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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)

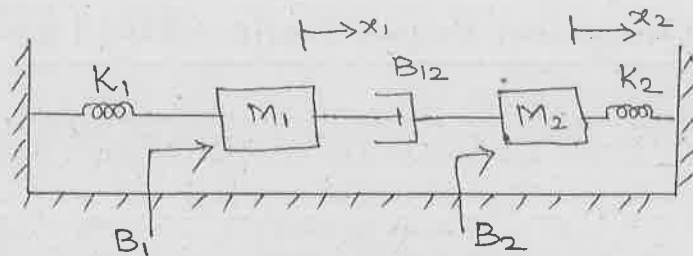


Figure 1

Or

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

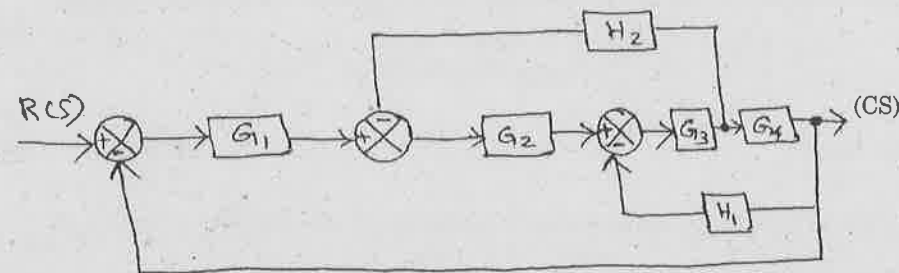


Figure 2

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) $G(s) = 10 / [s^2(s+1)(s+2)]$ (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 $G(s) = 1 / [s^2(1+s)(1+2s)]$. 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)

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

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

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)

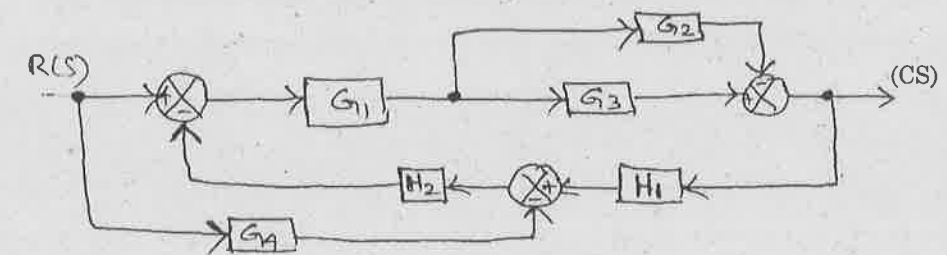


Figure 3

Or

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

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