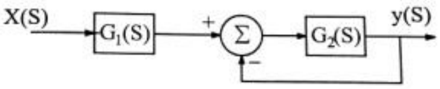
**SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES (AUTONOMOUS)**
**16EEE223 - CONTROL SYSTEMS**
**ACADEMIC YEAR 2018-19**

## QUESTION BANK
## PART A – 2 MARKS QUESTIONS

### UNIT-1 MATHEMATICAL MODELING OF SYSTEMS

1. Define control system.
2. Give some basic properties of signal flow graph.
3. Find the transfer function of the network given in fig.




4. Why negative feedback is preferred in control system?
5. Define Transfer function.
6. What do you mean by Linear-Time invariant systems?
7. What is the electrical analogy of force and rotational damping in torque-voltage analogy?
8. Write Mason's gain formula.
9. Write any two advantages of block diagram representation.
10. What are the basic components of an automatic control system?

### UNIT-II TIME RESPONSE AND STABILITY ANALYSIS

1. State the effect of PI compensation in system performance.
2. What are the basic elements used for modelling mechanical rotational system?
3. Specify the time domain specifications.
4. State the significations of Nichol's plot.
5. What are constant M & N circles?
6. How the system is classified based on damping ratio?
7. What is meant by steady state error?
8. What is the effect of PI controller on the system performance?
9. Define rise time and write its expression.
10. Define damping ratio.

### UNIT-III FREQUENCY DOMAIN ANALYSIS

1. How will you find the root locus on real axis?
2. Find the range of K for closed loop stable behaviour of system with characteristic equation $2S^4+12S^3+22S^2+12S+K$ using Routh Hurwitz criterion.
3. What are the advantages of Routh Hurwitz Criterion?
4. What is a dominant pole?
5. Define root locus.
6. Define Routh Hurwitz Criterion.
7. What is breakaway point?
8. What is breakin point?
9. What is centroid?
10. What is angle of departure?

### UNIT-IV CONTROLLERS AND COMPENSATORS

1. Define Nyquist stability criterion.
2. Draw the polar plot for G(s)= $1/(1+4S)(1+7S)$
3. What is corner frequency?
4. What is Nichol's chart?

5. Define stability.
6. Define gain margin and phase margin.
7. Define phase cross over frequency.
8. Define gain cross over frequency.
9. Define bode plot.
10. Define polar plot.

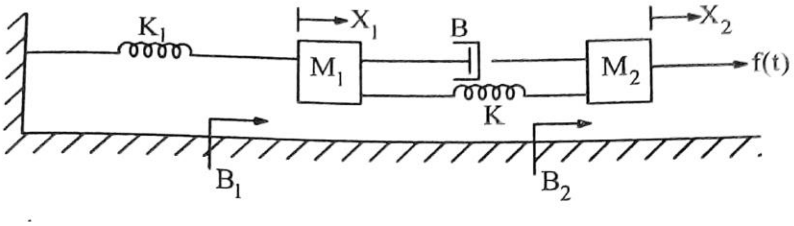
## UNIT-V STATE SPACE ANALYSIS

1. Write advantages of state space approach.
2. Write the expression for transfer function in terms of state model.
3. Define controllability.
4. Write the general expression for state model of a system.
5. What is the difference between Kalman's and Gilberth's test?
6. Define state and state variable of a model system.
7. List the main properties of a state transition matrix.
8. State Sampling theorem
9. Define observability of a system.
10. Draw the sampler and hold circuit.

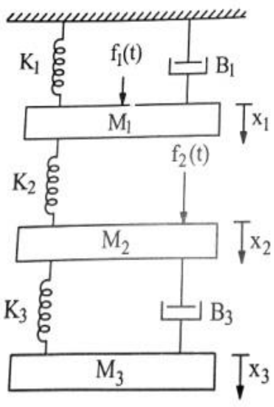
## PART-B (10 MARK QUESTIONS)

## UNIT-I MATHEMATICAL MODELING OF SYSTEMS

1. Explain the features of closed loop feedback control system.
   [Refer Pg.no.1.2]
2. List out the Guidelines to determine the Transfer function of Mechanical Rotational System.
   [Refer Pg.no.1.18]
3. Write the differential equations governing the mechanical translational system shown in fig. and determine the transfer function.

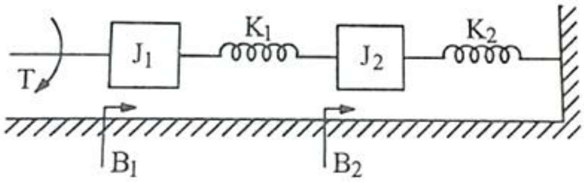



   [Refer Pg.no.1.9 --- Example 1.1]
4. Write the differential equations governing the mechanical translational system as shown in fig. draw the Force-Voltage and Force-Current analogous circuits and verify by mesh and node equations.



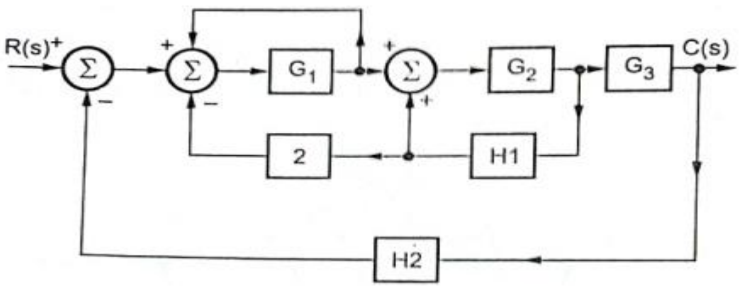

   [Refer Pg.no.1.35 --- Example 1.9]

5. Write the differential equations governing the mechanical rotational system shown in fig. Draw the electrical equivalent analogy circuits.

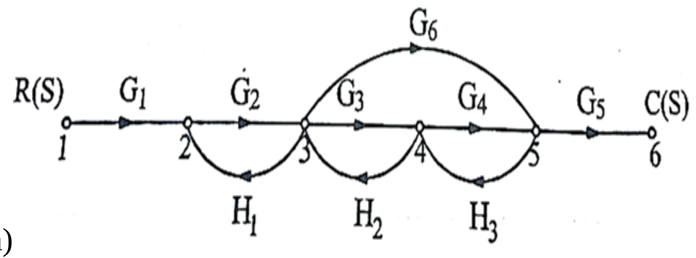



[Refer Pg.no.1.49 --- Example 1.12]

6. Find the transfer function of the system shown in fig using block diagram reduction technique and signal flow graph.

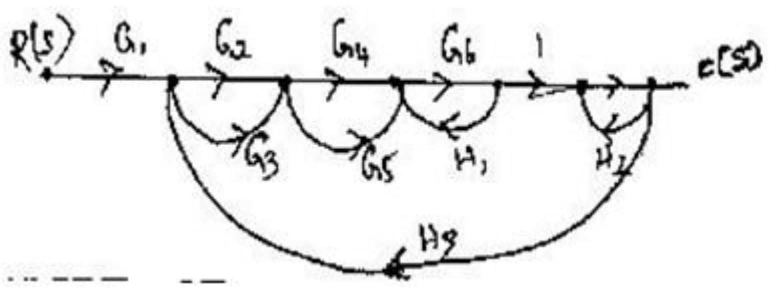



7. Use Mason's gain formula for determining the overall T.F. of the system shown.




(a)

[Refer Pg.no.1.93 --- Example 1.29]



(b)

## UNIT-II TIME RESPONSE AND STABILITY ANALYSIS

1. 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 peak overshoot for a unit step input.

   [Refer Pg.no.3.27 --- Example 3.4]
2. State and explain the effect of PID controllers on the system dynamics

   [Refer Pg.no.2.20 & 3.23]
3. Derive the response of second order under damped system with unit step input.

   [Refer Pg.no.3.11 – 3.13]

4. **Derive the response of second order critically damped system with unit step input.**

   [Refer Pg.no.3.13 – 3.14]

5. For a unity feedback control system the open loop transfer function $G(s)=\frac{10(S+2)}{S^2(S+1)}$

   i) Find position, velocity and acceleration error constants

   ii) Find the steady state error when the input is R(S) where $R(s)=\frac{3}{S}-\frac{2}{S^2}+\frac{1}{3S^3}$

   [Refer Pg.no.3.45 --- Example 3.11]

6. **Explain the Time domain specifications with neat diagram.**

   [Refer Pg.no.3.16 – 3.18]

7. **Derive the response of second order over damped system with unit step input.**

   [Refer Pg.no.3.15 – 3.16]

## UNIT-III FREQUENCY DOMAIN ANALYSIS

1. Using Routh Hurwitz criterion determine the stability of the system representing the characteristics equation $S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$. Comment on location of roots of the characteristic equation.

   [Refer Pg.no.5.13 --- Example 5.2]

2. Using Routh Hurwitz criterion determine the stability of the system representing the characteristics equation $S^5+S^4+2S^3+2S^2+3S+5=0$. Comment on location of roots of the characteristic equation.

   [Refer Pg.no.5.14 --- Example 5.3]

3. With neat steps write down the procedure for construction of root locus. Each rule give an example.

   [Refer Pg.no.5.67 - 5.70]

4. A unity feedback control system has an open loop transfer function $G(S) = K / (S(S^2+4S+13))$. Sketch the root locus.

   [Refer Pg.no.5.71 --- Example 5.22]

5. A unity feedback control system has an open loop transfer function $G(S) = K / (S(S+2)(S+4))$. Sketch the root locus.

   [Refer Pg.no.5.75 --- Example 5.23]

6. A unity feedback control system has an open loop transfer function $G(S) = K(S+9) / (S(S^2+4S+11))$. Sketch the root locus.

   [Refer Pg.no.5.79 --- Example 5.24]

## UNIT-IV CONTROLLERS AND COMPENSATORS

1. Sketch the bode plot and find the gain and phase margin.

$$G(S) = \frac{20}{S(1+3S)(1+4S)}.$$

   [Refer Pg.no.4.34 --- Example 4.5]

2. Sketch the bode plot and find the gain and phase margin.

$$G(S) = \frac{10}{S(1+0.4S)(1+0.1S)}.$$

   [Refer Pg.no.4.31 --- Example 4.4]

3. Sketch the bode plot and find the gain and phase margin. G(S) = $\frac{5}{S(S+10)(S+20)}$.

**4.** For the following transfer function draw the polar plot find and determine the gain and phase margin.
G(S) H(S) = 1 / (S(1+S)(1+2S))
[Refer Pg.no.4.44 --- Example 4.7]

**5.** For the following transfer function draw the polar plot find and determine the gain and phase margin.
G(S) H(S) = 1 / ($S^2$(1+S)(1+2S))
[Refer Pg.no.4.47 --- Example 4.8]

**6.** Draw the Nyquist plot for the system whose open loop transfer function is G(S) H(S) = K / (S(S+2)(S+10)). Determine the range of K for which closed loop system is stable.
[Refer Class notes]

## UNIT-V STATE SPACE ANALYSIS

1. Consider a system with state space model given below.

$$X = \begin{vmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -1 \end{vmatrix} X + \begin{vmatrix} 0 \\ 5 \\ -24 \end{vmatrix} u \; ; \; y = |1 \quad 0 \quad 0| \; x + |0| u$$

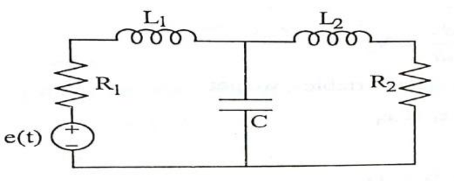
Verify that system is observable and controllable.
[Refer Class notes]

2. Consider a system with state space model given below.

$$X = \begin{vmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{vmatrix} X + \begin{vmatrix} 0 \\ 2 \\ 0 \end{vmatrix} u \; ; \; y = |1 \quad 0 \quad 0| \; x + |0| u$$

Verify that system is observable and controllable.
[Refer Class notes]

3. Construct the state model of the following electrical systems.




[Refer Pg.no.7.10 --- Example 7.1]

4. Draw the state model of a linear single input single output system and obtain its corresponding equations.
[Refer Pg.no.7.2 --- Section 7.3]

5. Consider the following system with differential equation given by
$\dddot{y} + 6\ddot{y} + 11\dot{y} + 6y = 6u$
[Refer Class notes]

6. Obtain the state model in diagonal canonical form.
[Refer Pg.no.7.31 --- Section 7.7]