Chettinad College of Engineering & Technology
Approved by AICTE-New Delhi and Affiliated to Anna University-Chennai

Academic Year 2024-2025

Question Bank

Year/Semester: II/ III **Date: 12/08/2024**	**Department : ECE** **Subject Code/Title : EC3351 / Control Systems** **Faculty Name : Ms.D.Ragavi**	**Unit : I** **Section : Part A/B/C**

UNIT I

SYSTEMS COMPONENTS AND THEIR REPRESENTATION

Part A:

1. **What is control system? (R)**

A system consists of a number of components connected together to perform a specific function. In a system when the output quantity is controlled by varying the input quantity then the system is called control system.

2. **What are the two major types of control system? (R)**

The two major types of control system are open loop and closed loop.

3. **Define open loop control system. (R)**

The control system in which the output quantity has no effect upon the input quantity is called open loop control system. This means that he output is not feedback to the input for correction.

4. **Define closed loop control system.(R)**

The control system in which the output has an effect upon the input quantity so as to maintain the desired output value is called closed loop control system.

5. **What are the components of feedback control system? (R)**

The components of feedback control system are plant, feedback path elements, error detector and controller.

6. **Distinguish between open loop and closed loop system.(AZ)**

1. Inaccurate	Accurate
2. Simple and economical	Complex and costlier
3. The changes in output due to external disturbance are not corrected	The changes in output due to external disturbances are corrected automatically

4. They are generally stable	Great efforts are needed to design a stable system

7. **Why negative feedback is invariably preferred in closed loop system? (AZ)**

   The negative feedback results in better stability in steady state and rejects any disturbance signals.

8. **Define transfer function.** (**R)**

   The transfer function of a system is defined as the ratio of the Laplace transform of output to Laplace transform of input with zero initial conditions.

9. **What are the basic elements used for modeling mechanical translational system**. (**R)**

   Mass, spring and dashpot.

10. **What are the basic elements used for modeling mechanical rotational system? (R)**

    Moment of inertia J, dashpot with rotational frictional coefficient B and torsional spring with stiffness K.

11. **Write the force balance equation of an ideal mass element. (A)**

    $F = M\, d^2x/dt^2$

12. **Write the force balance equation of ideal dashpot element. (A)**

    $F = B\, dx/dt$

13. **Write the force balance equation of ideal spring element. (A)**

    $F = kx$

14. **Name two types of electrical analogous for mechanical system.** (**R)**

    The two types of analogies for the mechanical system a Force voltage and force current analogy.

15. **Write the analogous electrical element's in force voltage analogy for the elements of mechanical translational system. (A)**

    - Force-voltage e
    - Velocity v-currents
    - Displacement x-charge q
    - Frictional coefficient B-Resistance R
    - Mass M-Inductance L
    - Stiffness K-Inverse of capacitance 1/C

16. **Write the analogous electrical elements in force current analogy for the elements of mechanical translational system.** (**A)**

- Force-current i
- Velocity v-voltage v
- Displacement x-flux φ
- Frictional coefficient B-conductance 1/R
- Mass M- capacitance C
- Stiffness K-Inverse of inductance 1/L

17. What is block diagram? (R)

A block diagram of a system is a pictorial representation of the functions performed by each component of the system and shows the flow of signals. The basic elements of block diagram are block, branch point and summing point.

18. What is the basis for framing the rules of block diagram reduction technique? (R)

The rules for block diagram reduction technique are framed such that any modification made on the diagram does not alter the input output relation.

19. What is a signal flow graph? (R)

A signal flow graph is a diagram that represents a set of simultaneous algebraic equations. By taking L. Į the time domain differential equations governing a control system can be transferred to a set of algebraic equations in s-domain.

20. What is transmittance? (R)

The transmittance is the gain acquired by the signal when if travels from one node to another node in signal flow graph.

21. What is sink and source? (R)

Source is the input node in the sig al for graph and it has only outgoing branches. Sink is an output node in the signal flow graph and it has only incoming branches.

22. Define non touching loop. (R)

The loops are said to be no touching if they do not have common nodes.

23. Write Masons Gain formula. (A)

Masons Gain formula states that the overall gain of the system is

$T= 1/\Delta \Sigma P_k \Delta_k$

k- Forward path in the signal flow graph

P_k -Forward path gain of k^{th} forward path

Δ = 1-[sum of individual loop gains +[sum of gain products of all possible combinations of two non touching loops]-[sum of gain products of all possible

combinations of three non touching loops]+...

Δ_k = Δ for that part of the graph which is not touching kth forward path.

24. What is servomechanism? (R)

The servomechanism is a feedback control system, in which the output is mechanical position (or time derivatives of position velocity and acceleration).

25. What is servomotor? (R)

The motors used in automatic control systems or in servomechanism are called servomotors. They are used to convert electrical signal into angular motion.

26. What is synchro? R

A synchro is a device used to convert an angular motion to an electrical signal or vice versa.

27. Why negative feedback is invariably preferred in closed loop system? (AZ)

The negative feedback results in better stability in steady state and rejects any disturbance signals.

28. What are the basic properties of signal flow graph? (R)

The basic properties of signal flow graph are

- Signal flow graph is applicable to linear systems.
- It consists of nodes and branches.
- A node adds the signal of all incoming branches and transmits this sum to all
- outgoing branches.
- Signals travel along branches only in the marked direction and is multiplied by
- the gain of the branch.
- The algebraic equations must be in the form of cause and effect relationship.

29. Name any two dynamic models used to represent control systems. (R)

- Translational model
- Rotational model

30. Write the analogous electrical elements in force voltage analogy and force current analogy for the elements of mechanical translational and rotational system. (A)

Translational/Rotational System	Force Voltage Analogy	Force Current Analogy
Force, f or Torque, T	Voltage, e	current, i
Velocity, V or Angular Velocity, ω	current, i	Voltage, e

Displacement, x or θ charge , q flux, Φ

Angular Displacement

Frictional coefficient, B Resistance

or Frictional coefficient, B Mass, M or Moment of Inertia, J inductance, L capacitance C

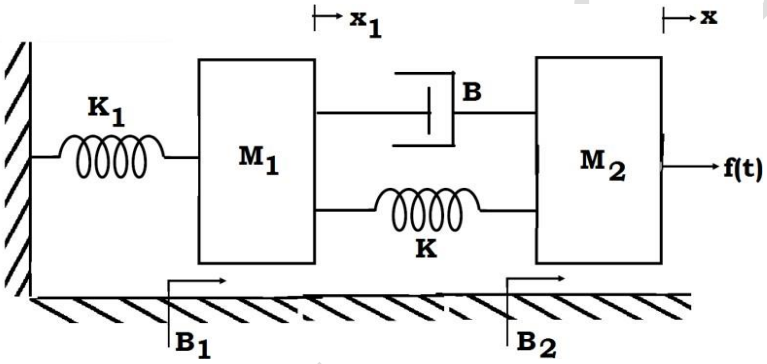
Stiffness, K or Stiffness, K Inverse of capacitance 1/C Inverse of inductance, 1/L

Newton‟s second law Kirchhoff‟s voltage law Kirchhoff‟s current law.

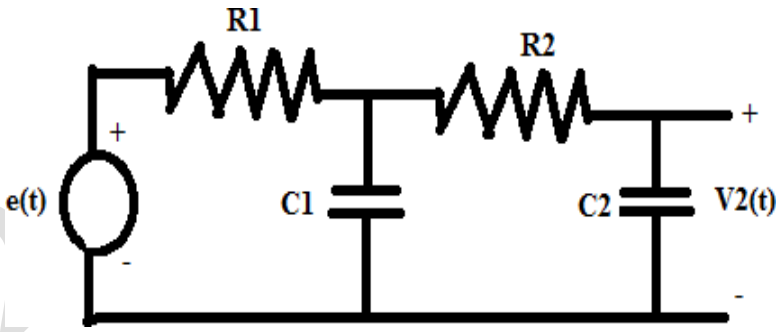
Part B:

1. Inspect the given system and derive the differential equations governing the system (**E)**

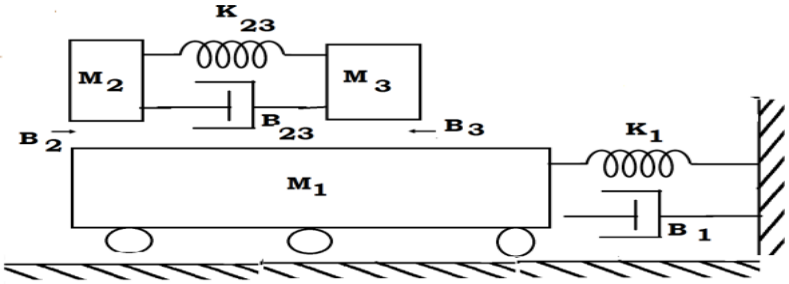
(i) Mechanical System **(7)**



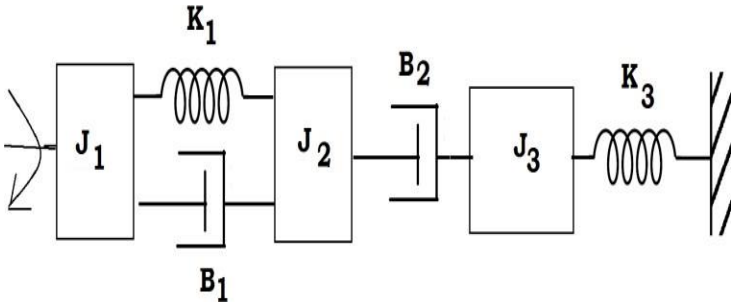
(ii) Electrical System **(6)**



2. Write the differential equations governing the mechanical system shown in figure. Draw the force voltage and force current analogous circuits**.(13) (C)**



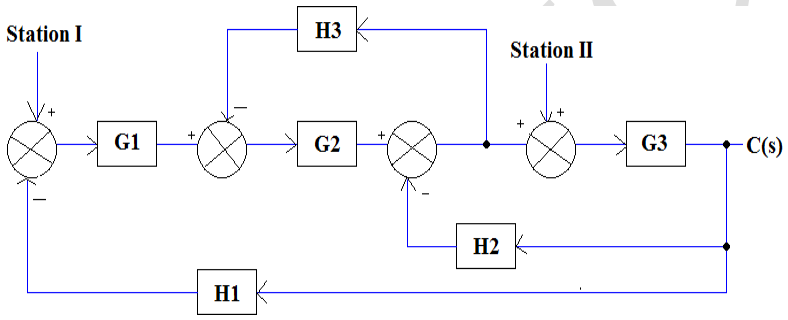
3. Give the Torque voltage and torque current analogous circuit for the given system. **(13) (C)**



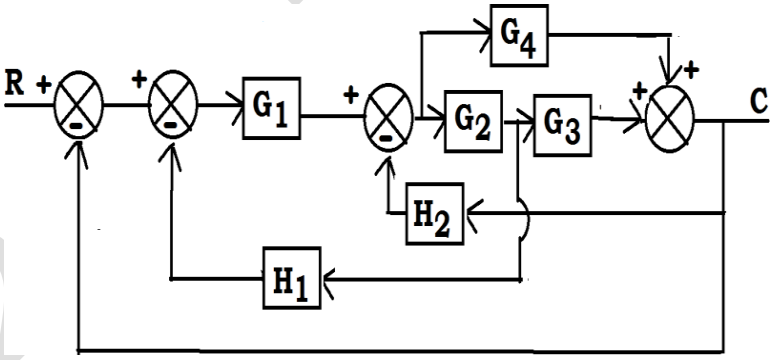
4. (i) State the block diagram reduction rules with example**. (7) (U)**

(ii) Mention in detail about any five terminologies used in signal flow graph**.(6) (R)**

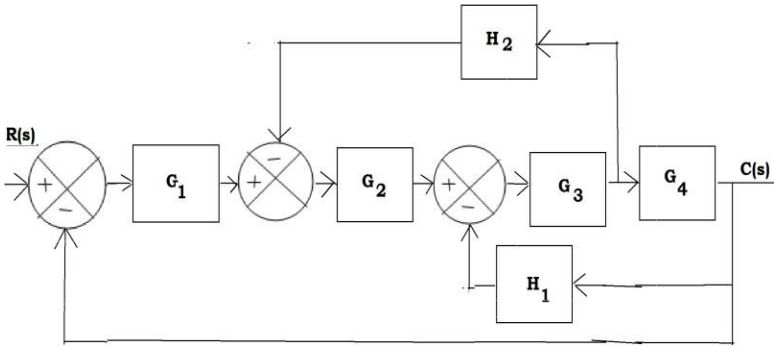
5. Evaluate the transfer function for the given system when the input R is (i)at station I (ii) at station II**.(13) (E)**



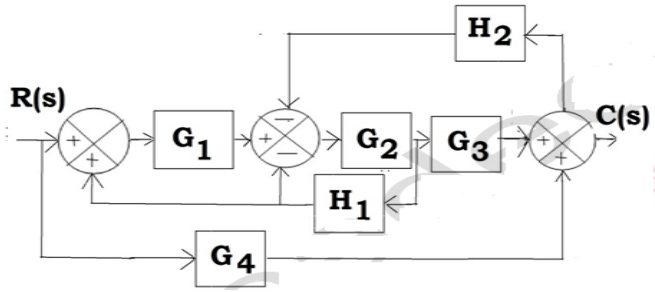
6. Analyze the given block diagram to derive the transfer function**. (13) (AZ)**



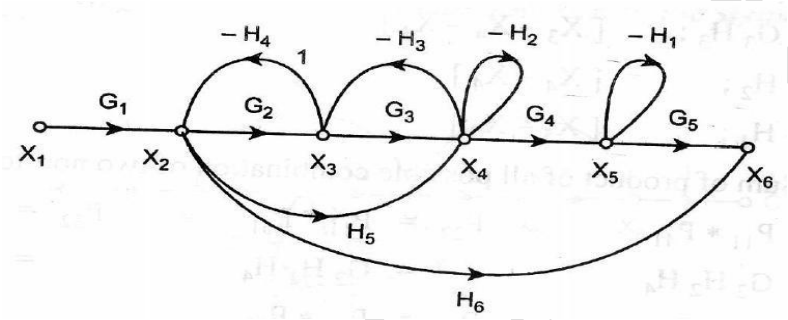
7. Examine the given system and reduce it to determine the transfer function **(13) (U)**



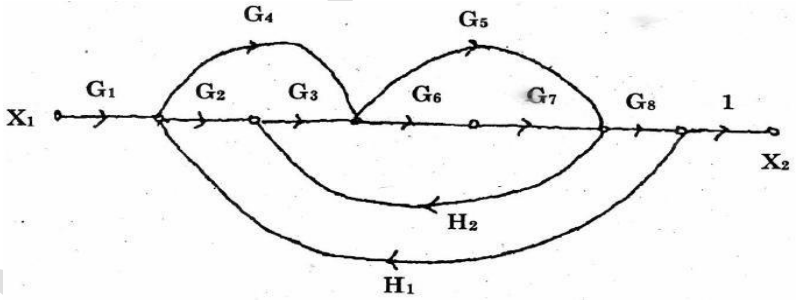
8. Utilize block diagram reduction rules to calculate the transfer function of the given system? **(13) (E)**



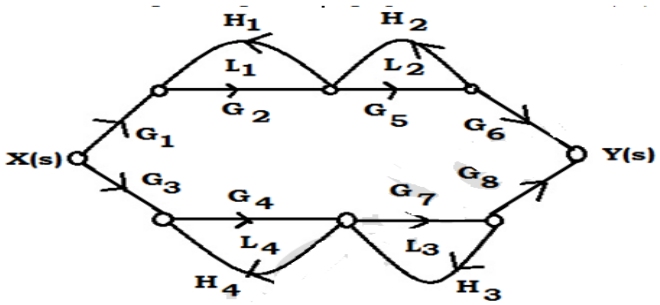
9. Illustrate Masons formula to derive the transfer function of a given SFG **.(13) (C)**



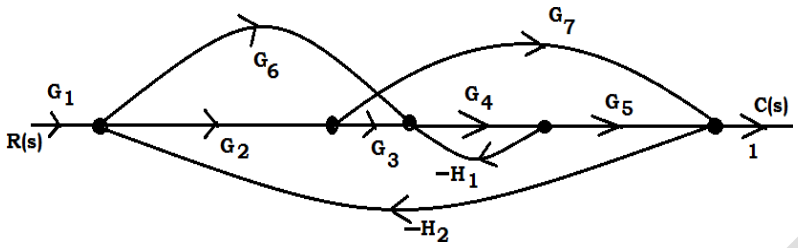
10. Demonstrate the usage of Mason's gain formula to derive the transfer function of the given graph**.(13) (C)**



11. Apply Masons gain formula to determine the transfer function of the given signal flow graph**.(13) (A)**



12. Obtain the closed loop transfer function of the system from the given Signal Flow graph**.(13) (A)**



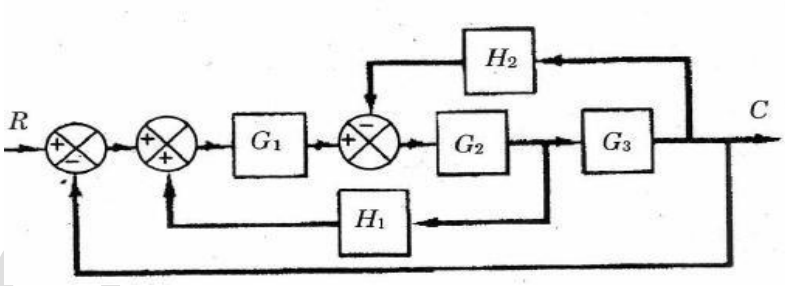
13. (i) Explain with a neat block diagram explain the working of field controlled DC motor as a control system**.(7) (U)**

(ii) Explain the features of closed loop control system**.(6) (U)**

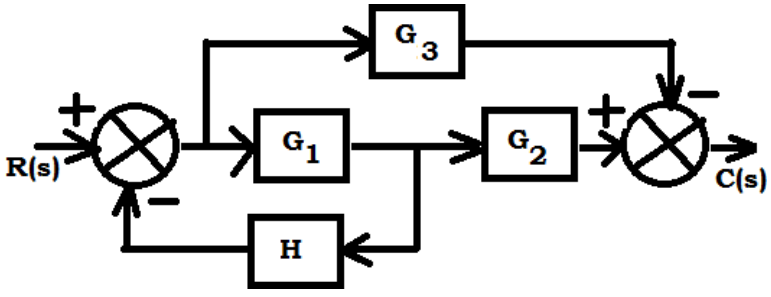
14. Narrate about the servomotor used in control system **(13) (R)**

Part C:

1. Convert the block diagram shown in figure to signal flow graph and find the transfer function using mason's gain formula. Verify with the block diagram approach**.(15) (C)**



2. Simplify the following diagram using block diagram reduction method. Also derive the transfer function of the same using signal flow graph**.(15) (A)**



3. Describe with a neat block diagram the working of Armature controlled DC motor as a control system.(**15) (U)**
4. Summarize about the construction, principle and usage of synchros in control systems**.(15) (U)**

Note : Refer class notes for Model Problems

Faculty Incharge **Head of the Department**

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HoD Remarks: