T. E (Instru) Sem V
Choice Based

29/11/18

1/2

(3 hours)

[Total marks 80]

N.B.: (1) Question no. 1 is compulsory

(2) Write any 3 questions from remaining

(3) Figures to the right indicates full marks

1. **Attempt any four.** (20)

a. Derive transfer function of state model .Also draw the block diagram representation of state model.

b. Explain derivative and integral error compensation

c. Define "Vander Monde matrix".

d. Explain the design procedure for finding STM using Cayley Hamilton theorem.

e. Write procedure to determine Matrix "K" Using Transformation Matrix "T" for pole-placement method.

2. a. Consider the system given by (10)

$$\frac{Y(s)}{U(s)} = \frac{s+3}{s^2+3s+2}$$

Obtain state-space representations in the controllable canonical form, observable canonical form, and diagonal canonical form.

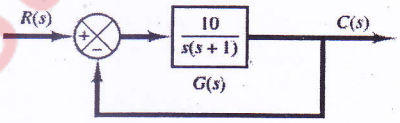
b. State necessary and sufficiency conditions for complete state controllability and observability. (10)

Find if following system is complete state controllable and complete state observable or not.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

3. a. Consider the position control system shown in Figure below. (10)



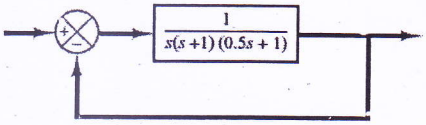
The feed-forward transfer function is $G(s) = \frac{10}{s(s+1)}$.

Design suitable compensator for desired parameters as; $\zeta = 0.5$ and $\omega_n = 3\ rad/sec$.

b. Describe Lag Compensation Techniques Based on the Frequency-Response Approach. (10)

4. a. Explain Lag–lead Compensation Techniques Based on the Root-Locus Approach. (10)

b. Consider the system shown in Figure below. (10)



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The open-loop transfer function is given by $G(s) = \frac{1}{s(s+1)(0.5s+1)}$.

It is desired to compensate the system so that the static velocity error constant Kv is 5 sec−1, the phase margin is at least 40°, and the gain margin is at least 10 dB.

5. a. Consider the system (10)

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

Where

$$A = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = [0 \quad 1]$$

Design a full-order state observer.

b. For the unity F/B system with PID Controller is used to control the system, the plant T.F. is $G(s) = \frac{1}{s(s+1)(s+5)}$. Determine PID Controller. (10)

6. a. Determine the state transition matrix for the system having : (10)

$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$.

Find the homogenous response if the initial conditions are :

$X(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.

b. Write significance of state transition matrix. What are properties of state transition matrix? (05)

c. Designing PID controller using Root-Locus, give steps. (05)

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