} 1 & 5 \end{bmatrix}, \quad \bar{N} = 5$
- $K = \begin{bmatrix} 1 & 5 \end{bmatrix}, \quad \bar{N} = 1$
- $K = \begin{bmatrix} 5 & 1 \end{bmatrix}, \quad \bar{N} = 5$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$K = \begin{bmatrix} 5 & 1 \end{bmatrix}, \quad \bar{N} = 5$

4) A system is represented by *1 point*

$$\dot{x} = \begin{bmatrix} 2 & 0 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u \; ; \; y = \begin{bmatrix} 1 & -1 \end{bmatrix} x$$

This system is augmented by integral control law $u = -Kx - K_i x_i$, where x_i is defined by $\dot{x}_i = r - Cx$. What will be values of K and K_i so that the system closed loop poles to be at $s = -5$ and $s = -1 \pm j$?

- $K = \begin{bmatrix} 22 & 9 \end{bmatrix} \; ; \; K_i = 10$
- $K = \begin{bmatrix} 22 & 9 \end{bmatrix} \; ; \; K_i = -10$
- $K = \begin{bmatrix} 9 & 22 \end{bmatrix} \; ; \; K_i = 10$
- $K = \begin{bmatrix} 9 & 22 \end{bmatrix} \; ; \; K_i = -10$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$K = \begin{bmatrix} 9 & 22 \end{bmatrix} \; ; \; K_i = 10$

5) The closed loop state model for the state feedback compensated system with integral control is given by *1 point*

- $\begin{bmatrix} \dot{x} \\ \dot{x}_i \end{bmatrix} = \begin{bmatrix} A - BK & -BK_i \\ -C & 0 \end{bmatrix} \begin{bmatrix} x \\ x_i \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r$
- $\begin{bmatrix} \dot{x} \\ \dot{x}_i \end{bmatrix} = \begin{bmatrix} A - BK & BK_i \\ C & 0 \end{bmatrix} \begin{bmatrix} x \\ x_i \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r$
- $\begin{bmatrix} \dot{x} \\ \dot{x}_i \end{bmatrix} = \begin{bmatrix} A - BK & -BK_i \\ C & 1 \end{bmatrix} \begin{bmatrix} x \\ x_i \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r$
- $\begin{bmatrix} \dot{x} \\ \dot{x}_i \end{bmatrix} = \begin{bmatrix} A - BK & -BK_i \\ -C & 0 \end{bmatrix} \begin{bmatrix} x \\ x_i \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} r$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\begin{bmatrix} \dot{x} \\ \dot{x}_i \end{bmatrix} = \begin{bmatrix} A - BK & -BK_i \\ -C & 0 \end{bmatrix} \begin{bmatrix} x \\ x_i \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r$

6) The Ackermann's formula for controller gain matrix and observer gain matrix are respectively given by *1 point*

- $K = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_c]^{-1} \phi(A), \qquad L^T = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_o]^{-1} \phi(A^T)$
- $K = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_o]^{-1} \phi(A^T), \qquad L^T = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_c]^{-1} \phi(A)$
- $K = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_o]^{-1} \phi(A), \qquad L^T = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_c]^{-1} \phi(A^T)$
- $K = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_c]^{-1} \phi(A^T), \qquad L^T = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_o]^{-1} \phi(A)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$K = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_c]^{-1} \phi(A), \qquad L^T = \begin{bmatrix} 0 & 0 & \dots & 1 \end{bmatrix} [Q_o]^{-1} \phi(A^T)$

7) A linear system is described by the state model $\dot{x} = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u, \qquad y = \begin{bmatrix} 0 & 1 \end{bmatrix} x$. The observer gain matrix so that the observer poles are at $s = -10$ and $s = -10$ will be *1 point*

- $L = \begin{bmatrix} 20 & 120.6 \end{bmatrix}^T$
- $L = \begin{bmatrix} 120.6 & 20 \end{bmatrix}^T$
- $L = \begin{bmatrix} 1 & 20.6 \end{bmatrix}^T$
- $L = \begin{bmatrix} 20.6 & 1 \end{bmatrix}^T$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$L = \begin{bmatrix} 120.6 & 20 \end{bmatrix}^T$

8) If output of a system is noisy or system is having disturbance, then *1 point*

- Controller poles are nearer to the imaginary axis as compared to observer poles
- Observer poles are nearer to the imaginary axis as compared to controller poles
- Observer and controller poles are overlapped
- Observer and controller poles both must be on the real axis

No, the answer is incorrect.
Score: 0

Accepted Answers:
Observer poles are nearer to the imaginary axis as compared to controller poles

9) A system is represented by $\dot{x} = Ax + Bu$; $y = Cx$. For state feedback controller design, the required MATLAB command will be
(where, dp is the desired closed loop pole locations.) *1 point*

- $K = acker(A, C, dp)$
- $K = acker(A, B, dp)$
- $K = place(A, B, dp)$
- Both (b) and (c)

No, the answer is incorrect.
Score: 0

Accepted Answers:
Both (b) and (c)

10) A system is represented by $\dot{x} = Ax + Bu$; $y = Cx$. For full state observer design, the required MATLAB command will be
(where, L is the desired full state observer pole locations.) *1 point*

- $K = acker(A', C', L)'$
- $K = place(A', C', L)'$, provided that L does not have multiple poles
- $K = acker(A, C, L)$
- Both (a) and (b)

No, the answer is incorrect.
Score: 0

Accepted Answers:
Both (a) and (b)