15. (a) (i) Obtain a state space model for an LTI system whose transfer function is given by $G(s) = \dfrac{-2s+1}{s^3+5s^2+3s+1}$. (6)

(ii) Obtain the transfer function of LTI system $X = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$; $Y = [1 \quad 0] X$ and also check the stability of the system. (7)

Or

(b) Solve the state equation for the system as given in Q.9 (in PART-A) to obtain the time response $x(t)$ for a unit step input. Assume zero initial conditions.

PART C — (1 × 15 = 15 marks)

16. (a) Convert the signal flow graph shown in Fig. 4 to block diagram representation and thereafter obtain the overall transfer function of the system by block diagram reduction technique :

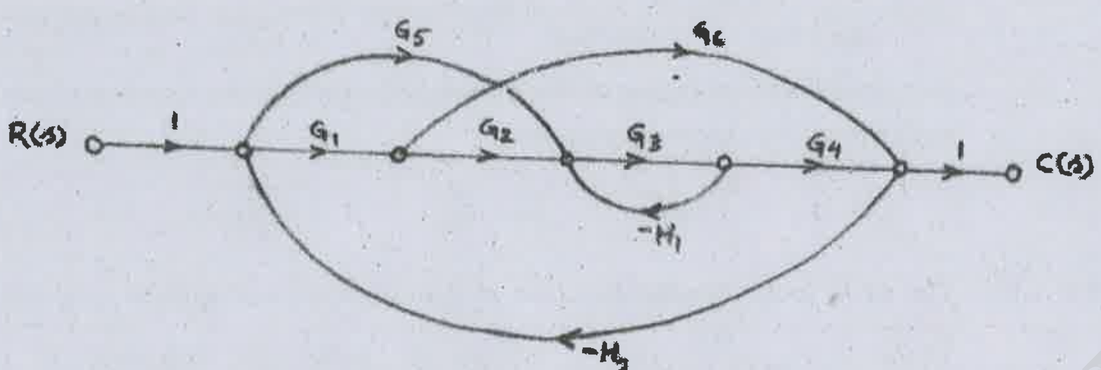


Fig. 4

Or

(b) Obtain a state space model for an armature controlled d.c. motor. Neglect load torque, assume armature inductance to be zero and consider angular position of the motor shaft as the output. Use standard notations.

18/05/19

Reg. No. :

Question Paper Code : 80114

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third/Fourth Semester

Electronics and Communication Engineering

EC 8391 – CONTROL SYSTEMS ENGINEERING

(Common to Medical Electronics, Electronics and Telecommunication Engineering)

(Regulation 2017)

Time : Three hours Maximum : 100 marks

May be permitted : Bode Plot-Semi-Log graph sheet and polar chart.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give two disadvantages of closed loop control over open loop control.

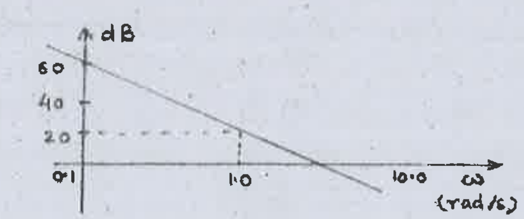
2. Obtain the gain $\dfrac{Y}{X}$ for the signal flow graph shown below :

3. What do you mean by order and type of a system?

4. Define a unit impulse function.

5. What do you mean by a nonminimum phase system?

6. Obtain the transfer function of the system whose Bode magnitude plot is as given below :



7. What is the main objective of root locus analysis technique.

8. Write the transfer function of a PID controller?

9. An LTI system given by the following state variable description :

$$X = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \quad Y = [1 \quad 0] X .$$

Determine whether the system is controllable or not.

10. The z-transfer function of an open loop system is given by $G(z) = \dfrac{2(z-1.5)}{(z-0.5)(z+0.5)}$. Is the open loop system stable? Justify.

PART B — (5 × 13 = 65 marks)

11. (a) Obtain the transfer function for the coupled circuit as shown Fig. 1 :

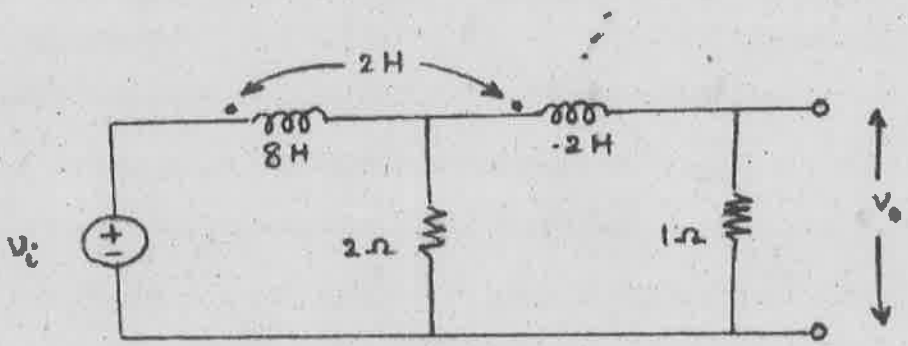


Fig. 1

Or

(b) Write the differential equations governing the motion of the mechanical system as shown in Fig. 2. Also obtain its analogous electrical circuit using either force-voltage or force-current analogy. (8 + 5)

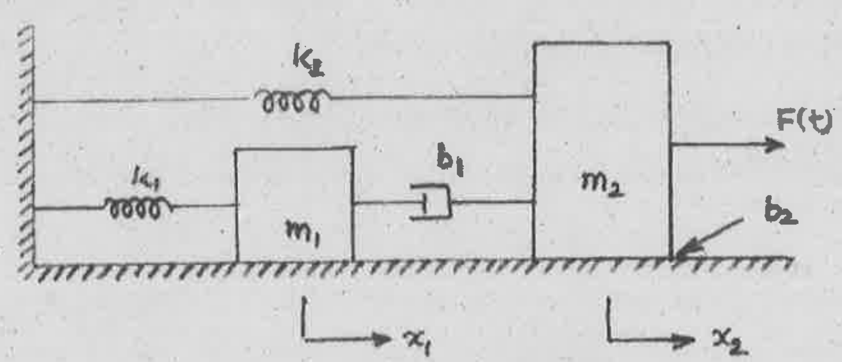


Fig. 2

12. (a) Derive the expression of the step response of a standard second order underdamped system. Use standard notations.

Or

(b) A unity feedback system with a PD controller as shown in Fig. 3. Determine the values of K_P and K_D so that the steady state error to a unit ramp input is 0.001 and damping ratio is 0.5.

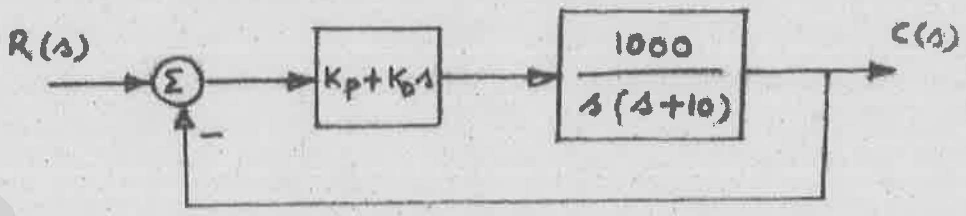


Fig. 3

13. (a) The open loop transfer function of a unity feedback system is given by, $G(s) = \dfrac{64(s+2)}{s(s+0.5)+(s^2+10s+64)}$. Sketch the Bode plot and compute the gain and phase margins of the closed loop system. Also comment on the stability of the closed loop system.

Or

(b) The open loop transfer function of a unity feedback system is given by, $G(s) = \dfrac{50}{s(s+1)+(s+5)(s+10)}$. Sketch the polar plot, calculate the gain and phase margins of the closed loop system and comment on the stability of the closed loop system.

14. (a) The open loop transfer function of a unity feedback system is given by, $G(s) = \dfrac{K}{s(s+1)+(s+5)}$ where $K > 0$. Apply Nyquist stability criterion to determine a range of K over which the closed loop system will be stable.

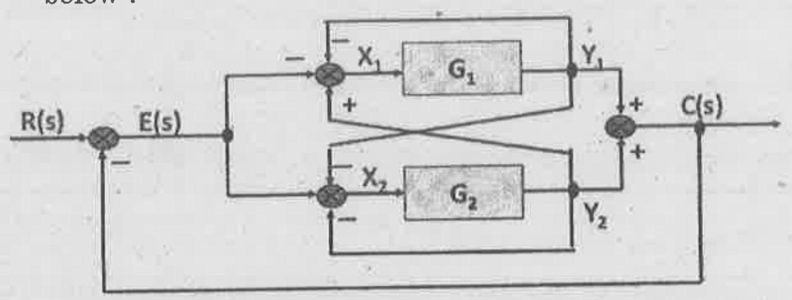
Or

(b) Draw the root locus diagram for the loop transfer function $G(s)H(s) = \dfrac{K(s+6)}{s(s+4)}$ and calculate K for which the closed loop system will be critically damped.

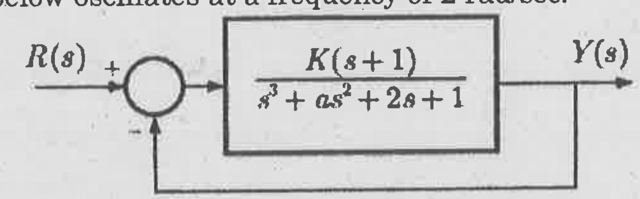
03/11/18

PART C — (1 × 15 = 15 marks)

16. (a) (i) Determine the transfer function C(s)/R(s) for the figure shown below : (7)

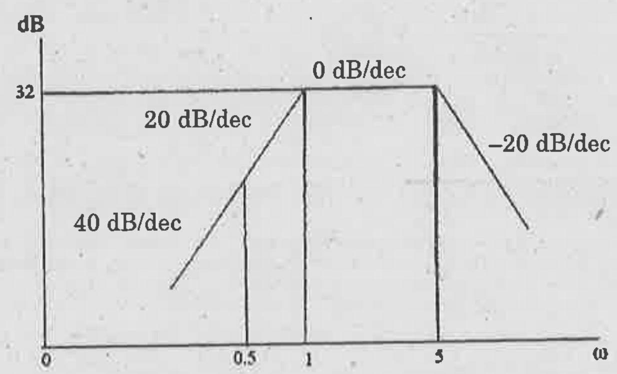


(ii) Determine the positive values of K and a so that the system shown below oscillates at a frequency of 2 rad/sec. (8)

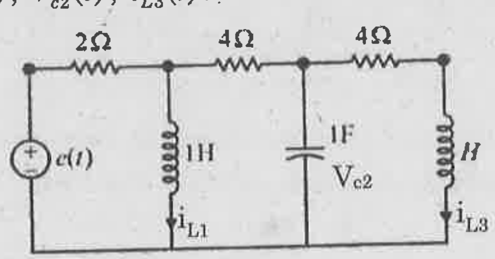


Or

(b) (i) Determine the transfer function of the system for the magnitude plot shown below. (7)



(ii) For the circuit shown in figure, choose state variables x_1, x_2, x_3 to be $i_{L1}(t)$, $V_{c2}(t)$, $i_{L3}(t)$. (8)



Determine the state equation

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = A\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + B[e(t)].$$

Reg. No. :

Question Paper Code : 25075

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

Third Semester

Electronics and Communication Engineering

EC 8391 — CONTROL SYSTEMS ENGINEERING

(Common to Electronics and Telecommunication Engineering)

(Regulations 2017)

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. Define closed-loop control system with a suitable example.

2. Write the force-voltage analogous of a mechanical spring and dash pot.

3. What will be the response of a first-order system with unit step input?

4. Discuss the effect of adding a pole to open loop transfer function of a system.

5. In a Bode plot of a unity feedback control system, the value of phase of $G(j\omega)$ at the gain cross over frequency is –125°. What is the phase margin?

6. Differentiate phase lead and phase lag compensator?

7. Find the range of K for stability of a closed loop system with characteristic equation $S^4+8S^3+36S^2+80S+K=0$ using Routh stability criterion.

8. The Nyquist plot of $G(j\omega)H(j\omega)$ for a closed loop control system, passes through $(-1, j0)$ point in the GH plane. What is the gain margin of the system in dB?

9. List any four advantages of state – variable analysis?

10. Draw the block diagram of state space model.

PART B — (5 × 13 = 65 marks)

11. (a) Write the differential equations governing the behavior of the translational mechanical systems shown in Figure 1 and hence find $X_1(s)$. (13)

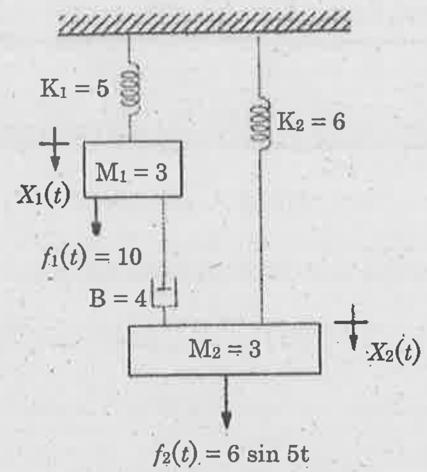


Figure 1

Or

(b) A system is represented by signal flow graph shown in Figure 2, obtain the overall gain of the system using Mason's gain formula. (13)

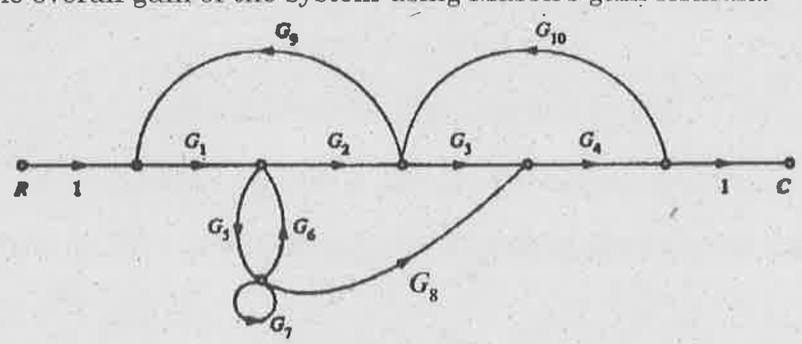


Figure 2

12. (a) (i) Consider the system shown in Figure 3, where damping ratio is 0.6 and natural undamped frequency is 5 rad/sec. Obtain the rise time t_r, peak time t_p, maximum overshoot M_p, and settling time 2% and 5% criterion t_s when the system is subjected to a unit-step input. (6)

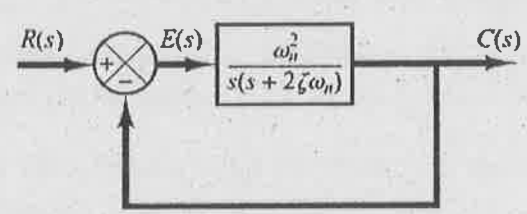


Figure 3

(ii) Derive the expression for peak time and settling time for the underdamped second order system with unit step input. (7)

Or

(b) (i) For a unity feedback system $G(s)=\frac{200}{s(s+8)}$ and $r(t)=2t$ determine steady state error. If it is desired to reduce this existing error by 5% find the new gain of the system. (7)

(ii) Explain in detail about PID controllers used in control systems. (6)

13. (a) The open loop transfer function with unity feedback given by $G(s)=\frac{1}{s(1+0.1s)(1+s)}$. From the bode plot, determine the gain crossover frequency, phase crossover frequency, gain margin and phase margin. (13)

Or

(b) The open loop transfer function for a unity feedback system is given by, $G(S)=\frac{K}{S(1+0.2S)(1+0.05S)}$. Sketch the polar plot and determine the value of K so that gain margin is 18dB. (13)

14. (a) Sketch the root locus of the system whose transfer function is given by $\frac{C(s)}{R(s)}=\frac{K}{s(s+4)(s^2+s+1)+K}$. (13)

Or

(b) Sketch the Nyquist plot for the following open loop transfer function is given by $G(s)H(s)=\frac{K(1+s)^2}{s^3}$. Determine the range of K for stability. (13)

15. (a) A system is given by

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 2\end{bmatrix}[u] \text{ with } \begin{bmatrix}x_1(0)\\ x_2(0)\end{bmatrix}=\begin{bmatrix}0\\ 1\end{bmatrix}.$$

Where u is unit step function. Find the state transition matrix and there from find the state response, i.e.. $x(t)$ for $t>0$. (13)

Or

(b) Find the state equation and output equation for the system given by $\frac{Y(s)}{R(s)}=\frac{s^3+5s^2+6s+1}{s^3+4s^2+3s+3}$. Also check for controllability and observability. (13)

20/11/19/AN

Reg. No. :

Question Paper Code : 90177

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Third/Fourth/Fifth Semester

Electronics and Communication Engineering

EC8391 – CONTROL SYSTEMS ENGINEERING

(Common to Medical Electronics/ Electronics and Telecommunication Engineering/ Mechatronics Engineering)

(Regulations 2017)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

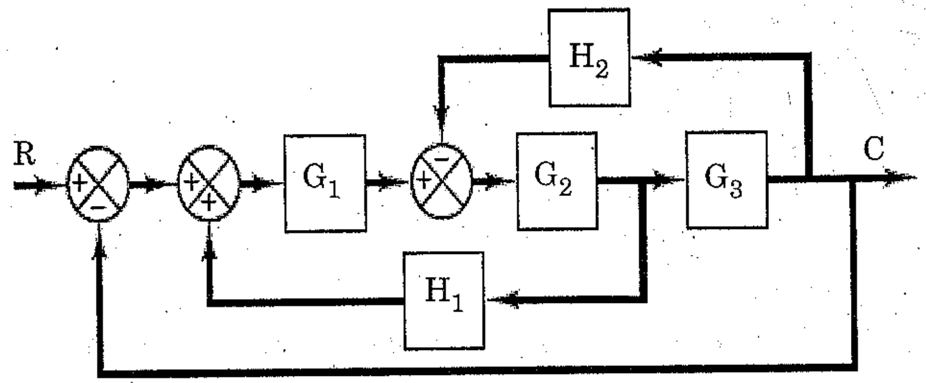
PART – A

(10×2=20 Marks)

1. Distinguish between feed forward control system and feedback control systems.
2. Specify the usefulness of AC servomotors in motion control systems.
3. Write the performance measures in transient response analysis of second order system.
4. For the given transfer function, find the type and order of the system $\frac{C(s)}{R(s)} = \frac{10(s+2)}{s(s^2+3s+5)}$.
5. In minimum phase system, how the starting and end point of polar plot are identified ?
6. Why compensators are necessary in feedback control systems ?
7. Comment on the stability of the system, when the roots of characteristic equation are lying on imaginary axis.
8. How do you define relative stability ?
9. Write the canonical form of state model for n^{th} order system.
10. Justify how digital Control System is superior to conventional control theory.

PART – B (5×13=65 Marks)

11. a) Draw the signal flow graph for the given system block diagram, and obtain the closed loop transfer function of the system C(S)/R(S) using Mason's Gain formula.



(OR)

b) Describe the construction and working principle of Synchros. Also explain how it is used in servo applications.

12. a) A unity feedback control system has an open loop transfer function $G(s)=\frac{10}{s(s+5)}$. Determine its closed loop transfer function, damping ratio and natural frequency of oscillations. Also evaluate the rise time, peak overshoot, peak time and settling time for a step input of 12 units.

(OR)

b) What is the need for PID control for feedback control systems ? Explain how it is designed for second order systems.

13. a) List out the frequency domain specifications of a standard second order system. Derive the expressions for Resonant peak and Bandwidth of a second order system.

(OR)

b) The open loop transfer function of a unity feedback system is G(s) = K/(s(s+1)). It is desired to have the velocity error constant $K_v = 12\ sec^{-1}$ and phase margin as 40°. Design a lead compensator to meet the above specifications.

14. a) Use the Routh stability criterion to determine the location of roots on the s-plane and hence the stability for the system represented by the characteristic equation $S^6 + S^5 + 3S^4 + 3S^3 + 5S^2 + 2S + 1 = 0$.

(OR)

b) Using Nyquist Stability Criterion, find the relative stability of the system whose open loop transfer function is defined as $G(s)\,H(s)=\frac{K(s+1)}{s^2(s+2)(s+4)}$.

15. a) The state model of the system is given by

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

Determine whether the system is completely controllable or not.

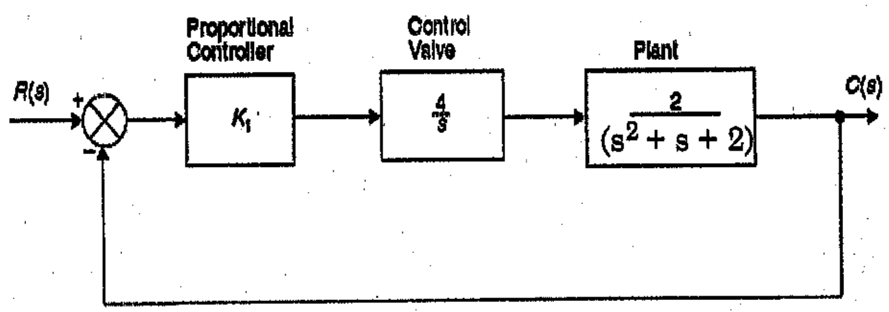
(OR)

b) Obtain the state model of the system whose transfer function s given as

$$\frac{Y(s)}{U(s)}=\frac{10}{s^3+4s^2+2s+1}.$$

PART – C (1×15=15 Marks)

16. a) Sketch the root locus diagram of the control system as shown in figure; find the value of the proportional controller gain K_1 to make the system is just unstable.



(OR)

b) The open loop transfer function of the plant is

$$G(s)\,H(s)=\frac{10e^{-s\tau_D}}{s(0.1s+1)(0.05s+1)}$$

Use Bode plot, find the gain margin and phase margin when $\tau_D = 0$.