Section C

5. (a) Write short notes on the following : **6**

(i) Resonant peak

(ii) Resonant frequency

(b) For a standard 2^{nd} order system, determine the frequency response of the closed loop system and obtain the expressions for the resonant peak, resonant frequency and the bandwidth. **19**

6. (a) Briefly explain the following : **8**

(i) What are discrete time control systems and their significance ? How can a continuous time system be converted to a discrete time system ?

(ii) Nyquist stability criterion and how is it used to estimate the stability of a system.

(b) Sketch the Bode plot for the given system :

$$G(j\omega) = \frac{10(j\omega + 3)}{j\omega(j\omega)\left[(j\omega)^2 + j\omega + 2\right]}.$$ **17**

Roll No. .... **Total Pages : 06**

MAR-21-210201

B. Tech. EXAMINATION, March 2021

Semester VI (NS)

CONTROL SYSTEM

EC-322

Time : 2 Hours *Maximum Marks :* 100

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

Note : Attempt *Four* questions in all, selecting *one* question from each Sections A, B, C and D. All questions carry equal marks.

Section A

1. (a) Define the term 'Transfer function'. What are its characteristics ? **8**

(b) Find the transfer function $\frac{V_C(s)}{V(s)}$, for the circuit shown in Fig. 1. **17**

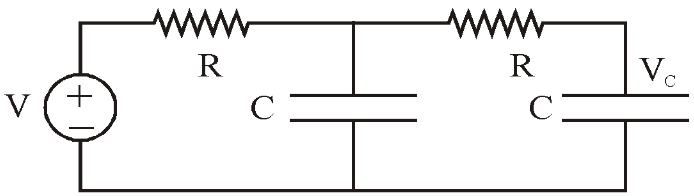

Fig.1

2. (a) What are signal flow graphs ? What is Mason's gain formula and how can it be used to obtain the equivalent transfer function of a complex system ? **8**

(b) Consider the state and output equations of a system. Construct the signal flow graph and by using Mason's gain formula, determine the transfer function of the system.

$$x'_1 = 2x_1 - 5x_2 + 3x_3 + 2r$$

$$x'_2 = -6x_1 - 2x_2 + 3x_3 + 4r$$

$$x'_3 = x_1 - 3x_2 - 4x_3 + 8r$$

$$y = -4x_1 + 6x_2 + 9x_3.$$ **17**

Section B

3. (a) Write short notes on the following : **10**

(i) Routh Hurwitz Criterion

(ii) Gain and Phase Margins

(iii) Type and Order of a System.

(b) The open loop transfer function of the plant is given as $G(s) = \frac{25}{s(s+5)}$ and H (s) = 1. Find the natural frequency (ω_n), damping ratio (ζ), damped frequency (ω_d), rise time (t_r), settling time (t_s) and percentage overshoot (M_p%). **15**

4. (a) Write short notes on the following : **10**

(i) Lead-Lag compensator

(ii) Rise time of 2^{nd} order systems

(iii) Damping Ratio

(iv) BIBO stability criterion.

(b) Determine the number of right-half-plane poles in the closed-loop transfer function :

$$T(s) = \frac{10}{s^5 + 7s^4 + 6s^3 + 42s^2 + 8s + 56}.$$ **15**

9. Write short notes on the following : **10×2.5=25**

(i) Open loop and closed loop systems

(ii) Importance of negative feedback in control systems

(iii) Steady state error

(iv) Transient and Steady State Response

(v) States of a system

(vi) Root locus plots

(vii) Natural and damping frequency

(viii) F-V analogous transfer function for series RLC circuit

(ix) Mason's gain formula

(x) PID controllers.

Section D

7. (a) What is state space representation of a linear continuous time system ? Discuss the three different methods for obtaining the state space model of a liner continuous time system. **10**

(b) Obtain the state space representation in the controller canonical form for the following transfer function :

$$G(s) = \frac{2s+1}{(s+4)(s+7)}. \qquad \textbf{15}$$

8. (a) Write short notes on the significance of the following : **7**

(i) Expositional and internal stability in control systems

(ii) State transition matrix.

(b) Determine the controllability and observability of the following system :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ -6 & -6 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}. \qquad \textbf{18}$$