

PROBLEM 1

Consider the following system:

$\dot{x} = Ax + Bu$
 $y = Cx + Du$

where A, B, C, D are matrices of appropriate dimensions.

Assume that the system is controllable and observable.

Design a state feedback controller $u = -Kx$ such that the closed-loop poles are at $s = -1 \pm j$ and $s = -2$.

Also design an observer $\dot{\hat{x}} = A\hat{x} + Bu + L(y - C\hat{x})$ such that the observer poles are at $s = -3 \pm j$.

Finally, design a prefilter $W(s)$ such that the closed-loop transfer function is $T(s) = \frac{1}{s+1}$.

Assume that the system is initially at rest.

Plot the step response of the closed-loop system.

Plot the state trajectories of the closed-loop system.

Plot the control signal $u(t)$ for the closed-loop system.

Plot the observer error $e(t) = x - \hat{x}$ for the closed-loop system.

Plot the prefilter $W(s)$ for the closed-loop system.

Plot the closed-loop transfer function $T(s)$ for the closed-loop system.

Plot the closed-loop characteristic polynomial for the closed-loop system.

Plot the closed-loop eigenvalues for the closed-loop system.

Plot the closed-loop eigenvectors for the closed-loop system.

Plot the closed-loop controllability matrix for the closed-loop system.

Plot the closed-loop observability matrix for the closed-loop system.

Plot the closed-loop transfer function matrix for the closed-loop system.

Plot the closed-loop state transition matrix for the closed-loop system.



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