Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), MAY 2024
ELECTRICAL AND ELECTRONICS ENGINEERING
(2020 SCHEME)

Course Code : 20EET302

Course Name: Linear Control Systems

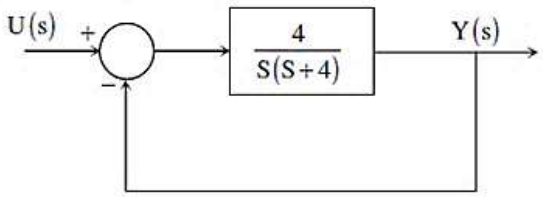
Max. Marks : 100 **Duration: 3 Hours**

Provide Graph and Semilog sheet

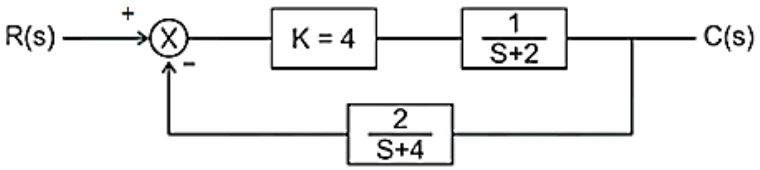
PART A

(Answer all questions. Each question carries 3 marks)

1. List the advantages of closed loop control systems.
2. The transfer function of a simple RC network functioning as a controller is $\frac{s+z1}{s+p1}$. Find out the condition for the RC network to act as lead network.
3. Find the natural frequency of the following second order system as shown in figure.



4. Find steady state error of the following systems whose input is unit step.



5. Discuss the effect of addition of Pole and Zero into the root locus.
6. Discuss the existence of angle of departure and angle of arrival in root locus.
7. Obtain the gain margin of the following unity feedback system whose open loop transfer function is $G(s) = \frac{8(s+4)}{(s-1)(s-2)}$.
8. Explain the concept of stability analysis using Polar plot.
9. State and explain Nyquist stability criterion
10. Write the importance of M and N circle.

PART B

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

MODULE I

11. a) Derive the transfer function of AC servo motor. (7)
    b) Discuss the effect of negative and positive feedback in overall gain of a control systems. (7)

OR

12. a) Obtain the transfer function lag lead network. (7)
    b) Explain the operating principle of Synchro. (7)

MODULE II

13. a) Explain the time domain specifications of a second order system. (5)
    b) A unity feedback control system has an open loop transfer function $G(s) = \frac{10}{s(s+2)}$. Find the rise time, percentage over shoot, peak time and settling time (9)

OR

14. a) For a unity feedback control system, the open loop transfer function $G(s) = \frac{10(s+2)}{s^2(s+1)}$.(i) Determine the position, velocity and acceleration error constants. (ii) Also determine the steady state error when the input is R(s) $= \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^3}$. (8)
    b) With the help of Routh's stability criterion find the stability of the following systems represented by the characteristic equations. (6)

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

MODULE III

15. a) Describe the merits and demerits of PID controller (4)
    b) Sketch the root locus of the system whose open loop transfer function is $G(s)H(S) = \frac{k}{s(s+2)(S+4)}$. (10)

OR

16. a) Explain the procedure to design a lead compensator using Root locus technique (7)
    b) Discuss the Zigler Nicholes method of PID tuning. (7)

MODULE IV

17. a) Derive the expressions for resonant peak and resonant frequency and hence establish the correlation between time and frequency response of a second order system. (10)

b) Given ξ = 0.7 and ω_n = 10 rad/sec. Calculate resonant peak and resonant frequency of a second order system. (4)

OR

18. Draw the Bode plot for the following Transfer Function $G(s) = \frac{20(0.1s+1)}{s^2((0.2s+1)(0.02s+1)}$. From the bode plot, determine (a) Gain Margin (b) Phase Margin (c) Comment on the stability. (14)

MODULE V

19. a) By Nyquist stability criterion, determine the stability of closed loop system, whose open loop transfer function is given by $G(s)H(s) = \frac{s+2}{(s+1)(s-1)}$. Comment on the stability of open-loop and closed loop system. (12)

b) What are the advantages of Nicholes chart. (2)

OR

20. a) Explain the procedure to design Lag lead compensator using Bode plot. (12)

b) What is the difference between Nyquist and Polar plot. (2)

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