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F - 1036

M.Sc. (Fourth Semester)
EXAMINATION, MAY-JUNE, 2022
ELECTRONICS
Paper Third
(Automatic Control System and Artificial Neural Network)

Time : Three Hours] *[Maximum Marks : 80*

Note : Attempt all sections as directed, students are allowed to use scientific calculators in the examination hall special graphs viz polar graph, semilog graph and plain graph should be provided to the students in the examination hall (on demand).

(Section-A)

(Objective/Multiple Choice Questions)

(1 mark each)

Note : Attempt all questions.

Choose the most appropriate answer.

1. System has position error constant K_h=13, the steady state error for input $5t^2$ u(t) is:

   (A) 4

   (B) 2

   (C) ∞

   (D) 0

2. The value of function $F(s)=\left(\frac{2}{s^2+3}\right)$ at $t=0^+$ using initial value theroem is:

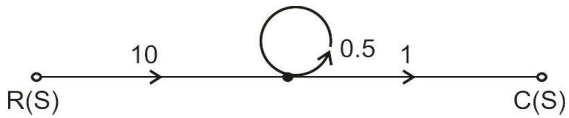
   (A) 3

   (B) 2

   (C) $3/2$

   (D) 0

3. The transfer function of the signal flow graph (SFG) given below is:



   (A) 20

   (B) 12

   (C) 16

   (D) 5

4. The overall transfer function of two blocks in parallel is:
   (A) Sum of Individual Gain
   (B) Product of Individual Gain
   (C) Difference of Individual Gain
   (D) Division of Individual Gain
5. For the system

$$\frac{c(s)}{R(s)} = \frac{25}{(s^2 + 8s + 16)},$$

   the nature of the time response will be:
   (A) Over Damped
   (B) Under Damped
   (C) Critically Damped
   (D) None
6. The Rougth Hurwitz criterian give:
   (A) Relative Stability
   (B) Absolute Stability
   (C) Gain Margin
   (D) Phase Margin
7. How can the steady state error be reduced:
   (A) By Decreasing the types of System
   (B) By Decreasing the Steady Error Constants
   (C) By Increasing the System Gain
   (D) By Increasing the Input

8. The natural frequency of oscillations $w_n = 13$ rad/sec and damping ratio ξ is 0.8, then the peak time is:
   (A) 12 sec.
   (B) 0.002 sec.
   (C) 3 sec.
   (D) 0.4 sec.
9. The frequency at which the Nyquist Plot crosses the negative real axis is known as:
   (A) Natural Frequency
   (B) Damped Frequency
   (C) Grain Crossover Frequency
   (D) Phase Crossover Frequency
10. The analysis of multiple input multiple output system is conveniently studied by:
    (A) Steady State Approach
    (B) Root Locus Approach
    (C) Characteristics Equation Approach
    (D) Nichols Chart
11. It the root locus lie only on the negative real axis, then the time response becomes:
    (A) Over Damped
    (B) Under Damped
    (C) Oscillatory
    (D) Sustained Oscillations

12. State transition matrix $\phi(t)$ is given by:

(A) $[(SI - A)]$

(B) $[(SI - A)^{-1}]^{\Psi}$

(C) $L^{-1}[(SI - A)^{-1}]$

(D) $L^{-1}[(SI - A)]$

13. A system is said to be _____ if every state x can exactly be determined from the measurement of the output y over a finite interval of time:

(A) Controllable

(B) Observable

(C) Non Casual

(D) Unstable

14. For the State Equation $\dot{X} = AX + BU$ and $y = ex$, the Transfer Matrix is:

(A) $C\,[(SI - A)^{-1}]B$

(B) $B\,[(SI - A)^{-1}]A$

(C) $A\,[(SI - A)^{-1}]C$

(D) $C\,[(SI - A)^{-1}]A$

15. A state space analysis technique is a:

(A) Time Domain Approach

(B) Frequency Domain Approach

(C) Both

(D) None of the above

16. The sigmoid activation function is defined as:

(A) $\frac{1}{(e^{t} + e^{-t})}$

(B) te^{-t}

(C) $\frac{1}{(1 + e^{t})}$

(D) $\frac{1}{(1 + e^{-t})}$

17. A perceptron is:

(A) A single layer feed forward neural network with pre-processing

(B) An auto associative neural network

(C) A double layer auto-associative neural network

(D) A neural network that contains feedback

18. The network that involves backward links from output to the input and hidden layers is called as:

(A) Self Organizing Maps

(B) Perceptrons

(C) Recurrent Neural Network

(D) Multi Layered Perceptron

19. Different learning Method does not include:

(A) Memorization

(B) Analogy

(C) Deduction

(D) Introduction

20. Traffic Light System is example of:
    (A) Open Loop System
    (B) Closed Loop System
    (C) Both (A) and (B)
    (D) None

(Section- B)

(Very Short Answer Type Questions)

(1.5 marks each)

Note : Attempt all questions. Each answer should be in 2-3 lines.

1. Define poles, zeros and characteristic equation of a control system.
2. Write down the rules for drawing Signal Flew Graph (SFG).
3. Write down the Transient Response (Time Domain) specifications of prototype second order control system.
4. Write down the frequency domain specialisations of prototype second order control system.
5. What is the basic concept of controllability of control system?
6. Write down the steps for drawing a polar plot of a control system.

7. Differentiate between absolute stability and Relative Stability of linear control system.
8. Define phase cross over frequency and gain cross over frequency.
9. Draw and explain model of neuron.
10. What are the benefits of neural network.

(Section - C)

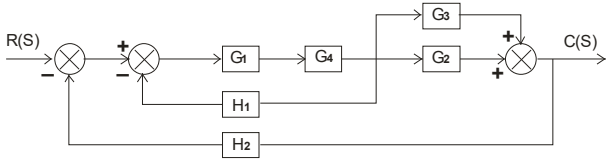
(Short Answer Type Questions)

(2.5 marks each)

Note : Attempt all questions. Write answer in 75 words.

1. Describe different types of activation functions used in neural network.
2. Draw and explain in brief, single layered network architecture of a neural network.
3. What are the effect of feedback on the overall response of a control system?
4. Derive the expressions of steady stats errors for unit step and unit ramp inputs.
5. Establish a correlation between time and frequency response of a control system.
6. Find out the Time Domain response of 2^{nd} order. Control system subjected to unit step input.

7. Using block diagram reduction techniques, find closed loop transfer function e(S)/R(S) shown in fig-



8. Determine the stability of the following system using Routh's criterian

$$a(s)\ H(s) = \frac{1}{(s+2)(s+4)}$$

9. Explain the concept of lag bad compensation.
10. Verify whether the following system is controllable

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} 4$$

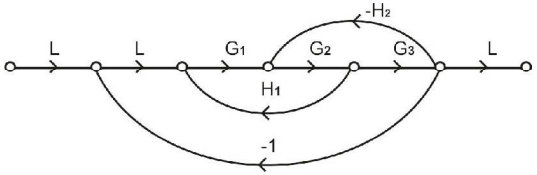
Section D

(Long Answer Type Questions)

(4 marks each)

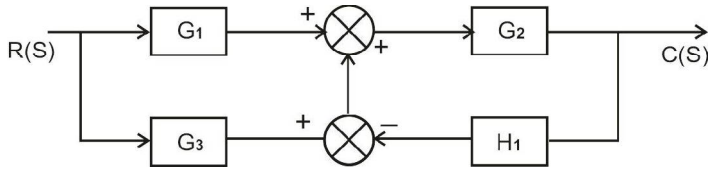
Note:- Attempt all questions. Each answer should be in $\leq$ 150 words.

1. Write down Mason's Gain Formula. Using it, find out the Transfer Function c(s)/R(s) shown below:

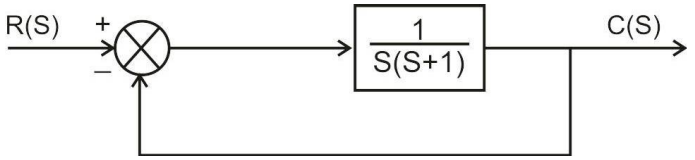


OR

Using block diagram reduction technique, determine the overall Transfer Function of control system shown in figure:



2. Determine the values of Rise Time, Peak Time, Delay Time and Settling Time, when control system shown in figure subject to unit step input:



OR

Determine the stability of a closed loop control system whose characteristic equation is:

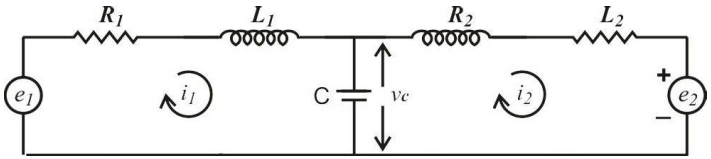
$$s^5 + s^4 + 2s^3 + 2s^2 + 11s + 10 = 0$$

3. Find out the solutions of n^{th} order state equations in time domain.

OR

Find out the solution of n^{th} order state equations in Frequency Domain.

4. For the network shown in figure below, determine the state model, concider i_1, i_2 and v_2 as state variable. The output variables are i_1 and i_2.



OR

State and prove the Nyquist Stability Criterian. Also mention the steps for Nyquist plot of a control system.

5. Write short note on any one of the following:
   (i) Learning and Training of a Neural Network.
   (ii) Architecture of a Neural Network.