Reg. No. : E N G G T R E E . C O M

Question Paper Code : 30137

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third Semester

Electronics and Communication Engineering

EC 3351 – CONTROL SYSTEMS

(Common to : Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the transfer function of the network as shown in Fig. 1.

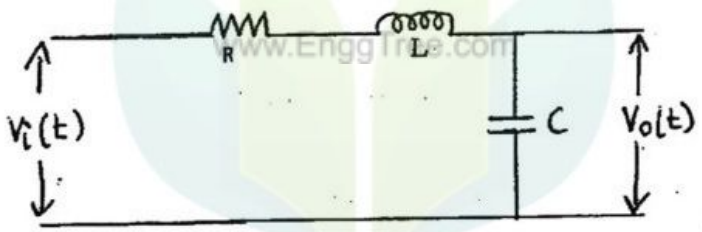

Fig. 1

2. List the components of feedback control system.
3. Recall the importance of PD control? State the effect of a PD controller on the system performance.
4. Find the order of the closed-loop transfer functions for the systems given by
   (a) $C(s)/R(s) = 10[1 + 2s + s^2]/[1 + 3s + s^2 + s^3]$.
   (b) $C(s)/R(s) = 6[1 + 2s]/[1 + 4s]$.
5. List the disadvantages of frequency response analysis.
6. List the effects of dominant poles.
7. State the angle and magnitude criterion for root locus.
8. Define Gain margin.
9. Mention the different canonical forms.
10. List the advantages of state-variable analysis.

PART B — (5 × 13 = 65 marks)

11. (a) (i) For the block diagram of the system shown in Figure 11.(a) (i), Apply block diagram reduction technique, determine the closed-loop transfer function. (6)

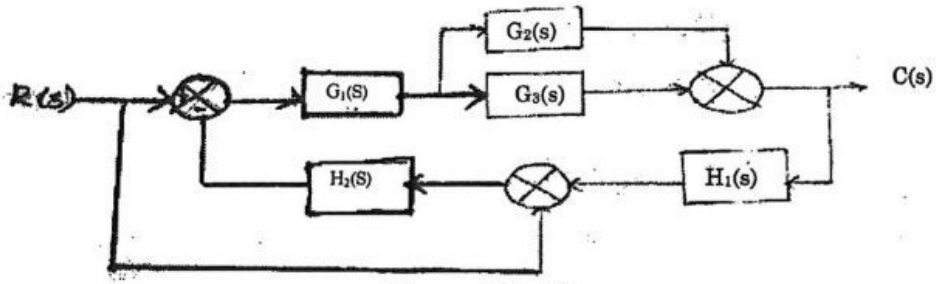

Figure. 11(a)(i)

(ii) Evaluate the transfer function of the electrical network shown in Figure 11.(a)(ii) (7)

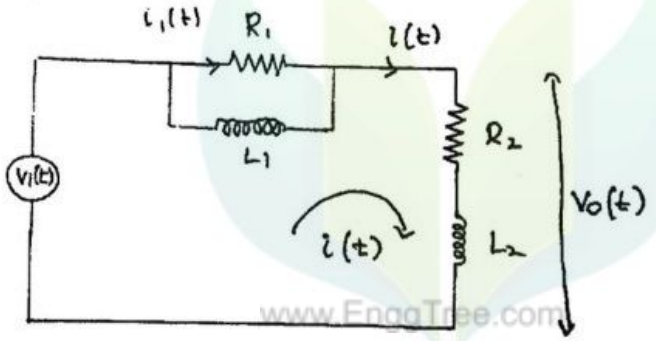

Figure. 11(a)(ii)

Or

(b) For the mechanical translational system shown in Figure 11(b) : Determine

(i) differential equations

(ii) F-V analogous circuit

(iii) F-I analogous circuit

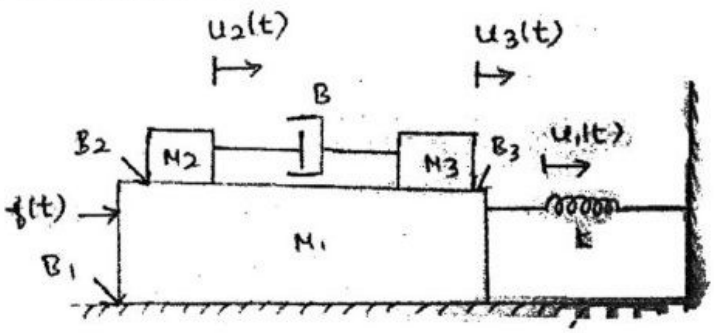

Figure. 11(b)

12. (a) (i) The unity feedback system is characterized by an open loop transfer function, $G(s)=\frac{K}{s(s+10)}$. Determine 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 time to peak overshoot for a unit step input. (6)

(ii) When a unit-step signal is applied, the time response of the second order system is $c(t)=1+0.2e^{-60t}-1.2^{-10t}$. Determine

(1) the closed loop transfer function of the system

(2) undamped natural frequency. ω_n and

(3) damping ratio of the system. (7)

Or

(b) A unity feedback control system has an open loop transfer function $G(s)=10/(s(s+2))$. Find the rise time percentage overshoot, peak time and settling time for a step input of 12 units.

13. (a) The loop transfer function of a system is given by $G(s)H(s)=(Ks^2)/(1+0.2s)(1+0.02s)$. Sketch the bode plot for the given system.

Or

(b) Sketch the polar plot of the function: $G(s)H(s)=(s+2)/[s^2(s+2)(2s+1)]$.

14. (a) The unity feedback control system has an open loop transfer function : $G(s)H(s)=K/[s(s+4)(s^2+4s+20)]$. Sketch the root locus.

Or

(b) (i) Examine the stability of the system using Routh's criterion for the characteristic equation of a system given by $s^5+2s^4+3s^3+6s^2+10s+15=0$. (6)

(ii) Determine the stability of the following system using Routh's criterion: $G(s)H(s)=1/(s+2)(s+4)$. (7)

15. (a) A system is given by the state equation $x(t)+\begin{bmatrix}0 & 1\\ 0 & 0\\ 2 & 1\end{bmatrix} u(t)$ and output equation $y(t)=\begin{bmatrix}0 & 0 & 1\\ 1 & 1 & 0\end{bmatrix}$. Justify. whether the system is controllable.

Or

(b) Determine the state space model for the electrical system shown in the Figure. 15 (b).

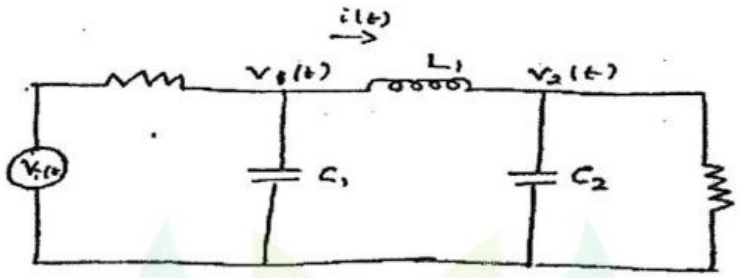

Figure. 15(b)

PART C — (1 × 15 = 15 marks)

16. (a) The transfer function of the system is given by $T(s)=\dfrac{s^2+3s+3}{s^3+2s^2+3s+1}$. Draw the Signal Flow Graph for the given transfer function.

Or

(b) Determine the state representation of a continuous-time LTI system with system function $G(s)=\dfrac{3s+7}{(s+1)(s+2)(s+5)}$.

ECE

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

Question Paper Code : 30137

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third Semester

Electronics and Communication Engineering

EC 3351 – CONTROL SYSTEMS

(Common to : Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the transfer function of the network as shown in Fig. 1.

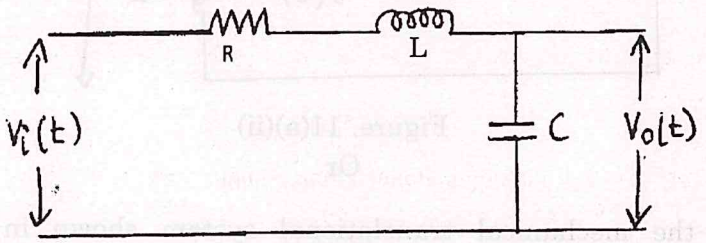

Fig. 1

2. List the components of feedback control system.
3. Recall the importance of PD control? State the effect of a PD controller on the system performance.
4. Find the order of the closed-loop transfer functions for the systems given by
   (a) $C(s)/R(s) = 10[1 + 2s + s^2]/[1 + 3s + s^2 + s^3]$.
   (b) $C(s)/R(s) = 6[1 + 2s]/[1 + 4s]$.
5. List the disadvantages of frequency response analysis.
6. List the effects of dominant poles.
7. State the angle and magnitude criterion for root locus.
8. Define Gain margin.
9. Mention the different canonical forms.
10. List the advantages of state-variable analysis.

12. (a) (i) The unity feedback system is characterized by an open loop transfer function, $G(s)=\frac{K}{s(s+10)}$. Determine 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 time to peak overshoot for a unit step input. (6)

(ii) When a unit-step signal is applied, the time response of the second order system is $c(t)=1+0.2e^{-60t}-1.2^{-10t}$. Determine

(1) the closed loop transfer function of the system

(2) undamped natural frequency. ω_n and

(3) damping ratio of the system. (7)

Or

(b) A unity feedback control system has an open loop transfer function $G(s)=10/(s(s+2))$. Find the rise time percentage overshoot, peak time and settling time for a step input of 12 units.

13. (a) The loop transfer function of a system is given by $G(s)H(s)=(Ks^2)/(1+0.2s)(1+0.02s)$. Sketch the bode plot for the given system.

Or

(b) Sketch the polar plot of the function: $G(s)H(s)=(s+2)/[s^2(s+2)(2s+1)]$.

14. (a) The unity feedback control system has an open loop transfer function : $G(s)H(s)=K/[s(s+4)(s^2+4s+20)]$. Sketch the root locus.

Or

(b) (i) Examine the stability of the system using Routh's criterion for the characteristic equation of a system given by $s^5+2s^4+3s^3+6s^2+10s+15=0$. (6)

(ii) Determine the stability of the following system using Routh's criterion: $G(s)H(s)=1/(s+2)(s+4)$. (7)

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Question Paper Code : 20924

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Third Semester

Electronics and Communication Engineering

EC 3351 – CONTROL SYSTEMS

(Common to Electronics and Telecommunication Engineering)

(Use of Semi-log graph and Polar graph and Normal graph sheet is permitted)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

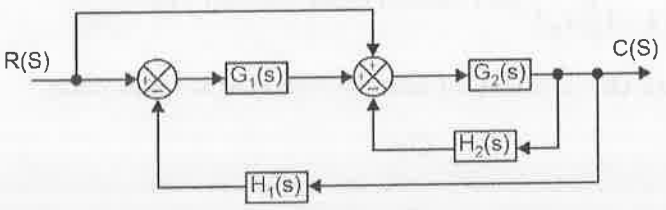
1. Define transfer function of a system.
2. Write Masons Gain formula.
3. What is the significance of integral mode in a PID controller?
4. List the time domain specifications of second order system.
5. Define Gain Margin.
6. When lag-lead compensator is required?
7. Define BIBO stability.
8. State Routh-Hurwitz criterion for stability.
9. What is state variable?
10. Define Controllability and Observability.

PART B — (5 × 13 = 65 marks)

11. (a) Derive the transfer function of armature controlled DC servo motor system. (13)

Or

(b) Using block diagram reduction technique, obtain the closed loop transfer function for the following system. (13)



12. (a) (i) The open loop transfer function of the mechanical system is given by $G(s)=\frac{10(s+2)}{s(s+1)(s+3)}$. Find the type of input signal that will provide rise to a constant steady state error and calculate its values. (7)

(ii) Discuss about PI controller with suitable electronic circuit and derive its transfer function. (6)

Or

(b) The open loop transfer function of a unity feedback system is given by $G(s)=\frac{25}{s(s+5)}$. Obtain the rise time, peak time and settling time when the system is subjected to unit step input. (13)

13. (a) The open loop transfer function of the system, $G(s)=\frac{1}{s(4s+1)(0.5s+1)}$. Sketch the polar plot and obtain the value of gain margin and phase margin. (13)

Or

(b) Derive the frequency domain specifications of second order system. (13)

14. (a) (i) The open loop transfer function of feedback control system is given by $G(s)=\frac{K}{(s^2+6s+25)(s^2+6s+8)}$. Using Routh criterion, determine the range of K and frequency of oscillation of the system. (8)

(ii) Discuss in detail about relative stability in control systems. (5)

Or

(b) Sketch the root locus plot for the unity feedback system whose open loop transfer function is given by $G(s)=\frac{K}{s(s^2+6s+1)}$. (13)

15. (a) (i) Determine the canonical state model of the system whose transfer function given as $\frac{Y(s)}{U(s)}=\frac{2s+10}{(s+2)(s+3)(s+4)}$. (7)

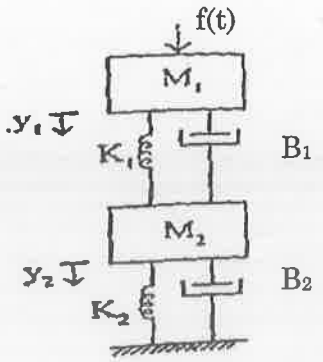
(ii) A linear time invariant system is described by the following state model. (6)

$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$ and Initial state vector, $X_0=\begin{bmatrix}1\\ 0\end{bmatrix}$

Compute the solution of homogeneous state equation.

Or

(b) Construct the state model of the give mechanical system. (13)



PART C — (1 × 15 = 15 marks)

16. (a) (i) Derive the solutions of Homogeneous state equations. (9)

(ii) Determine the state controllability of the following system. (6)

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

Or

(b) A unity feedback system has an open loop transfer function, $G(s)=\frac{K}{s(s+1)}$. Design a suitable phase lead compensator to satisfy the following specifications.

(i) The phase margin of the system is $\geq 45^\circ$

(ii) Steady state error for a unit input $\leq 1/15$

(iii) The gain crossover frequency of the system must be less than 7 rad/sec. (15)

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

Question Paper Code : 50957

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third Semester

Electronics and Communication Engineering

EC 3351 — CONTROL SYSTEMS

(Common to Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the properties of signal flow graph?

2. List the basic components of block diagram.

3. Define peak over shoot.

4. A unity feedback system has an open loop transfer function of $G(s)=\frac{12}{(s+1)(s+6)}$. Determine the steady state error for unit step input.

5. Define phase margin.

6. List the advantages of bode plot.

7. Define Relative stability.

8. What is centroid of root locus? How the centroid is computed?

9. What are the characteristics of lead compensation? when is the lead compensation employed?

10. Draw the frequency plot of lag compensator.

PART B — (5 × 13 = 65 marks)

11. (a) Determine the transfer functions $X_1(s)/F(s)$ and $X_2(s)/F(s)$ for system shown in figure 1.

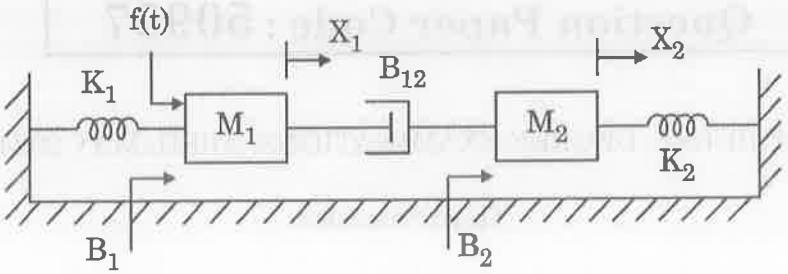

Fig. 1

Or

(b) (i) Derive an expression for the transfer function of armature controlled DC motor system with necessary diagram. (8)

(ii) Discuss in details about multivariable control system with suitable diagram. (5)

12. (a) (i) Elucidate the analytical design for PI control system. (8)

(ii) The damping ratio of the system is 0.75 and the natural frequency of oscillation is 12 rad/sec. Determine peak overshoot and settling time. (5)

Or

(b) With neat diagram, explain about analog PID controller and derive its output equation. (13)

13. (a) The open loop transfer function of the system, $G(s)=\frac{20}{s(3s+1)(4s+1)}$. Sketch the bode plot and obtain the value of gain cross over frequency. (13)

Or

(b) An unity feedback system having an open loop transfer function, $G(s)=\frac{1}{s(s+1)(s+0.5)}$. Sketch the polar plot and determine the value of gain margin and phase margin. (13)

14. (a) (i) The open loop transfer function of feedback control system is given by $G(s)=\frac{K}{s(s+2)(s+1)}$. Using Routh criterion, determine the range of K and frequency of oscillation of the system. (8)

(ii) Discuss the concept of BIBO stability. (5)

Or

(b) The open loop transfer function of unity feedback system is given below. $G(s)=\frac{K}{s(s+2)(s+4)}$. Sketch the root locus plot for the above system and determine the value of K. (13)

15. (a) (i) Construct a state model for the system described by the differential equation, $\frac{d^3y}{dt^2}+6\frac{d^2y}{dt}+11\frac{dy}{dt}+6y+u=0$. Also draw the block diagram representation of the state model. (8)

(ii) Discuss the solution of homogeneous state equation. (5)

Or

(b) A discrete time system described by the difference equation, $Y(k+2)+5y(k+1)+6y(k)=u(k)$ and initial conditions $y(0)=y(1)=0$; $T=1s$. Determine the state model in canonical form. Also compute the state controllability of the above discrete time system. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Design a lead compensator for a unity feedback system with open loop transfer function, $G(s)=\frac{K}{s(s+1)(s+5)}$ to satisfy the following specifications

(i) Velocity error constant, $Kv \geq 50$ and

(ii) Phase margin is ≥ 20. (15)

Or

(b) (i) Derive the transfer function of armature controlled DC servo motor system. (7)

(ii) Find the transfer function $C(s)/R(s)$ for the signal flow graph shown in figure. (8)

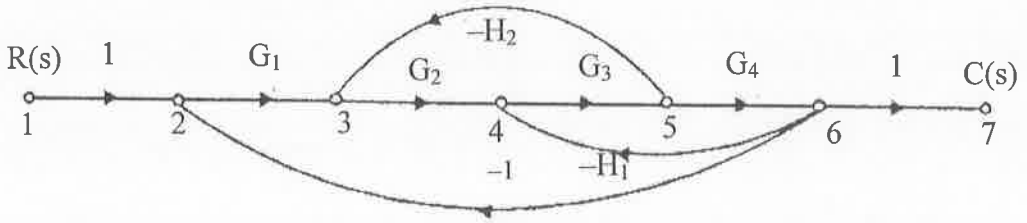

Fig. 2