B.E. (Electrical Engineering (Electronics & Power)) Seventh Semester (C.B.S.)

Control System - II

P. Pages : 3 **TKN/KS/16/7546**

Time : Three Hours Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Illustrate your answer whenever necessary with help of neat sketches.

1. a) Explain with the help of flow chart the general design procedure for the compensators. **6**

b) Lead compensator is used for improving transient performance of the system. Justify. **7**

OR

2. a) Compare feedback compensation and cascade compensation. **3**

b) Derive transfer function of an electrical lead network. Determine the frequency at which maximum phase lead is obtained. Draw its BODE PLOT. **10**

3. a) The state equation of the system are given by **7**

$$\dot{x}_1 = 4x_1 + x_2 - 2x_3 + u$$
$$\dot{x}_2 = x_1 + 2x_3 + u$$
$$\dot{x}_3 = x_1 - x_2 + 3x_3$$
$$y = x_1$$

Obtain Jordan's canonical form.

b) Determine STM for matrix. **6**

$$A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$

OR

4. a) Linear Time Invariant (LTI) matrix described y **13**

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} u$$

$$y = x_1$$

Transform the state model into canonical state model & obtain the explicit solution for state vector and the output when u is a unit step function. Assume the initial state vector as $x^T(0) = [0 \quad 0 \quad 2]$.

5. a) Define controllability and observability explain: **7**

i) Kalman's test for controllability and observability.

ii) Gilbert's test for controllability and observability for diagonal and Jordan's canonical system matrix.

b) Write the state equation of system shown in Fig 5 b in which x_1, x_2 and x_3 constitute the state vector. Determine system is completely controllable and observable. **7**

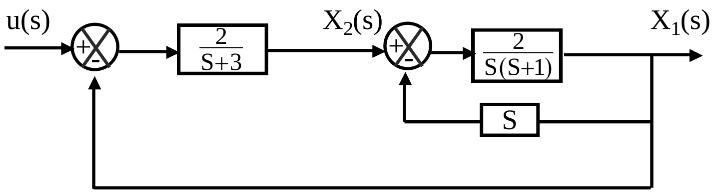

Fig 5 b

OR

6. The open loop system is describe by **14**

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

1) Comment on stability of the system.

2) Is it possible to stabilise the system by using state feedback?

3) If the answer to part 2 is yes. design state feedback controller so as to place the eigen value at -1, -2. Draw the block structure of the feedback controller.

7. a) State and prove Parseval's theorem. Give its significance. **7**

b) For a standard unity feedback system. Obtain the value of damping ratio & which minimises ISE. Also find the minimum value 8 ISE. Assume r(t) as unit step function. **6**

OR

8. Consider feedback system shown in fig. 8. The output is required to track the unit step I/P. Determine the value of α that minimises ISE & Find the minimum value of ISE. **13**

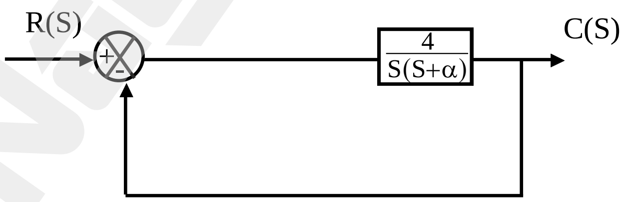

Fig 8

9. a) Explain the phenomenon of Jump resonance for soft and hard spring. **7**

b) Derive Describing function for saturation amplifier having gain K in the linear region and saturating at the I/P voltage of $\pm$ S. **6**

OR

10. a) Write down the procedure for the construction of phase trajectory using delta (δ) method. **7**

b) State and explain significance of singular point and find the singular points for the linear system described by equation. **6**

$\ddot{x} + 2\xi w_n \dot{x} + {w_n}^2 x = 0$

For w_n = 1 rad/ sec and ξ = 0.15.

11. a) State Shanon's Sampling Theorem. **2**

b) The Discrete time system is described by. **7**

$y(k+2) - 5y(k+1) + 6y(k) = u(k) \;\&\; c(k) = 2y(k)$

Assume $y(o) = 0;\; y(1) = 1, u(k) = 1$ for $k \geq 0$

$= 0$ for $k < 0$

Find output c(k) and the sequence generated.

c) Discuss various methods used for stability analysis of sampled data control system. **5**

OR

12. a) Determine the value of K such that the sampled data system shown in fig. 12.a is stable. **7**

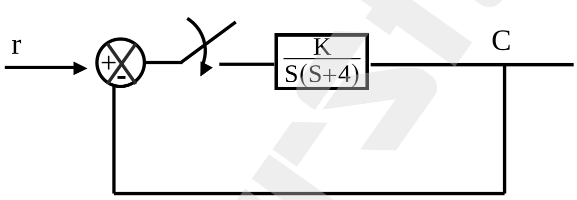

Fig 12.a.

b) A sample data system is characterized by following equations. Comment on the stability of system. **7**

i) $z^3 - 0.5z^2 + 2.49z - 0.496 = 0$

ii) $2z^4 + 7z^3 + 10z^2 + 4z + 1 = 0$

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