Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023

Semester : Semester IV - 2021
Course Code : EEE2007
Course Name : Sem IV - EEE2007 - Control Systems Engineering
Program : EAE&EEE

Date : 12-JUN-2023
Time : 9.30AM - 12.30PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **(10 X 3 = 30M)**

1. The state space representation of a system is a common and extremely powerful method of representing a system mathematically. Describe the equations which represents the state model of a system.

(CO5) [Knowledge]

2. The performance characteristics of a control system are specified in terms of the transient response to unit step input. The transient response of a practical control system exhibits damped oscillations before attaining the steady state. Define the following performance indices that are used to characterize the step response to a second order system.
(a) Delay time (b) Rise time (c) Peak time

(CO2) [Knowledge]

3. List down the rules used in block diagram reduction techniques for reducing
a. Two blocks in series
b. Two blocks in parallel,
c. A minor feed back loop.

(CO1) [Knowledge]

4. The values of *static error constants* depend on the type of the system. List the various static error constants with their mathematical expressions.

(CO2) [Knowledge]

5. *Root locus* is a graphical method in which the movement of poles in the s-plane is located when gain K is varied from 0 to infinity. Describe the terms centroid and asymtotes and the method to determine the same

(CO3) [Knowledge]

6. System stability is one of the most important performance specification of a control system. Define the terms absolute stability and relative stability in control systems.

(CO3) [Knowledge]

7. The purpose of a compensator is to improve the performance of the control system by reducing the error between the desired output and the actual output of the system. It is used to alter the system's response characteristics to meet the design specifications. Draw the circuit diagram for a phase lead compensator and list its advantages.

(CO4) [Knowledge]

8. Define the transfer function of a linear time invariant system. Describe the poles , zeros and order of atransfer function.

(CO1) [Knowledge]

9. Define the terms gain cross over frequency, phase cross over frequency and corner frequency in Bode plots.

(CO3) [Knowledge]

10. The nature of time response of the second order system depends on the damping. Sketch the approximate time response of second order system when the damping ratio is a) 5 b)1 c)0.8 d) 0.2 e) 0

(CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 15 = 30M)**

11. While designing a control system, its required to know the exact location of closed loop system poles in S plane because the location of poles are closely related to stability. Suggest a suitable method to find the location of closed loop poles in S plane. For a system with the characteristic equation given below identify the number of poles lying LHS, RHS and Imaginary axis of S plane

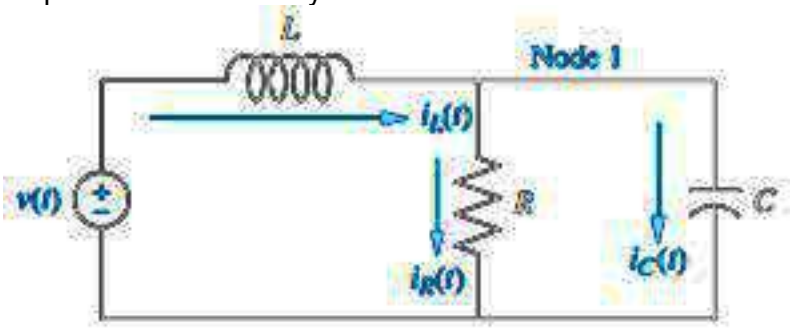
$S^5+S^4+2S^3+2S^2+S+1=0$

(CO3) [Comprehension]

12. An input signal r(t)=(5+2t+(*1/2*)t^2) is applied to a unity negative feedback control system with $G(s) = \frac{5(s+4)}{s^2(s+1)(s+20)}$. Evaluate the steady state error.

(CO2) [Comprehension]

13. For the electric circuit given below, identify the order of the system and the optimum number of state variables required to define the system. Also obtain its state model.

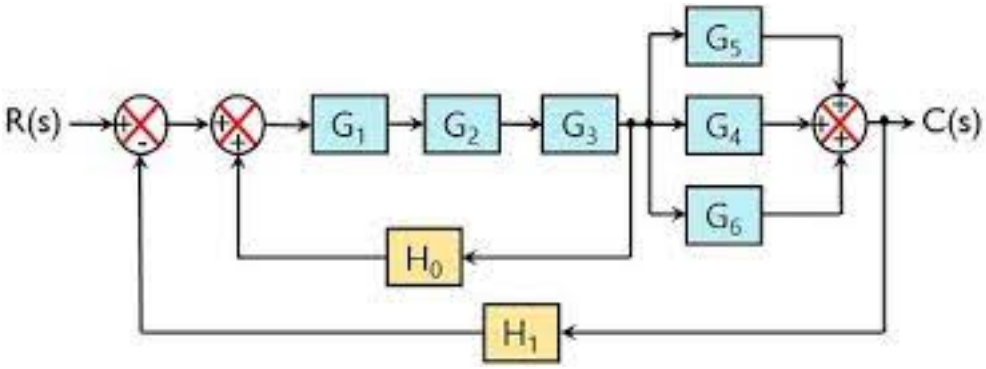


(CO5) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS **(2 X 20 = 40M)**

14. Using Block diagram reduction techniques, reduce the block diagram given below and obtain the transfer function



(CO1) [Application]

15. A control system is to be designed for an aircraft. It is important to analyze the stability, therefore the designer should know how the closed-loop poles move in the s plane as the loop gain K is varied. Sketch the root locus plot for the unity feedback control system whose open loop transfer function is given below.

$$G(s)H(s) = \frac{K(S+2)}{S(S+1)}$$

Mark all salient points on the root locus. Illustrate the calculations for the number of root loci, number of asymptotes, angle of asymptotes, centroid, break away points and Imaginary axis crossover frequency (CO3) [Application]