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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH. DEGREE EXAMINATION (S), FEBRUARY 2024
ELECTRONICS AND COMMUNICATION ENGINEERING
(2020 SCHEME)

Course Code: **20ECT307**

Course Name: **Control Systems**

Max. Marks: **100** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

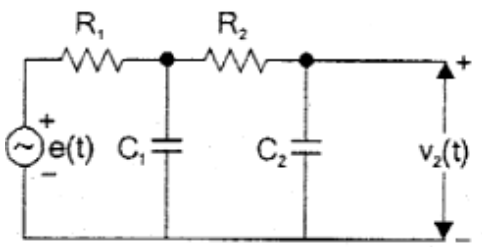
1. Differentiate open loop system from closed loop system.
2. Write Mason's gain formula and explain the terms in it.
3. Explain the transient and steady state response of a system.
4. Define any 3 standard test signals with equations.
5. Construct Routh array and determine the stability of the system whose characteristic equation is $s^4+8s^3+18s^2+16s+5=0$.
6. Define BIBO stability. How the roots of characteristic equation are related to stability?
7. Explain Nyquist stability criterion with neat diagrams.
8. Differentiate gain margin with phase margin.
9. Obtain the state model of the system whose transfer function is given as $\frac{Y(s)}{U(s)} = \frac{1}{s^2+10s+7}$.
10. List the drawbacks in the transfer function analysis of control systems.

PART B

(Answer one full question from each module, each question carries 14marks)

MODULE I

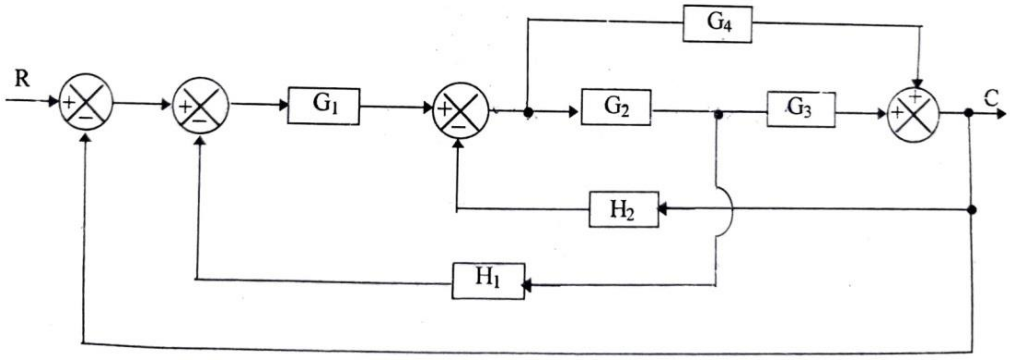
11. a) Determine the transfer function of the electrical system shown in figure. (10)



b) Explain any two examples of closed loop control system. (4)

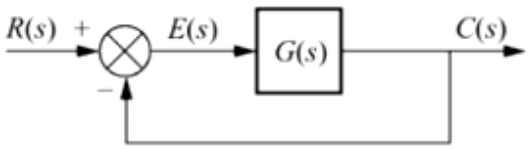
OR

12. Determine the transfer function C/R of the system shown in figure using block diagram reduction technique. (14)



MODULE II

13. a) Obtain the response c(t) of the system shown in figure when the input is unit step $G(s) = \frac{10}{s^2 + 10s + 25}$. (10)



b) What are steady state error of the system? (4)

OR

14. Explain step response of second order system for undamped and critically damped case when the input is unit step. (14)

MODULE III

15. Sketch the root locus plot for the system whose open loop transfer function is given by $G(s)H(s) = \frac{K(0.5+S)}{S(1+S)(2+S)}$. (14)

OR

16. a) Construct Routh array and determine the stability of the system whose characteristic equation is $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Comment on the location of the roots of characteristic equation. (8)

b) Explain the effect of introduction of P, PI and PID controllers in the systems. (6)

MODULE IV

17. Sketch Bode plot for the following transfer function and determine the (14)

system gain K for the gain cross over frequency to be 5 rad/sec.

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$$

OR

18. The open loop transfer function of a closed loop control system is given by

$$G(s) = \frac{4}{s(s+2)}$$ (14)

It is desired to have the phase margin at least 50° and the velocity error constant is 20 and the gain margin ≥ 10dB. Design a phase lead series compensator using bode plot.

MODULE V

19. a) Obtain the state model of the system whose transfer function is $\frac{Y}{U} = \frac{4}{s^3+3s^2+12s+4}$ (10)

b) Sketch the block diagram and signal flow graph of general form of state model. (4)

OR

20. a) Explain controllability and observability with an example. (5)

b) A linear time invariant system is described by the state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -3 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$ (9)

Compute the state transition matrix.

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