B.E. Electrical (Electronics & Power) Engineering Seven Semester

EE / EP704 - Control Systems-II

P. Pages : 3 **GUG/W/18/1776**

Time : Three Hours Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of non-programmable calculator is permitted.

1. a) Derive the transfer function of a passive RC lead network Fig: 1 (a) **8**

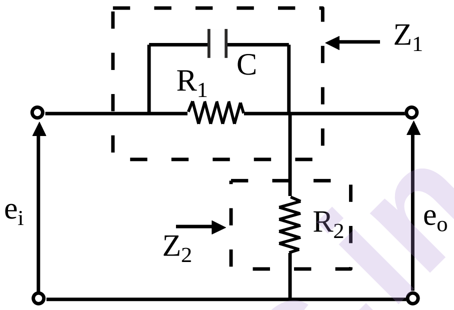


Fig. 1 (a)

b) Derive the T.F of Lag compensator and Expression for maximum value of phase Lag. **8**

OR

2. Derive the T.F of lag-lead compensator and Draw its Bode Plot. State condition when Lag-lead compensator are used. **16**

3. a) What is state transition matrix (STM)? Also describe the properties and the computation of the same. **8**

b) Comment whether the given matrix can reduce to its canonical form i.e. (diagonal) If not, obtain Jordon's canonical form. **8**

$$A = \begin{bmatrix} 4 & 1 & -2 \\ 1 & 0 & 2 \\ 1 & -1 & 3 \end{bmatrix}$$

OR

4. a) Obtain the transfer function of the system defined by the following state space equation. **8**

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

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

b) Derive the expression for the solution of non-homogenous state equation. **8**

5. a) For the system given by state model. **8**

$$\dot{x} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & 3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} u$$

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

Comment on controllability & observability by using Kalman's test.

b) For the system shown in Fig. 5 b) Investigate controllability and observability & stability of the system. **8**

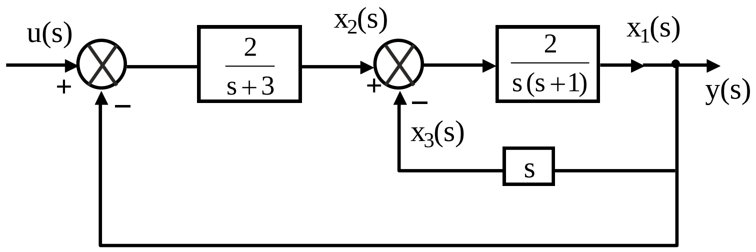


Fig. 5 (b)

OR

6. a) Explain Gilberts & Kalman's test for controllability & observability. **8**

b) **8**

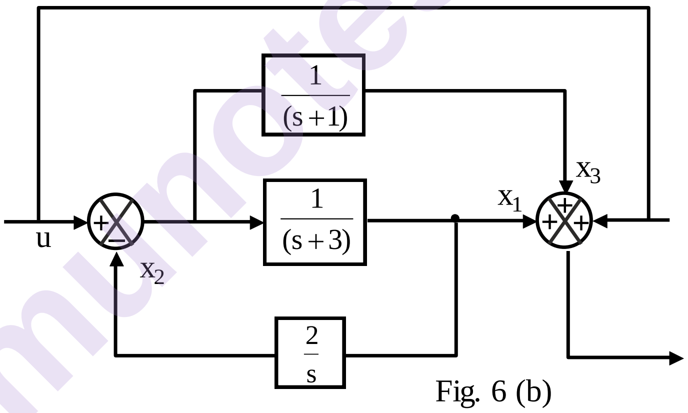


Fig. 6 (b)

Investigate the controllability and observability of the above shown system Fig. 6 b).

7. a) Explain how describing function method can be used for the stability analysis of non-Linear system. **8**

b) Define and explain the following stabilities in reference to phase-plane analysis of non-Linear system. **8**

i) Stable System
ii) Asymptotically stable system
iii) Globally Asymptotically stable system.

OR

8. a) Construct the phase trajectory using $\delta -$ method for a system described by **8**

$$3\ddot{x} + 12|\dot{x}|\dot{x} + 12x = 0$$

Given: $x(0) = 1; \dot{x}(0) = 0$.

b) Obtain the location and the type of the singular point for the system. **8**

$\ddot{x} + 0.5\dot{x} + 2x + x^2 = 0.$

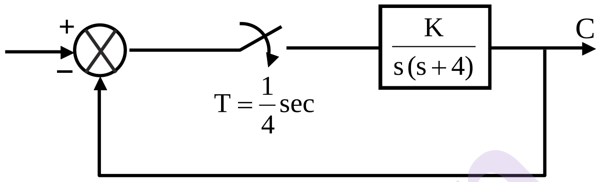
9. a) Discuss various methods used for stability analysis of SDCS. **8**

b) Find the inverse Z-transform of the following. **8**

a) $\dfrac{3z^2 + 2z + 1}{\left(z^2 + 3z + 2\right)}$ b) $\dfrac{1 - e^{-aT}}{(z-1)\left(z - e^{-aT}\right)}$

OR

10. a) Determine the value of K such that given SDS be stable. **8**



b) For the system shown in Fig. 10 b). Investigate Stability of the system for - **8**

i) T = 0 Sec ii) T = 1 Sec

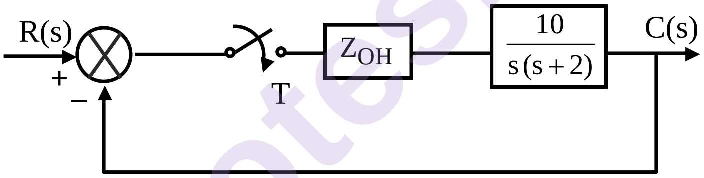


Fig. 10 (b)

Show the root distribution with respect to unit circle for T = 1 sec and comment on the nature of response.

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