MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Department of Electrical and Electronics Engineering
Question Bank - Academic Year (2021-22)

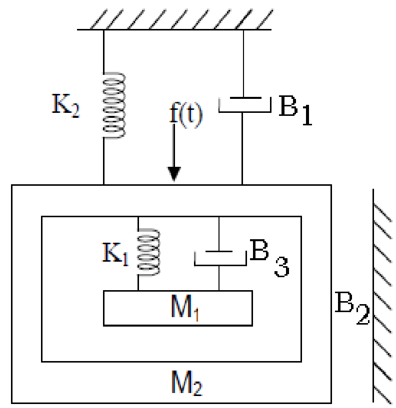
Course Code & Course Name	**:**	**19EEC06 / CONTROL SYSTEMS**
Name of the Faculty	**:**	**Dr. R. PRAKASH**
Year/Sem	**:**	**II/IV**

Unit-I: System and Its Representation
Part-A (2 Marks)

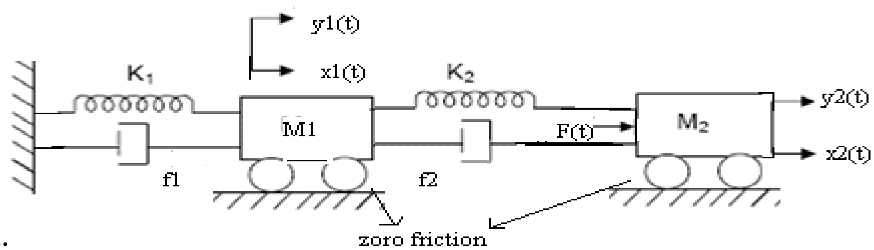
1. Formulate the force balance equation for ideal dash pot and ideal spring.
2. Create the expression for Masons gain formula to find the system transfer function.
3. Can we use servomotor for position control? Support the answer with necessary details.
4. Give the aligned position of a Synchro transmitter and synchro receiver.
5. Define open loop and closed loop system.
6. Compare Signal Flow Graph approach with block diagram reduction technique of determining transfer function.
7. State the terms Path and Forward Path.
8. Mention the Block Diagram Reduction techniques.
9. Describe the characteristics of negative feedback in control systems.
10. Write short notes on Synchros.

Part-B (16 Marks)

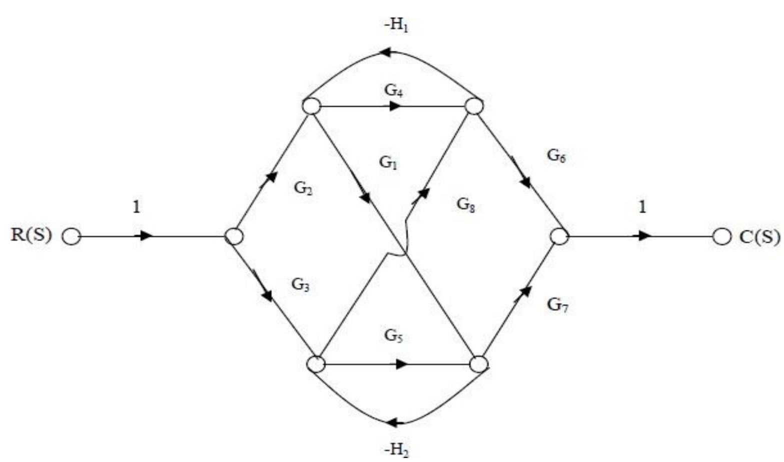
1. For the mechanical system shown in figure, draw the force-voltage and force-current electrical analogous circuit.



2. Determine the transfer function of the mechanical system shown in figure. Also draw its F-V analogy circuit and F-I analogy circuit.

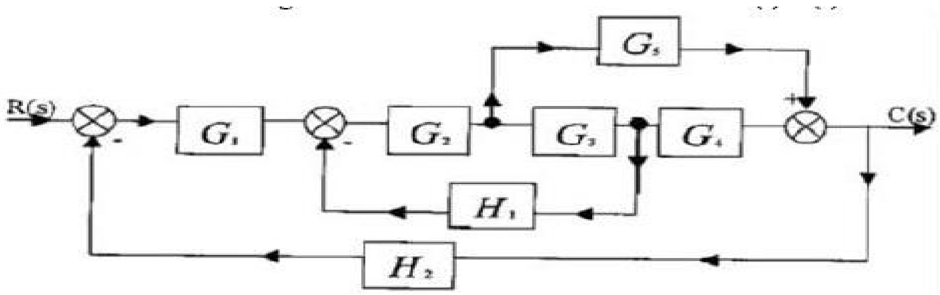


3. Find the overall gain of the system whose signal flow graph is shown in figure.



4. (i) Derive the equations of transfer function of Armature controlled DC motor.

(ii) Reduce the block diagram and obtain C(s) / R(s).



5. (i)Compare DC Motor and DC Servo Motor and list out the applications of DC Servo Motor.
(ii)With neat diagram, explain the working principle of Field Controlled DC Servo Motor.

Unit-II: Time Response
Part-A (2 Marks)

1. Infer why derivative controller is not separately used in control systems.
2. Write down the relation between static and dynamic error coefficients.
3. Give the type and order of the following system $G(S)H(S)=200/S^2+20S+200$
4. What is steady state error? Mention the 3-different static error constants.
5. What is meant by time response?
6. Distinguish between type and order of the system.
7. State the settling time.
8. Define peak overshoot.
9. Write short notes on transient response & steady state response?
10. What are the standard test signals and for what purpose standard test signals are used?

Part-B (16 Marks)

1. (i) A unity feedback system is characterized by the open-loop transfer function G(s) = 1/ (s (0.5s+1) (0.2s+1)). Determine static error constants and the steady state errors for unit-step, unit-ramp and unit-acceleration inputs.

   (ii) 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 of the system. Obtain the steady state error of the system, when Subjected to an input given by the polynomial, $r(t) = a_0+a_1t+(a_2/2)t^2$.
2. Measurements conducted on a Servomechanism show the system response to be c(t)=1+0.2 ê-60t -1.2 ê –10 t. when subjected to a unit step. Obtain an expression for closed loop transfer function and also calculate rise time, peak time, Maximum overshoot and settling time.

3. A unity feedback control system has 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. Find the rise time, percentage overshoot, peak time and settling time for a step input.

4. Discuss the functioning P, I and D controllers with necessary diagrams and state how they are used to meet the specifications for the given system.
5. A unity feedback control system has the forward path transfer function

$$G(S) = \frac{K}{S+9}$$

   Choose the value of K such that the closed loop system has a damping ratio of 0.5. For this value of K, find the steady state error of the closed loop system when it is subjected by an input given by $r(t) = 1.5 + 2t + 0.5t^2$.

Unit –III: Frequency Response

Part-A (2 Marks)

1. State cut-off rate & resonant peak(Mr).
2. Define bandwidth.
3. Draw the polar plot for the transfer function G(S)=1/(1+TS).
4. Illustrate the circuit of lead compensator and draw its pole zero diagram.
5. What is meant by frequency response of system? What are frequency domain specifications?
6. List the frequency domain methods to find the stability of the system.
7. Give the advantages of frequency response analysis?
8. What is a polar plot? Give the advantages of polar plots?
9. Formulate the transfer function of a lead compensator network.
10. What is Nichol's chart?

Part-B (16 Marks)

1. Sketch the polar plot for the following transfer function and find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. G(S) = 400/ S (S+2)(S+10)
2. Sketch the Bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. G(S) = 10(1+0.1S)/ S(1+0.01S) (1+S).
3. Write the short notes on correlation between the time and frequency response?
4. Given G(s) =$Ke^{-0.2s}$/s(s+2)(s+8).Draw the Bode plot and find K for the following two cases: Gain margin equal to 6dB and Phase margin equal to 45°.
5. Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies. G(S) = 10/ S(1+0.4S) (1+0.1S)

Unit IV: Stability and Compensator Design
Part-A (2 Marks)

1. Identify any two limitations of Routh-stability criterion.
2. Point out the advantages of Nyquist stability criterion over that of Routh's criterion.
3. What is meant by system stability?
4. State Nyquist stability criterion.
5. List the advantages of Routh Hurwitz stability criterion.
6. What is the advantage of using root locus for design?
7. Express the rules to obtain the breakaway point in root locus
8. Describe BIBO stability Criterion
9. Define Centroid.
10. Write about Root locus Method.

Part-B (16 Marks)

1. (i)Express the mathematical preliminaries for nyquist stability criterion.
   (ii)Explain the procedure for Nyquist Stability Criterion.
2. (i) State and explain about different cases of Routh Hurwitz criterion.
   (ii)Point out the concepts BIBO stability.
   (ii) Write detailed notes on relative stability with its roots of S- plane.
3. Construct the root locus and determine the stability of the system whose characteristic equation is $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$.Aloso determine the number of roots lying on right half of s-plane,left half of s-plane and on imaginary axis.
4. Draw the root locus of the following system. G(S)=K(S+3)/S(S+1)(S+2)(S+4)
5. By routh stability criterion determine the stability of the system represented by the characteristic equation $9s^5-20s^4+10s^3-s^2-9s-10=0$.Comment on the location of roots of characteristic equation.

Unit V: State Variable Analysis

Part-A (2 Marks)

1. Name the methods of state space representation for phase variables.
2. What is meant by quantization?
3. Write the properties of State transition matrix?
4. Determine the controllability of the system described by the state equation.
5. Evaluate modal matrix.
6. List the advantages of Sate Space representations?
7. Describe State and State Variable.
8. Define State equation.
9. Analyze the concept of Controllability.
10. Summarize Sampled –data Control System.

Part-B (16 Marks)

1. Explain the stability analysis of sampled data control systems.
2. Mention in detail a state space representation of a continuous time systems and discrete time systems.
3. Examine how controllability and observability for a system can be tested, with an example.
4. A system is represented by state equation X= AX + BU; Y= CX. Determine the transfer function of the system Where,

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix}, C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$$

5. Test the controllability and observability of the system by any one method whose state space representation is given as

$$\begin{bmatrix} X1 \\ X2 \\ X3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} X1 \\ X2 \\ X3 \end{bmatrix} + \begin{bmatrix} X1 \\ X2 \\ X3 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} X1 \\ X2 \\ X3 \end{bmatrix}.$$

Subject Faculty HOD