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

Question Paper Code : 80340

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Fourth Semester

Electronics and Communication Engineering

EC 6405 — CONTROL SYSTEM ENGINEERING

(Common to Mechatronics Engineering and Medical Electronics Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Provide Semilog sheet, Polar graph and ordinary graph sheet)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is a control system?

2. List the basic elements of translational mechanical systems.

3. Specify the time domain specifications.

4. What is meant by steady state error?

5. State the significance of Nichol's plot.

6. What is series compensation?

7. Define BIBO stability.

8. What is dominant pole?

9. List the main properties of a state transition matrix.

10. State sampling theorem.

PART B — (5 × 16 = 80 marks)

11. (a) Write the differential equations governing the mechanical rotational system shown in figure 11.(a). Draw the Electrical equivalent analogy circuits (current and voltage). (16)

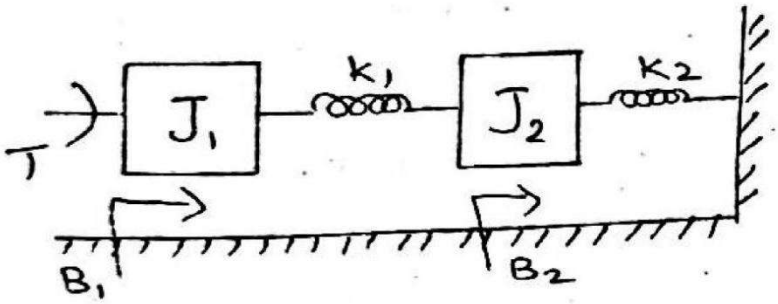

Figure 11.(a)

Or

(b) (i) Reduce the block diagram shown in figure 11(b) (i) and find C/R. (12)

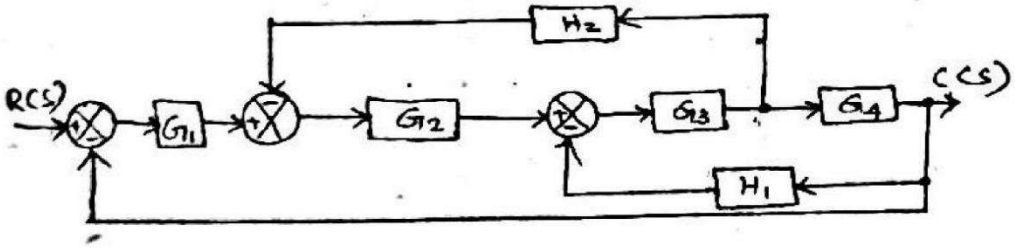

Figure 11(b) (i)

(ii) Compare open loop and closed loop control system. (4)

12. (a) Derive the time domain specifications of a second order system subjected to a step input. (16)

Or

(b) (i) For a unity feedback control system, the open loop transfer Function is $G(s) = [10(s+2)]/[s^2(s+1)]$, find (12)

(1) the position, velocity, acceleration error constants.

(2) the steady state error when $R(s) = (3/s) - (2/s^2) + (1/3s^3)$.

(ii) State the effect of PI & PD compensation on the system performance. (4)

13. (a) The open loop transfer function of a unity feedback system is given by $G(s) = 1/[s(1+s)^2]$. Sketch the polar plot and determine the gain and phase margin. (16)

Or

(b) (i) Write down the procedure for designing Lag compensator using Bode plot. (12)

(ii) State about Parallel feedback compensation. (4)

14. (a) (i) State Nyquist stability criterion and explain the three situations while examining the stability of the linear control system. (8)

(ii) Construct R-H criterion and determine the stability of a system representing the characteristic equation

$S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$. Comment on location of the roots of the characteristics equation. (8)

Or

(b) With neat steps write down the procedure for construction of root locus. Each rule give an example. (16)

15. (a) A discrete time system is described by the difference equation $y(k+2) + 5y(k+1) + 6(yk) = u(k)$

$Y(0) = y(1) = 0$ and $T = 1$ sec, Determine

(i) State model in canonical form

(ii) State transition matrix. (16)

Or

(b) (i) Check the controllability of the system by Kalman's test whose state model is given as,

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & +2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} u;\ y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}. \quad (8)$$

(ii) Write detailed notes on Sampler and hold circuits. (8)

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Question Paper Code : 71732

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017

Fourth Semester

Electronics and Communication Engineering

EC 6405 — CONTROL SYSTEM ENGINEERING

(Common to Mechatronics Engineering and Medical Electronics Engineering)

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Masons gain formula.

2. Differentiate closed loop and open loop control system.

3. Define steady state error.

4. Draw the transfer function model for PID control.

5. What is meant by gain margin?

6. What is the necessity of compensators?

7. What are the advantages of Routh Hurwitz stability criterion?

8. Define Nyquist stability criterion.

9. List some advantages of sampled data control systems.

10. State sampling theorem.

PART B — (5 × 13 = 65 marks)

11. (a) Draw the equivalent electrical analogous circuit for the mechanical system shown below force-voltage analogy.

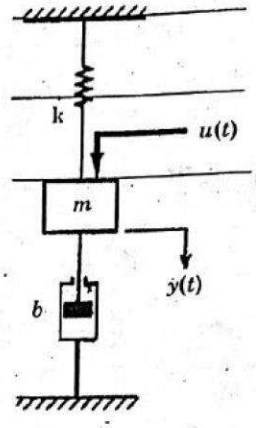


Fig. Q. 11 (a)

Or

(b) Simplify the following diagram using block diagram reduction method. Also derive the transfer function of the same using signal flow graph.

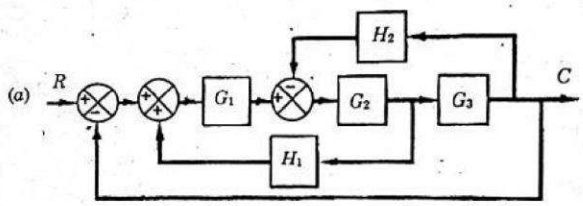


Fig. Q. 11 (b)

12. (a) The unity feedback system is characterized by an open loop transfer function $G(s) = K/s(s+10)$. Determine the gain K, so that the system will have a damping ratio of 0.5 for this value of K. Determine settling time, peak over shoot and peak time for a unit step input.

Or

(b) Explain about briefly the operation of P, PI and PID control compensation using simple MATLAB programs.

13. (a) Plot the polar plot for the following transfer function $G(S) = \dfrac{15}{(s+1)(s+3)(s+6)}$.

Or

(b) Discuss briefly about the lag, lead and lag-lead compensator with examples.

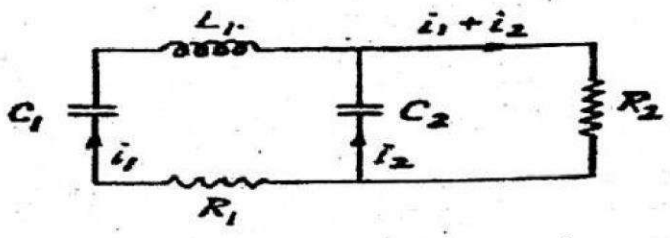
14. (a) Determine the range of K for stability of unity feedback system using Routh stability criterion whose transfer function

$$\frac{C(s)}{R(s)} = \frac{K}{s(s^2+s+1)(s+2)+K}$$

Or

(b) Explain briefly about the steps to be followed to construct a root locus plot of a given transfer function.

15. (a) Construct the state model of the following electrical system.



Or

(b) A system is characterized by transfer function $\frac{Y(s)}{U(s)} = \frac{2}{s^3+6s^2+11s+6}$.

Find the state and output equation in matrix form and also test the controllability and observability of the system.

PART C — (1 × 15 = 15 marks)

16. (a) For a system represented by state equation $X(t) = AX(t)$. The response is $X(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ and $X(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$.

Determine the system matrix A and the state transition matrix.

Or

(b) Draw the root locus diagram for a system open loop transfer function and then determine the value of k such that the damping ratio of the dominant closed loop poles is 0.4.

Open-loop transfer function $= \frac{20}{s(s+1)(s+4)+20ks}$