R16

Code No: 134AM

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, May - 2019
CONTROL SYSTEMS
(Common to EEE, ECE, EIE, ETM)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) Classify the following as open or closed loop system with valid reasons (i) An electrical On-Off switch, (ii) Room air-conditioner. [2]
b) Why do you need a feedback controller? Justify your answer with an example. [3]
c) What are the effects of integral control action? [2]
d) Find the peak overshoot for unit step response of the system described by closed loop transfer function, $G(s)=\frac{64}{s^2+16s+64}$ [3]
e) Outline the Bode plot for a Proportional Integral controller. [2]
f) Compare between absolute stability, conditional stability and relative stability. [3]
g) Draw the polar plot for $G(s)H(s)=\frac{1+2s}{1+3s}$. [2]
h) What is a Phase Lag compensator and why is it used? [3]
i) What are the advantages of State variable model of dynamic system? [2]
j) How do you determine the system eigen values and what is its role in the system response? [3]

PART – B

(50 Marks)

2. Determine the transfer function for the block diagram shown in Figure 1. [10]

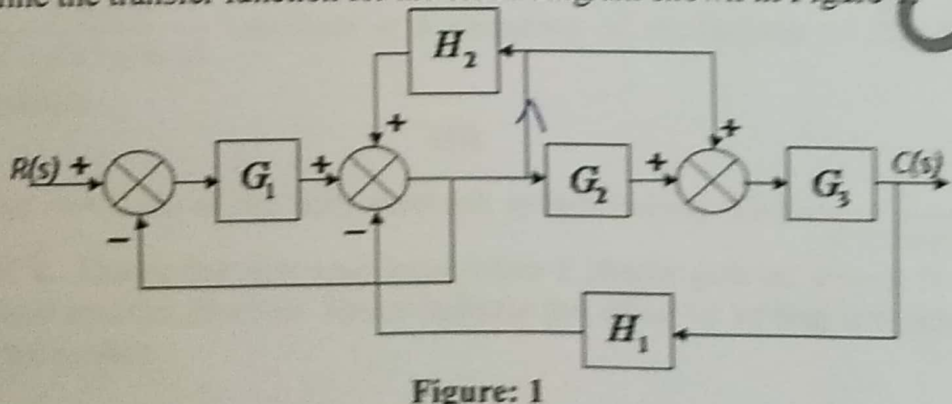

Figure: 1

OR

$m = \frac{T_0}{\omega_0}$ / $K_{tm} = \frac{T_0}{E_1}$

$\tau_m = \frac{J_m}{B_m - m}$ $K_m = \frac{k_{tm}}{B_m - m}$

3.a) Distinguish between Open loop control system and closed loop control system.

b) A two phase AC servo motor has the following parameters:
Starting torque = 0.166 N-m
Inertia = 1×10^{-5} kg-m^2
Supply voltage = 115 V
No load angular velocity = 304 rad/sec
Assuming torque – speed curve to be linear and zero viscous friction, derive the transfer function. [4+6]

4. The open loop transfer function of an unity feedback control system is given as $G(s) = \frac{K}{s(1+sT)}$
Determine the factor by which the gain 'K' should be multiplied so that the overshoot of the unity step response be reduced from 80% to 25%? [10]

OR

5.a) Determine the damping ratio and natural frequency of the system if the derivative feedback is absent ($K_0=0$) in the closed loop system shown in Figure 2. What is the steady state error resulting from unit ramp input?

b) Determine the derivative feedback constant 'K_0' which will increase the damping ratio of the system to 0.5. What is the steady state error resulting from unit ramp input with this setting of the derivative feedback constant? [5+5]

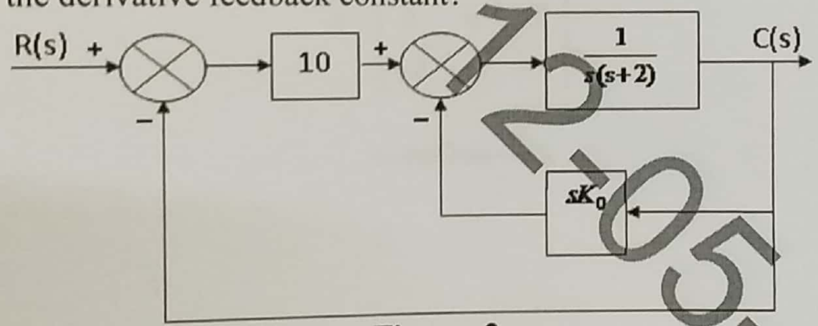

Figure: 2

6. Determine the values of K and β, so that the system whose open loop transfer function is $G(s) = \frac{K(s+1)}{s^3 + \beta s^2 + 5s + 1}$ oscillates at a frequency of oscillations of 2 rad/sec. Assume unity feedback. [10]

OR

7. Sketch the root locus of the unity feedback system having $G(s) = \frac{K}{s^2+2s+2}$ for positive values of K. Sketch the new root locus when a simple pole at $s = -5$ is added to the system loop transfer function. Hence indicate the effect of adding this pole on the root locus of the system. [10]

8. Investigate closed loop stability of a system having $G(s)H(s) = \dfrac{K(s+4)}{s(s-2)}$ using Nyquist criterion. Determine the limiting value of 'K' for stability. [10]

OR

9. Design a lead compensator for the system with an open-loop transfer function $G(s) = \dfrac{K}{s^2(1+0.1s)}$ for the specifications of acceleration error constant, $K_a = 10$ and phase margin, $\phi_{pm} = 30^0$. [10]

10. For the system given below, obtain:
a) Zero input response
b) Zero state response [10]
c) Total response.

$$A = \begin{bmatrix} 1 & 4 \\ -2 & -5 \end{bmatrix},\ B = \begin{bmatrix} 0 \\ 1 \end{bmatrix},\ u = 1 \text{ and } \begin{matrix} x_1(0) = 1 \\ x_2(0) = 0 \end{matrix}$$

OR

11.a) Distinguish between Transfer function model and State Space model. [4+6]
b) Diagonalize the system matrix given below.

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -5 & -4 \end{bmatrix}$$

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, April - 2018

CONTROL SYSTEMS

(Common to EEE, ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Write the Manson's gain formula. [2]
b) What are the basic properties of SFG? [3]
c) What are the standard test signals used in control systems? [2]
d) Distinguish between type and order of a system. [3]
e) Define a stable system. [2]
f) Explain the basics of root locus plot. [3]
g) What is polar plot? [2]
h) Define gain and phase margins. [3]
i) What is state diagram? [2]
j) Mention any four advantages of state variable representation. [3]

PART-B

(50 Marks)

2.a) Compare the AC and DC servomotors.
b) For the system represented by the block diagram shown in figure 1. Find $\frac{C}{R}$. [4+6]

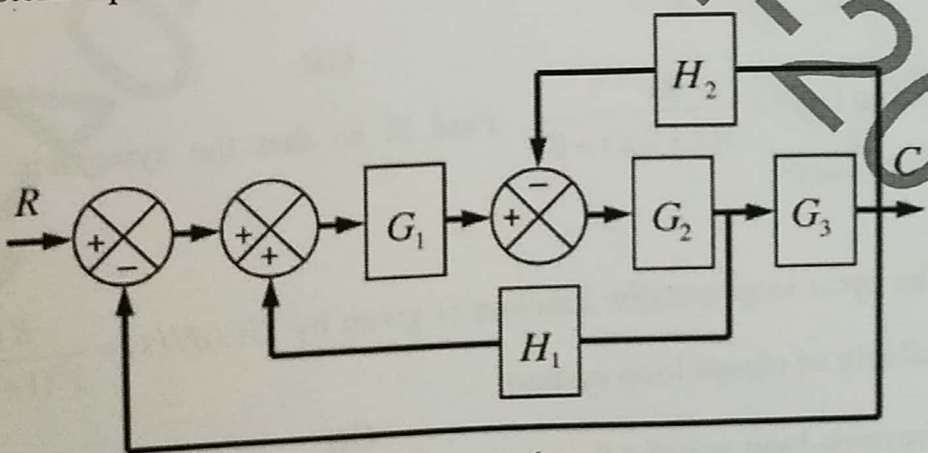

Figure: 1

OR

3.a) What are the characteristics of servomotors?

b) Find the overall gain $\frac{C(s)}{R(s)}$ for the signal flow graph shown in figure 2. [4+6]

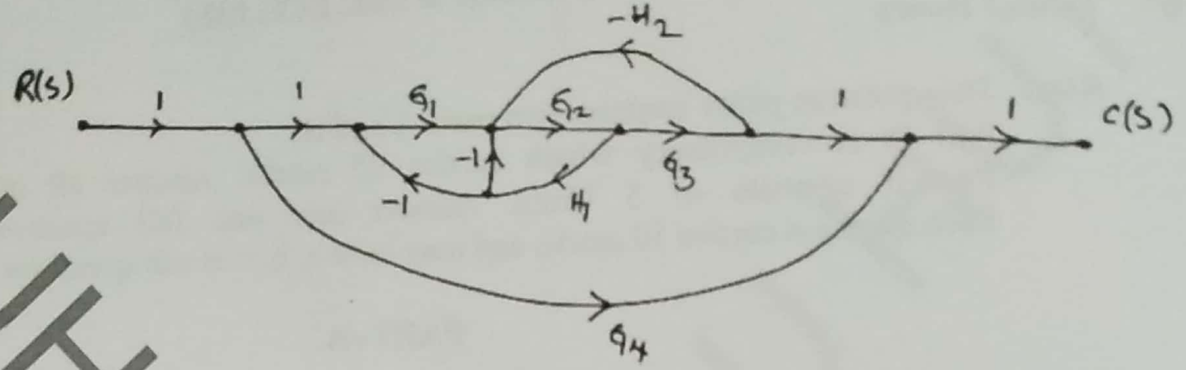

Figure: 2

4. The open-loop transfer function of a unity feedback control system is given by $G(s)=\frac{9}{s(s+3)}$. Find the natural frequency of response, damping ratio, damped frequency and time constant. [10]

OR

5. For unity feedback control system the open loop transfer function, $G(s)=\frac{10(s+2)}{s^2(s+4)}$. Find the e_{ss} when the input is $r(t)=3-2t+3t^2$. And find K_p, K_v, and K_a. [10]

6.a) Determine the RH stability of given characteristic equation, $s^4+8s^3+18s^2+16s+5=0$.

b) Sketch the root locus of the system, whose open loop transfer function is,

$$G(s)=\frac{K(s+15)}{s(s+1)(s+5)}$$

[4+6]

OR

7. Given $G(s)=\frac{Ke^{-0.2s}}{s(s+2)(s+8)}$. Find K so that the system is stable with, a) GM=2db, b) PM=45^0 [10]

8. The open loop transfer function is given by $G(s)H(s)=\frac{K(1+4s)}{s^2(1+s)(1+2s)}$, Determine the stability of closed loop system. [10]

OR

9. The open-loop transfer function of a system is given by

$$G_p(s)=\frac{K}{s(1+0.1s)(1+0.2s)}$$

Design a lag-lead compensator to meet the K_v=100sec^{-1} and Phase margin $\geq 30^0$. [10]

10.a) Define: i) State ii) State variables iii) State space representation.

b) Find the state transition matrix for the following matrix, $A=\begin{bmatrix}1 & 0\\ -1 & 1\end{bmatrix}$.

c) Obtain the state space representation for the following differential equation.

$\ddot{y}+5\dot{y}+7y=114$

Where 'y' is the output and 'u' is the input. [10]

OR

11. The state equation of a linear-time invariant system is given as,

$$\dot{X}=\begin{bmatrix}0 & 5\\ -1 & -2\end{bmatrix}X+\begin{bmatrix}1\\ 1\end{bmatrix}r \text{ and } y=\begin{bmatrix}1 & 1\end{bmatrix}X,$$

Find the transfer function and draw the state diagram. [10]

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, December - 2018

CONTROL SYSTEMS

(Common to EEE, ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Explain how feedback effects overall gain of the system. [2]
b) State and explain Mason's gain formula. [3]
c) What is meant by characteristic equation? [2]
d) What are the standard test signals? [3]
e) What are the limitations of Routh's stability? [2]
f) What are frequency domain specifications? [3]
g) Explain Lag compensation. [2]
h) What is the difference between polar plot and Nyquist plot? [3]
i) What are the properties of state transition matrix? [2]
j) What is meant by state in control system? [3]

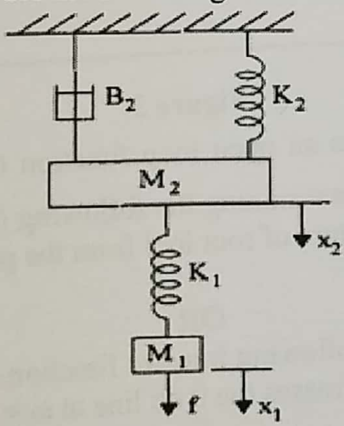
PART – B

(50 Marks)

2. Derive an expression for the transfer function of an armature controlled DC servo motor. [10]

OR

3.a) Obtain the transfer function for the following mechanical translational system figure 1.

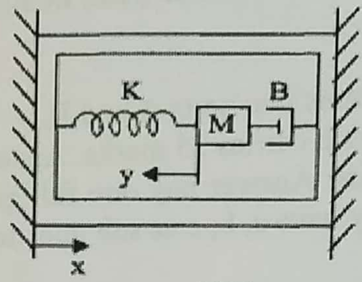


$$T(s) = \frac{X_2(s)}{F(s)}$$

Figure 1

b) Obtain the transfer function for the following mechanical translational system figure 2.

[5+5]



$$T(s) = \frac{Y(s)}{X(s)}$$

Figure 2

4.a) Write the equations for time domain specifications of a standard second order system with unit step input.

b) Explain the effect of Proportional control action on the performance of a second order system. [5+5]

OR

5. Consider the system shown in the Figure 3. With switch K open, determine the damping factor and the natural frequency of the system. If a unit ramp input is applied to the system, find the steady state output. Take K_A =5. The damping factor is to be increased to 0.7 by including a derivative output compensation. Find the value of k_t to achieve this. Find the value of undamped natural frequency and the steady state error due to a unit ramp input. [10]

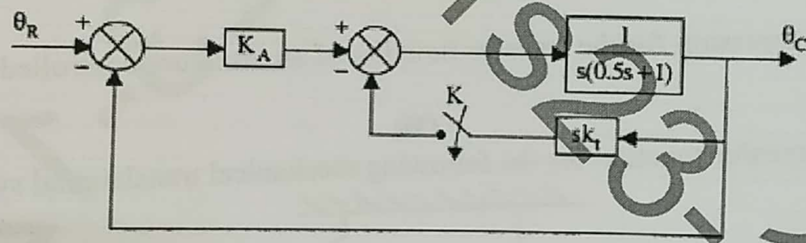


Figure 3

6. A unity feedback system has an open loop function G (s) = $\frac{k}{s(s^2+3s+10)}$ make a rough sketch of root locus plot by determining the following (a) Centroid, number and angle of asymptotes (b) angle of departure of root loci from the poles (c) Breakaway points if any. [10]

OR

7. Sketch the Bode plot for the following transfer function and determine the system gain K for which the magnitude plot crosses the 0 db line at ω = 15 rad/sec. [10]

$$G(s) = \frac{K}{s\,(s+1)(1+0.1s)(1+0.01s)}$$

8.a) Draw the complete Nyquist plot for the following open loop transfer function
G(s) H(s) = $\frac{2(s+0.25)}{s^2\,(s+1)(s+0.5)}$. If the system is unstable, how many poles of the closed loop system are in the right half of s-plane?

b) Draw the electrical circuit diagram that represents the Lead-Lag compensator and explain in detail. [5+5]

OR

9.a) Consider the following polar plot shown in Figure 4. If now a pole at origin and a pole at $s = -\frac{1}{T_2}$ are added, sketch the polar plot.

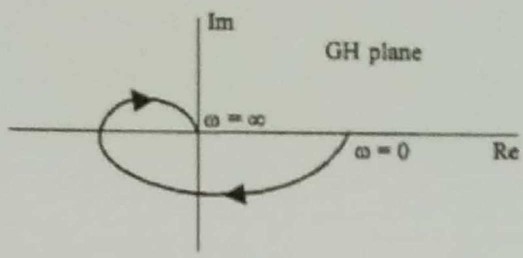


Figure: 4

b) Design a lag lead compensator for the unity feedback system with, $G(s) = \frac{K}{s(s+1)(s+2)}$ and satisfying the specifications $K_v = 10\ sec^{-1}$, $\varphi_{pm} = 50°$ and B.W > 2 rad/sec. [5+5]

10.a) Explain various methods of evaluation of state transition matrix.

b) Obtain the transfer function for linear time invariant system and also draw the state model. [5+5]

OR

11. Determine the state and output equations in vector matrix form for the system whose transfer function is given by $G(s) = \frac{s+2}{s(s^2+4s+3)}$. [10]

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Code No: 125DU

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2017

CONTROL SYSTEMES ENGINEERING

(Common to ECE, ETM)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART – A

(25 Marks)

1.a) Explain about various types of control systems with examples briefly. [2]
b) Briefly explain about the characteristics of feed-back signal. [3]
c) Why test signals are needed? Explain various test signals used in feed-back control systems. [2]
d) Define time constant and explain its importance. [3]
e) Explain the concept of stability of a control system with an example. [2]
f) Distinguish between qualitative stability and conditional stability of a control system. [3]
g) What is compensation? Explain different types of compensators. [2]
h) Define gain margin and phase margin in frequency domain stability analysis. [3]
i) Discuss the significance of state Space Analysis. [2]
j) Define state variables. [3]

PART – B

(50 Marks)

2.a) Explain the operation of ordinary traffic signal, which control automobile traffic at roadway intersections. Why are they open loop control systems? How can traffic be controlled more effectively?
b) For the system represented in below figure 1, obtain transfer function $\frac{C}{R_1}, \frac{C}{R_2}$. [5+5]

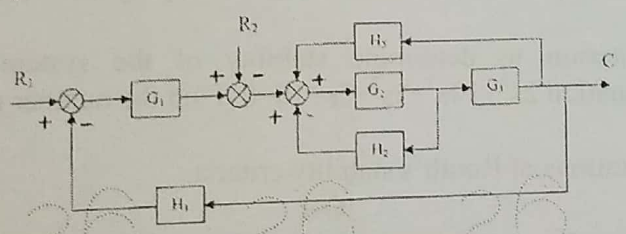

Figure 1

OR

3.a) Derive the transfer function of the following electrical network $\frac{V_o(s)}{V_i(s)}$ figure 2.

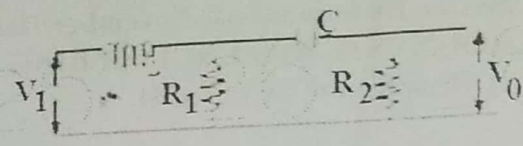

Figure 2

b) For a signal flow graph in below figure 3, determine the overall gain by masons gain formula. [5+5]

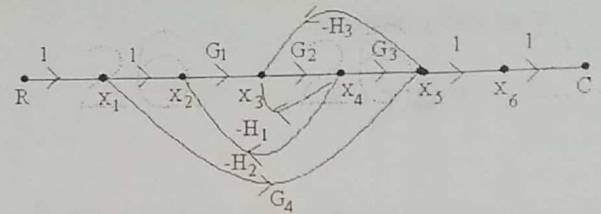

Figure 3

4.a) A unity feedback system is characterized by an open-loop transfer function $G(s)= K/s(s+5)$. 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 overshoot and time to peak overshoot for a unit-step input.

b) The open-loop transfer function of a servo system with unity feedback is $G(s)=10/s(0.1s+1)$. Evaluate the static error constants (K_p, K_v, K_a) for the system. Obtain the steady-state error of the system when subjected to an input given by the polynomial $r(t)=a_0+a_1t+a_2t^2/2$. [5+5]

OR

5.a) A unity feedback system has forward transfer function $G(s) = 20/(s+1)$. Determine and compare the response of the open and closed loop systems for unit step input. Suppose now that parameter variation occurring during operating conditions causes G(s) to modify to $G'(s)=20/(s+0.4)$. What will be the effect on unit-step response of open and closed loop systems? Comment upon the sensitivity of the two systems to parameter variations.

b) The response of a system subjected to a unit step input is $c(t) = 1 + 0.2e^{-60t}-1.2e^{-10t}$. Obtain the expression for the closed loop transfer function of the system. Also determine the undamped natural frequency and damping ratio of the system. [5+5]

6.a) Apply R-H criterion to determine stability of the system with the following characteristic equation $2s^4+10s^3+5s^2+5s+10=0$. Find the number roots with positive real parts, if any.

b) Explain the limitations of Routh's stability criteria. [5+5]

OR

7. Plot the root locus for the system with $G(s)H(s) = \frac{K(s+1)(s+3)}{s^3}$. Sketch the root locus and determine the range of K for which the system is stable. [10]

8. Sketch the Bode plots for a system $G(s) = \frac{15(s+5)}{s(s^2+16s+100)}$. Hence determine the stability of the system. [10]

OR

9.a) Explain the effect of addition of a pole at the origin on the polar plot of a given system.

b) Sketch the polar plot and hence find the frequency at which the plot intersects the positive imaginary axis for the system $G(s) = \frac{0.1}{s(1+s)(1+0.1s)}$. Also find the corresponding magnitude. [5+5]

10.a) Obtain the state variable representation of an armature controlled D.C Servomotor.

b) Derive the state models for the system described by the differential equation in phase variable form. [5+5]

$$\dddot{y} + 4\ddot{y} + 5\dot{y} + 2y = 2\ddot{u} + 6\dot{u} + 5u.$$

OR

11.a) Obtain the solution of a system whose state model is given by X = AX(t) +BU(t); X(0) $= X_0$ and hence define state Transition matrix.

b) Obtain the state model of the system shown in below figure 4. Consider the state variables as i_1, i_2 and v. [5+5]

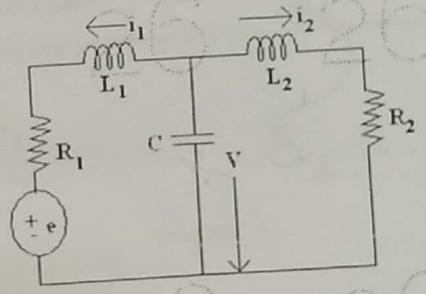

Figure 4

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Code No: 55012

R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2018

CONTROL SYSTEMS

(Common to EEE, ECE, ETM)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

\- - -

1.a) Draw the block diagram of a biological control system when a human hand approaches to an object to grip it.

b) For the mechanical system shown in Figure 1, (i) write the performance equations (ii) Draw analogous electrical network. [7+8]

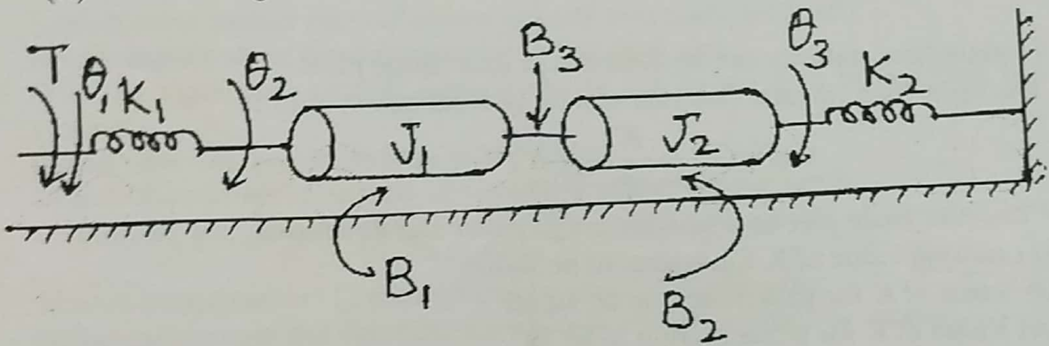

Figure 1

2.a) Derive the transfer function for AC servomotor and draw its torque-speed characteristics.

b) Find out the overall transfer function of the control system represented by the block diagram shown in Figure 2. [8+7]

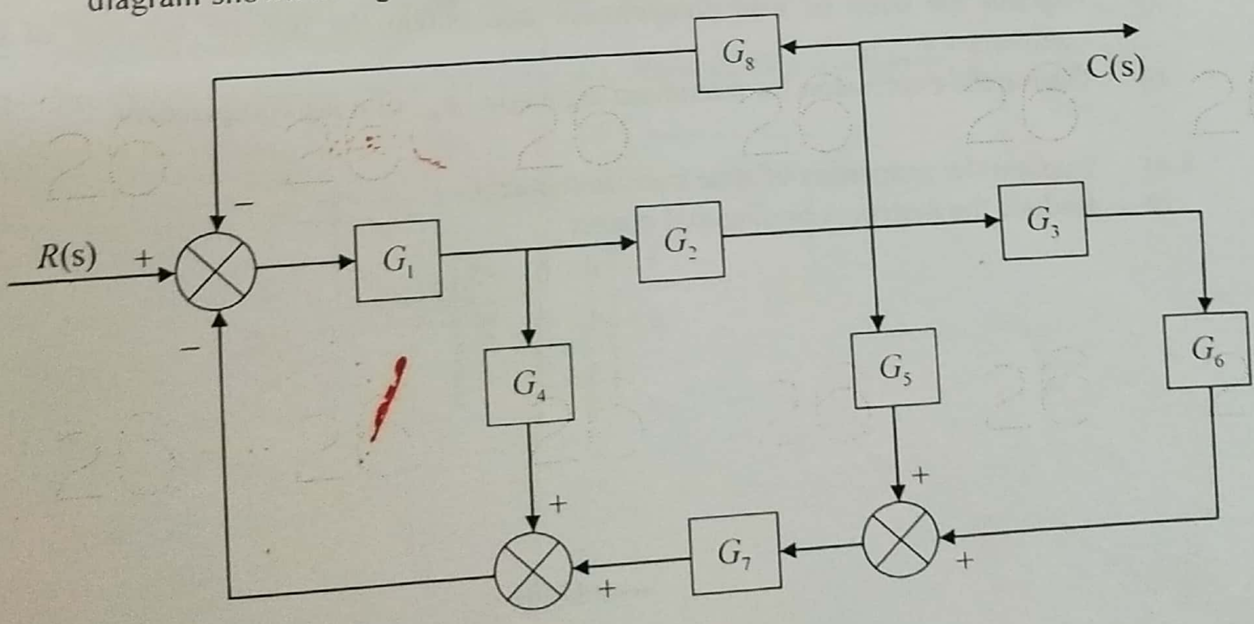

Figure 2

3.a) Derive the expressions for peak overshoot and settling time of a second order system subjected to a step input and also sketch the transient response.

b) A unity feed-back system has the forward path transfer function is $G(s) = 10/(s(s+9))$. Find the steady state error if the input $r(t) = 1.5 + 3t + 0.5t^2$. [8+7]

4.a) Discuss the effect of adding one pole and one zero (simultaneously and separately) to a given transfer function on the root loci.

b) The open loop transfer function of a unity feedback control system is given as

$$G(s)H(s) = \frac{K}{s(1+\tau s)}$$

It is desired that all the roots of the characteristics equation must lie in the region to the left of the line $s = -1$. Determine the values of K and τ required so that there are no roots to the right of the line $s = -1$. [6+9]

5.a) Explain how stability can be determined from Bode plots.

b) The open-loop transfer function of a unity feedback system is

$$G(s) = \frac{K}{s(s+2)(s+20)}$$

Construct Bode plot on a semilog graph paper and determine:
i) Limiting value of K for system to be stable
ii) Value of K for gain margin to be 10 dB
iii) Value of K for phase margin to be 50^0. [6+9]

6.a) Explain how the type of a system determines the shape of Polar plot.

b) Draw the Nyquist plot for open loop transfer function of a feedback control system is $G(s)H(s) = \dfrac{-3}{s(1-30s)}$. Comment on the stability. [5+10]

7.a) Explain the need of lead compensator and obtain the transfer function of lead-lag compensator.

b) Derive the expression for maximum lag angle 'ϕ_m' of a lag compensator. [8+7]

8.a) Explain the properties of state transition matrix.

b) Reduce the matrix A to diagonal matrix: [6+9]

$$A = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix}$$

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Code No: 125DU

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2017

CONTROL SYSTEMES ENGINEERING

(Common to ECE, ETM)

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PART – A

(25 Marks)

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b) Briefly explain about the characteristics of feed-back signal. [3]
c) Why test signals are needed? Explain various test signals used in feed-back control systems. [2]
d) Define time constant and explain its importance. [3]
e) Explain the concept of stability of a control system with an example. [2]
f) Distinguish between qualitative stability and conditional stability of a control system. [3]
g) What is compensation? Explain different types of compensators. [2]
h) Define gain margin and phase margin in frequency domain stability analysis. [3]
i) Discuss the significance of state Space Analysis. [2]
j) Define state variables. [3]

PART – B

(50 Marks)

2.a) Explain the operation of ordinary traffic signal, which control automobile traffic at roadway intersections. Why are they open loop control systems? How can traffic be controlled more effectively?
b) For the system represented in below figure 1, obtain transfer function $\frac{C}{R_1}, \frac{C}{R_2}$. [5+5]

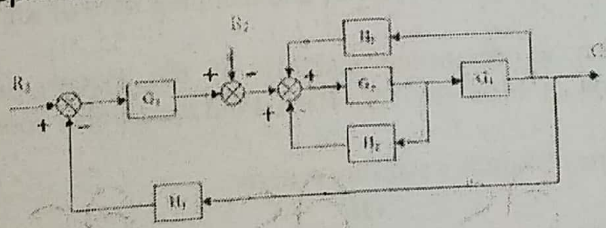

Figure 1

OR

3.a) Derive the transfer function of the following electrical network $\frac{V_o(s)}{V_i(s)}$ figure 2.

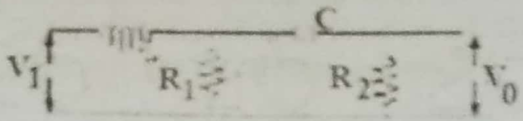

Figure 2

b) For a signal flow graph in below figure 3, determine the overall gain by masons gain formula. [5+5]

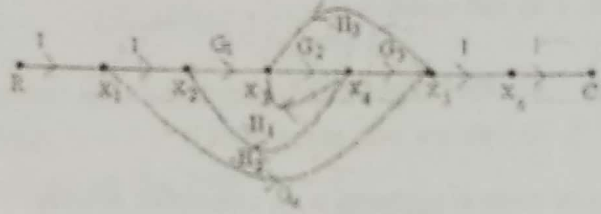

Figure 3

4.a) A unity feedback system is characterized by an open-loop transfer function $G(s)=K/s(s+5)$. 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 overshoot and time to peak overshoot for a unit-step input.

b) The open-loop transfer function of a servo system with unity feedback is $G(s)=10/s(0.1s+1)$. Evaluate the static error constants (K_p, K_v, K_a) for the system. Obtain the steady-state error of the system when subjected to an input given by the polynomial $r(t)=a_0+a_1t+a_2t^2/2$. [5+5]

OR

5.a) A unity feedback system has forward transfer function $G(s)=20/(s+1)$. Determine and compare the response of the open and closed loop systems for unit step input. Suppose now that parameter variation occurring during operating conditions causes G(s) to modify to $G'(s)=20/(s+0.4)$. What will be the effect on unit-step response of open and closed loop systems? Comment upon the sensitivity of the two systems to parameter variations.

b) The response of a system subjected to a unit step input is $c(t)=1+0.2e^{-60t}-1.2e^{-10t}$. Obtain the expression for the closed loop transfer function of the system. Also determine the undamped natural frequency and damping ratio of the system. [5+5]

6.a) Apply R-H criterion to determine stability of the system with the following characteristic equation $2s^4+10s^3+5s^2+5s+10=0$. Find the number roots with positive real parts, if any.

b) Explain the limitations of Routh`s stability criteria. [5+5]

OR

7. Plot the root locus for the system with $G(s)H(s)=\frac{K(s+1)(s-3)}{s^3}$. Sketch the root locus and determine the range of K for which the system is stable. [10]

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8. Sketch the Bode plots for a system $G(s) = \frac{15(s+5)}{s(s^2+16s+100)}$. Hence determine the stability of the system. [10]

OR

9.a) Explain the effect of addition of a pole at the origin on the polar plot of a given system.

b) Sketch the polar plot and hence find the frequency at which the plot intersects the positive imaginary axis for the system $G(s) = \frac{0.1}{s(1+s)(1+0.1s)}$. Also find the corresponding magnitude. [5+5]

10.a) Obtain the state variable representation of an armature controlled D.C Servomotor.

b) Derive the state models for the system described by the differential equation in phase variable form. [5+5]

$$\dddot{y} + 4\ddot{y} + 5\dot{y} + 2y = 2\ddot{u} + 6\dot{u} + 5u.$$

OR

11.a) Obtain the solution of a system whose state model is given by $\dot{X} = AX(t) + BU(t)$; $X(0) = X_0$ and hence define state Transition matrix. [5+5]

b) Obtain the state model of the system shown in below figure 4. Consider the state variables as i_1, i_2 and v.

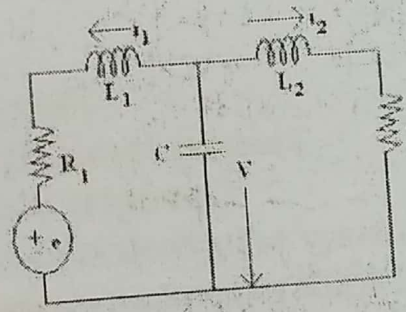

Figure 4

---ooOoo---

Code No: 115DU **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2016

CONTROL SYSTEMS ENGINEERING

(Common to ECE, ETM)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a) Give the Mason's Gain formula. [2]
b) List out the classification of control systems. [3]
c) What is meant by un-damped response? [2]
d) Write the effects of proportional derivative systems on second order response. [3]
e) What is the need of angle of asymptotes in Root-locus? [2]
f) Write the remedies if an entire row is zero while computing elements in R-H array. [3]
g) Draw the pole-zero plot of Lag compensator. [2]
h) Define gain-cross over frequency and phase-cross over frequency. [3]
i) Draw the state diagram of a state model. [2]
j) What is meant by diagonalization? Explain. [3]

PART - B

(50 Marks)

2.a) Discuss the characteristics of feedback in closed loop control system.
b) Define the Impulse response of the system. Also find the impulse response of the system with open loop transfer function. [5+5]

$$G(s) = \frac{10}{s(s+3)}$$

OR

3. Obtain the transfer function $\frac{Y(s)}{R(s)}$ for the flowing block diagram (figure 1): [10]

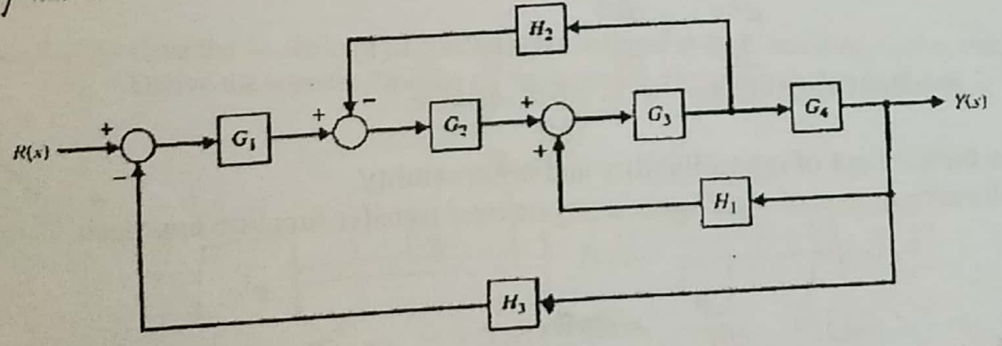

Figure 1

$\frac{10}{s(s+3)+10}$

$\frac{10}{s^2+3s+10}$

$\frac{C(s)}{R(s)} = \frac{10}{s^2+3s+10}$

4.a) Sketch the time response of the following figure 2 first order system when excited with unit step input.

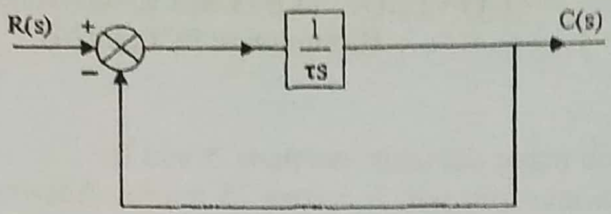

Figure 2

b) A second order system has a transfer function $(s) = \frac{25}{(s^2+8s+25)}$, Determine the settling time and peak overshoot when the system is excited with unit step input. [5+5]

OR

5.a) Find the steady state errors for the unit step, unit ramp and unit parabolic inputs for the system whose transfer function is $G(s) = \frac{1000(s+1)}{(s+10)(s+50)}$

b) Discuss the significance of 'type' and 'order' of the system in time response analysis. [6+4]

6. Define Root locus and explain procedure to sketch the Root-locus for a given transfer function. [10]

OR

7.a) Comment on system stability if the characteristic equation of closed loop system is
$$Q(s) = s^4 + 8s^3 + 18s^2 + 16s + 5 = 0$$

b) A unity feedback system with open loop transfer function $G(s) = \frac{K}{s(s+1)}$. Determine the range of 'K' for which system to be stable. [5+5]

8. Sketch the Bode plot for the unity feedback system with open loop transfer function
$$G(s) = \frac{80}{s(s+2)(s+20)}$$
Also find its gain margin and phase margin. [10]

OR

9.a) State and explain Nyquist stability criterion.
b) What is PID controller and write its merits and demerits. [5+5]

10.a) What is state transition matrix and derive its expression.
b) Obtain the state model for the system which is described as
$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 10y(t) = 5u(t)$$
Here, 'y' is output variable and 'u' is input variable. [4+6]

OR

11.a) Explain the concept of controllability and observability.
b) Write the advantages of state space analysis over transfer function approach. [5+5]

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Code No: 115DU

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November - 2015

CONTROL SYSTEMES ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A (25 Marks)

1.a) What are the advantages of closed loop system compared to open loop system? [2]
b) Discuss the effect of feedback on overall gain. [3]
c) Give the expression for the rise time of the step response for a second order system. [2]
d) Define the static error constants. [3]
e) How R-H criterion is useful in plotting root locus? [2]
f) What is Routh's stability criterion? [3]
g) Draw the pole zero plot for lag-lead compensator. [2]
h) What are the advantages of Bode plot? [3]
i) Define controllability. [2]
j) State any four properties of STM. [3]

PART - B (50 Marks)

2.a) Give the f-v analogy of mechanical translational system and electrical system.
b) Derive the transfer function of the mechanical system shown in figure 1. [3+7]

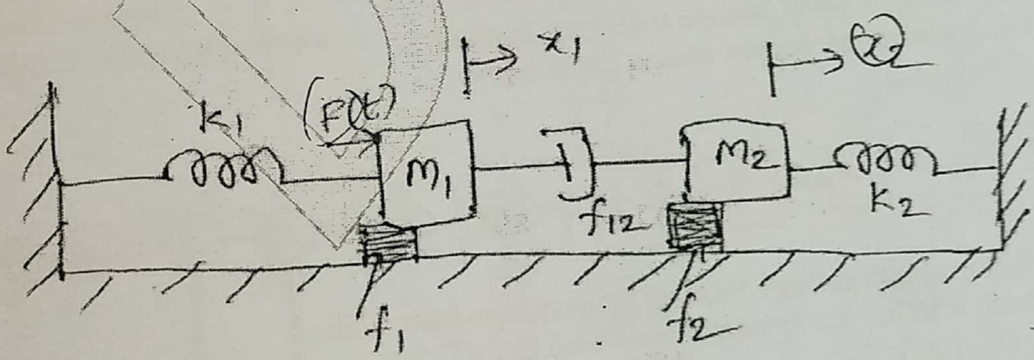
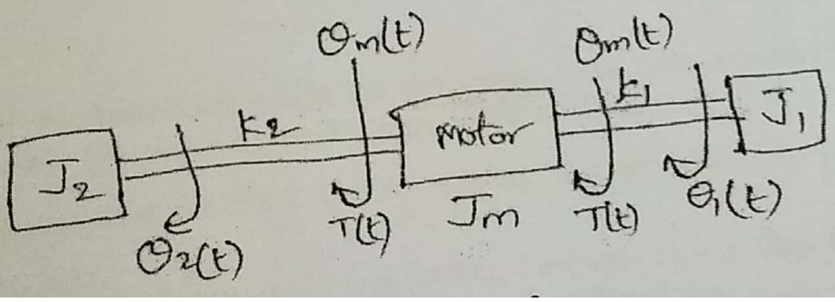


Figure.1

OR

3.a) Give the f-i analogy of mechanical rotational system and electrical system.
b) Derive the transfer function of the mechanical system shown in figure 2. [3+7]



4.a) For a unity feedback system given by $G(s)=\frac{20(s+2)}{s(s+3)(s+4)}$.

i) Find the static error constants ii) Find the steady state error for r(t) = 3 u(t) + 5 tu(t).

b) Explain about standard test signals. [7+3]

OR

5.a) A servo mechanism is characterized by the differential equation.

$\frac{d^2c}{dt^2}+6.4\frac{dc}{dt}+160[0.46c-r]=0$. Find the value of damping ratio.

b) Explain about time domain specifications. [5+5]

6.a) Sketch the root locus of $G(s)H(s)=\frac{K}{s(s+2)(s^2+2s+5)}$.

b) What is the effect of adding poles to G(s)H(s). [7+3]

OR

7.a) What is the effect of adding zeros to G(s)H(s).

b) Sketch the root locus plot of $G(s)H(s)=\frac{K}{s(s+1)(s+3)}$.

[3+7]

8. Draw the Bode magnitude and phase angle plots for the transfer function

$G(s)=\frac{2000(s+1)}{s(s+10)(s+40)}$.

[10]

OR

9.a) What is compensator? Explain about lead compensator.

b) Explain about frequency domain specifications. [6+4]

10.a) Derive STM using laplace transform method.

b) Diagonalize the system matrix given below.

$$A=\begin{bmatrix}0 & 1 & 0\\ 3 & 0 & 2\\ -12 & -7 & -6\end{bmatrix}.$$

[4+6]

OR

11.a) What is observability? Explain the tests for observability.

b) Check whether the system represented by

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u$$ is observable or not. [4+6]

---ooOoo---

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Code No: 55012

R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B. Tech III Year I Semester Examinations, December - 2014

CONTROL SYSTEMS

(Common to EEE, ECE & ETM)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1.a) Explain the feedback effect on parameter variation.
b) Obtain the transfer function of the mechanical system shown below in figure 1.

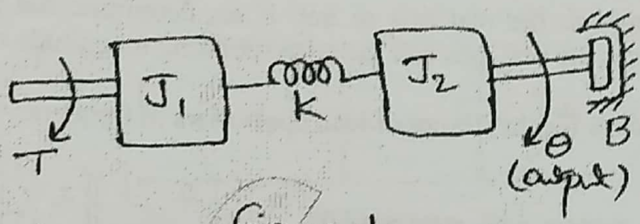

Figure 1.

2.a) Derive the transfer function of field controlled dc servo motor.
b) The block diagram of a speed control system is shown below in figure 2. Determine its transfer function.

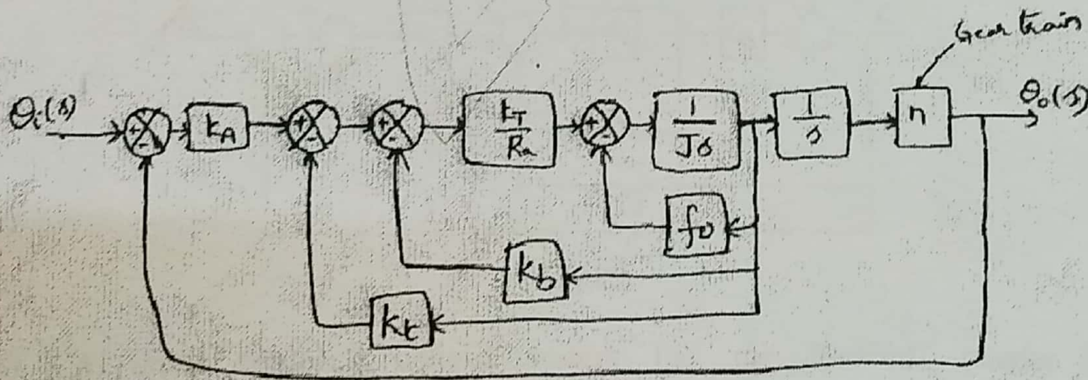

Figure 2

3.a) What is the beneficial effect of derivative error compensation on important performance indices of a type-1 control system? Elaborate.
b) A unity negative feedback control system has the plant $G(s)=\frac{k}{s\left(s+1.5\sqrt{k}\right)}$. Determine its peak overshoot and settling time due to unit step input. Determine the range of k for which the settling time is less than 1 sec.

4. The open loop transfer function of a feedback system is $G(s)H(s)=\dfrac{k}{s(s+4)(s^2+4s+20)}$. Draw the root locus and investigate the stability of the system.

5. Sketch the Bode plot for the transfer function $G(s)=\dfrac{ke^{-0.1s}}{s(1+s)(1+0.01s)}$ and determine the system gain k for the gain cross over frequency to be 5 rad/sec.

6. Sketch the polar plot of the transfer function $G(s)=\dfrac{1}{(1+s)(1+2s)}$. Determine whether this plot crosses the real axis or not. If so, determine the frequency at which the plot crosses the real axis and the corresponding magnitude of G(s).

7. Describe the procedure for the design of lead controllers in frequency domain.

8. Consider a control system with state model $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 2\end{bmatrix}u$ Where u is unit step function and $x(0)=\begin{bmatrix}0\\ 1\end{bmatrix}$. Compute the state transition matrix and there from find the response for t>0.

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Code No: 09A50204

R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, November/December - 2012
CONTROL SYSTEMS
(Common to EEE, ECE, ETM)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Derive the relevant expressions to establish the effect of feedback on sensitivity, signal to noise ratio and rate of response. −9 & 10

b) For the electrical system shown in Fig.P1(c), for given input i_1, find v_3 in terms of i_1. [7+8]

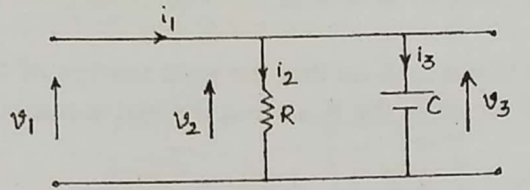

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Fig. P1(c)

2. Find the closed loop transfer function of the system whose block diagram is given in Fig P2 using block diagram reduction techniques and verify the result using signal flow graph technique. [15]

p-120

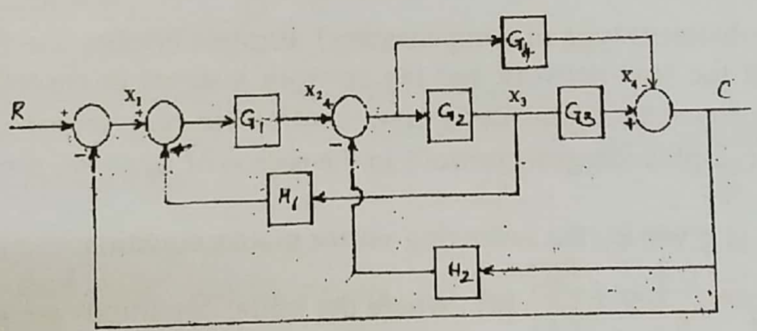

Fig P2.

3.a) A unity feedback control system has the forward transfer function $G(s) = \dfrac{25}{s(s+6)}$. Find the rise time, peak time and the maximum over shoot for unit step input.

b) Find the error constants and steady state error for a velocity input r(t) = 2t and step input of 2 units. The system is described by $G(s)\,H(s) = \dfrac{10}{s(s+5)}$. [7+8]

4.a) Sketch the root locus plot for the control system with a forward transfer function $G(s) = \dfrac{K(s+2)}{s^2+2s+3}$ and $H(s) = 1$.

b) A unity feedback system has the forward transfer function $G(s) = \dfrac{K(s+13)}{s(s+3)(s+7)}$, using R-H criterion, find the range of K for which the closed loop system is stable. [7+8]

5. The open loop transfer function of a unity feedback control system is

$$G(s) = \frac{K}{s(1+0.1s)(1+s)}$$

222 a) Determine the value of K so that the resonance peak Mp of the system is equal to 1.4.

b) Determine the value of K so that the gain margin of the system is 20 db.

c) Determine the value of the K so that the phase margin of the system is 60°.

[15]

6. Sketch the Nyquist plot for the transfer function:

$G(s)\,H(s) = \dfrac{52}{(s+2)(s^2+2s+5)}$. Find the relative stability parameters and discuss its stability. [15]

7.a) What are different type of compensators? Explain briefly. — 535

b) Show that the lead network and lag network inserted in cascade in an open loop acts as proportional-plus-derivative control (in the region of small ω) and proportional-plus-integral control (in the region of large ω), respectively. [7+8] 5U

8. A system is given by the following vector matrix equation:

$\dot{X} = \begin{bmatrix} 0 & 1 \\ -4 & -5 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} [u]$, where the initial conditions are given by

$X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

Determine

(a) State transition matrix,

(b) Zero input response

(c) Zero state response for u=1,

(d) Total response. [15]

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Code No: 09A50204 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B. Tech III Year I Semester Examinations, November/December-2013

CONTROL SYSTEMS

(Common to EEE, ECE, ETM)

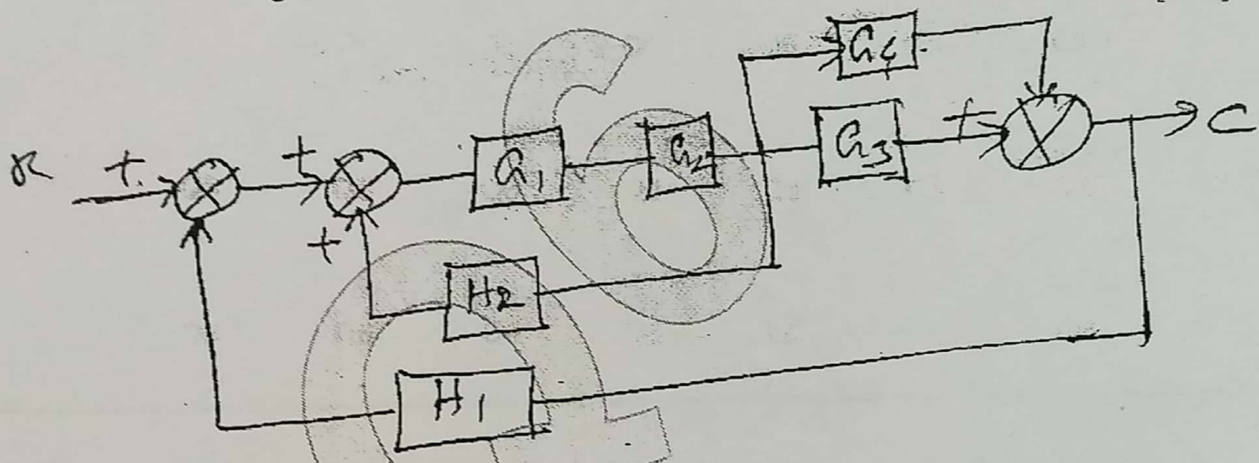
Time: 3 hours **Max. Marks: 80**

Answer any five questions
All questions carry equal marks

\- - -

1.a) What are the merits and de-merits of open-loop and closed-loop systems.
b) Explain the characteristics of feed-back and effects of feed-back. [7+8]

2.a) Explain Mason's Gain Formula.
b) Using signal flow graph method determine the gain C/R for the block diagram shown in figure. [7+8]



3.a) Derive expressions for rise-time, peak time end peak over short.
b) Obtain the unit-step response of a unity feed back system whose open-loop transfer function is $G(s) = \dfrac{4}{s(s+s)}$. [7+8]

4. A unity feed back control system has an open-loop transfer-function $G(s) = \dfrac{K}{s(s^2+4s+13)}$. Sketch the root locus. [15]

5.a) Define Phase margin and gain margin.
b) The specifications given on a certain second order feed back control system is that the over shoot of the step response should not exceed 25%.
i) What are the corresponding limiting values of the damping ratio and the peak resonance Mr?
ii) Determine the corresponding values for ω_r and t_p when $\omega_n = 10 rad/sec$. [15]

6.a) Sketch the Bode plot for the system having $G(s)H(s)=\frac{20}{s(1+0.1s)}$ and obtain phase margin and gain margin.

b) Write short note on polar plots. [7+8]

7. Open loop transfer function of an unity feedback system is $G(s)=\frac{500}{s(0.1s+1)}$.

Design a suitable compensator so that the system acquires a damping factor of 0.4 with out loss of steady state stability. [15]

8. Write short notes on:

a) Concepts of state and state variables

b) Obtain state model for the following differential equation $\dddot{y}+2\ddot{y}+6\dot{y}+7y=u.$ [7+8]

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