B.E. Seventh Semester (Electrical Engineering) (C.B.S.)

# Control System - II

P. Pages : 3 **NKT/KS/17/7459**

Time : Three Hours Max. Marks : 80

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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 answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

**1.** a) Derive the T. F. of passive RC phase lag-lead network shown in Fig. 1(a). **6**

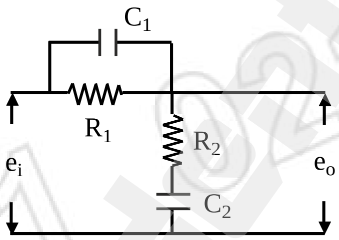


Fig. 1(a)

b) What is the compensation? Discuss the series & parallel compensation. **7**

**OR**

**2.** a) Compare & justify the selection of lag & lead compensator for following: **6**

i) Speed of response. ii) Signal to noise ratio at the o/p,

iii) Relative stability

b) Discuss in short the effect of adding poles and zeros to the open loop transfer function of the system. **7**

**3.** a) What is the STM? State & prove the properties of STM. **6**

b) Given T. F. of the system is $\frac{Y(s)}{U(s)} = \frac{as^2 + bs + c}{s^3 + ds^2 + es + f}$ from the state space model. **7**

**OR**

**4.** a) The state space model of a system is described by the following $eq^n s$: **7**

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

Is it possible to diagonalise the given state space model? If so obtain the canonical state space model. Also comment on stability of the system.

b) Consider the system **6**

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

Find state transition matrix (STM)

**5.** a) For the system shown in 'Fig 5 (a) comment on controllability, observability & stability of the system. **8**

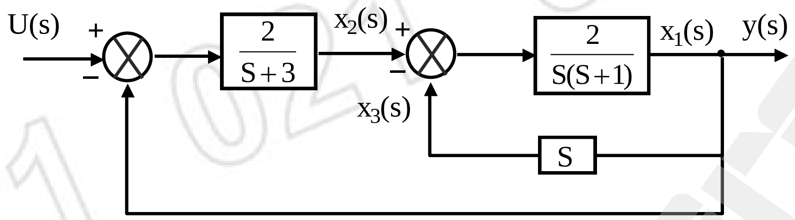


Fig. 5 (a)

b) Define controllability and observability & Explain Kalman's test for controllability & observability. **6**

**OR**

**6.** System is described by the equation **14**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 1 \quad 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

obtain the state variable feedback u = [K] x so that closed loop system exhibits an under-damped response with $r = 0.8,\ t_s = 4\sec$ & smallest time constant of a system is 0.1sec.

**7.** a) State the Parseval's theorem also its significance & limitation. **6**

b) For unity feedback 2nd order system shown in Fig. 7 (b) compute the value of damping ratio which minimizes ISE. Also calculate the min. value of ISE. Assume the i/P to be unit step i/p. **7**

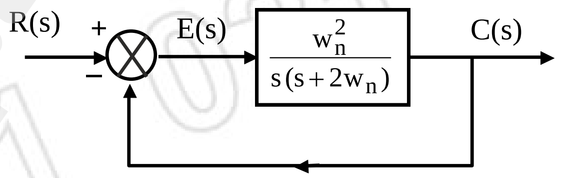


Fig. 7(b)

**OR**

**8.** a) For a unity feedback control system with $G(s) = \frac{K}{S}$, Compute the value of 'K' such that the following P.I. $(J) = \int_0^\infty \left[e^2 + \lambda(\ddot{e})^2\right] dt$ [where λ is the constant] is minimized. Also find the min. value of 'J'. Assume unit step i/p. **9**

b) What is performance Index & Write down the different types of performance Index. **4**

**9.** a) Compare the describing function & phase plane method for analysis of non-linear control system. **5**

b) Compare Delta &Isocline method for constructing phase trajectories. **9**

**OR**

**10.** A voltage amplifier has a linear gain 'K' units until the voltage is equal to or less than $V_{sat}$ when complete saturation occurs. Show that the describing function of this amplifier is **14**

$K_N(x,w) = \frac{2K}{\pi}\left[\phi + \frac{V_{sat}}{V_{man}}\cos\phi\right]$ $V_{man}$ is the man. value of i/p signal &

$\phi = \sin^{-1}\left[\frac{V_{sat}}{V_{man}}\right]$. Refer fig 10.

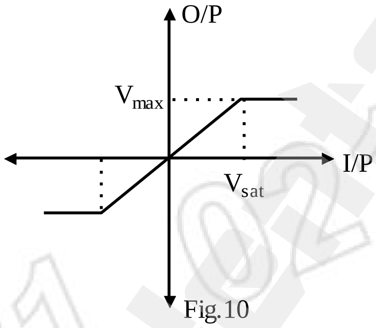


Fig.10

**11.** a) Discuss various methods used for stability analysis of sample data control system. **7**

b) State & explain Shannon's sampling theorem with its significance. **6**

**OR**

**12.** a) Sample data central system is described by the following equation **6**

$y(k+2) - 5y(k+1) + 6y(k) = u(k)$

given y (0) = 0 ; y (1) = 1

u(k) = 1 for k > 0

= 0 for k < 0

T = l sec.

Find y(k) thereby find y(0), y(1)

b) Determine pulse transfer function & stability of sample data control system shown in fig. 12 (b) **7**

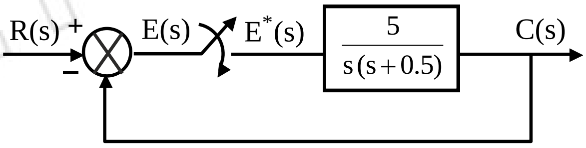


Fig. 12(b)

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