Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20415

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018

Fourth Semester

Electronics and Communication Engineering

EC 6405 — CONTROL SYSTEM ENGINEERING

(Common to : Medical Electronics/Mechatronics Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Polar graph, Semi log-sheet and Graph sheets are permitted)

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Compare open and closed loop in control systems.

2. What is a signal flow graph?

3. Name the standard test signals in time domain analysis.

4. Determine type and order of the following system $G(s)H(s) = K/[S(S+1)(S^2+6s+8)]$.

5. Write expression for Resonant Peak and Resonant Frequency.

6. What are constant M and N circles?

7. State the necessary condition for stability.

8. What is dominant pole?

9. Define State and state variable of a model system.

10. State Sampling theorem.

PART B — (5 × 13 = 65 marks)

11. (a) Write the differential equations governing the mechanical translational system shown in Figure 1 and determine the transfer function. (13)

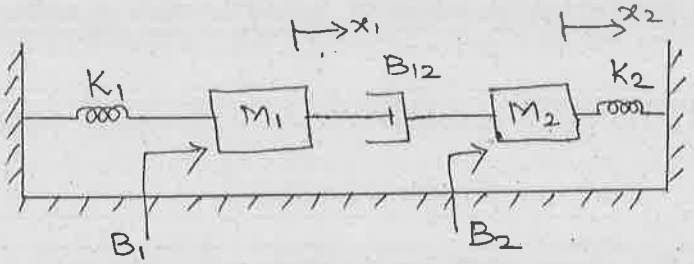

Figure 1

Or

(b) Using block diagram reduction technique, Find the closed loop transfer function for the system shown in Figure 2. (13)

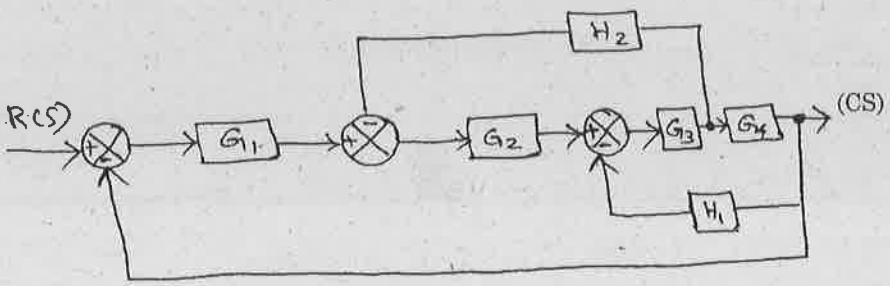

Figure 2

12. (a) Draw the block diagram of second order system. Classify it. Derive the time response of any one of the damped systems for unit step input. (13)

Or

(b) (i) Derive the type of input signal give rise to a steady state error and calculate their values of a servomechanism whose open loop transfer function given below

(1) $G(s)=10/\left[s^2(s+1)(s+2)\right]$ (3)

(2) $G(s)=10/[(s+2)(s+3)]$ (3)

(ii) Derive the effect of PD compensation in the time response of a system. (7)

13. (a) The open loop transfer function of a unity feedback system is given by $G(s)=1/\left[s^2(1+s)(1+2s)\right]$. Sketch the Polar plot and determine the gain and phase margin. (13)

Or

(b) Write down the procedure for designing Lag-Lead compensator using Bode plot. (13)

14. (a) (i) Construct R-H array and determine the stability of a system representing the characteristic equation $9S^5 - 20S^4 + 10S^3 - S^2 - 9S - 10 = 0$ and comment on location of the roots of the characteristics equation. (7)

(ii) Write short notes on relative stability. (6)

Or

(b) The open loop transfer function of a unity feedback control system is $G(s) = K(s+9)/[s(s^2 + 4s + 11)]$. Sketch the root locus of the system. (13)

15. (a) (i) Derive the state model of an n^{th} order linear system. (6)

(ii) Write detailed notes Sampler and hold circuits. (7)

Or

(b) Test the Controllability and Observability of the system by any one method whose state space representation is given as, (13)

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + O[u].$$

PART C — (1 × 15 = 15 marks)

16. (a) Convert the block diagram shown in Figure 3 to signal flow graph and find the transfer function using Mason's gain formula. (15)

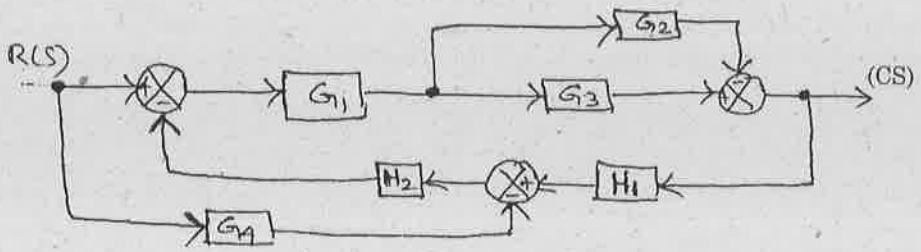

Figure 3

Or

(b) Sketch the Bode plot for the following transfer function. Also determine the gain and phase cross over frequencies. (15)

$G(s) = 10/s[s(1 + 0.4s)(1 + 0.1s)]$.

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