(b) Obtain a state space representation of the system

$$\frac{G(s)}{U(s)} = \frac{10(s+2)}{s^3+3s^2+5s+15}.$$ (8)

7. (a) Determine the optimal controller to minimize

$$J = \int_0^\infty (y^2+u^2)dt$$

for the process described by $\frac{dy}{dt} + y = u$. (8)

(b) Explain the concept of absolute stability in non-linear system. Also state and explain Popov's criterion of stability. (7)

C

Roll No. ..... Total Pages : 4

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August/September 2022

B.Tech. (EIC) Re-Appear IV SEMESTER

Control System Engineering (EI-401)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Graph papers and semilog graph papers are allowed.*

PART-A

1. (a) Why negative feedback is preferred in control system? (1.5)

(b) Give the different types of dc servo motors. (1.5)

(c) List the standard test signals used in analysis of control system. (1.5)

(d) Distinguish between steady state and transient response of system. (1.5)

(e) Give the relationship between static and dynamic error coefficients. (1.5)

(f) What does a gain margin close to unit or a phase margin close to zero indicate? (1.5)

(g) Why frequency domain compensation is normally carried out using the Bode plots? (1.5)

(h) What are the effects and limitations of phase-lag control? (1.5)

(i) What are the different types of equilibrium points encountered in non-linear systems and draw only approximately two the phase plane trajectories? (1.5)

(j) What do you understand about parameter optimization of Regulators? (1.5)

PART-B

2. (a) With its operating principle derive the transfer function of AC servo motor in control system. (6)

(b) Using block diagram reduction technique, find the close loop transfer function for the block diagram shown in Fig. 1. (9)

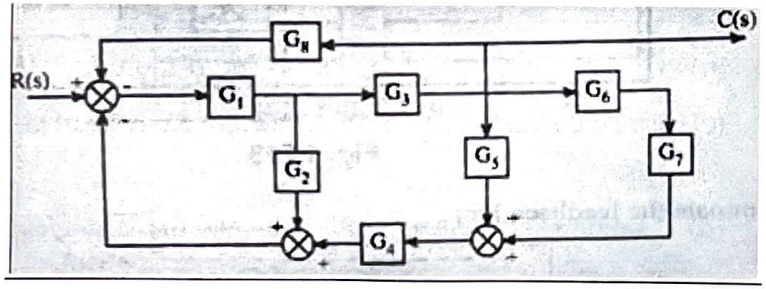

Fig. 1

3. (a) For the unity feedback system with G(s) = 125/s(s + 10). Find

(i) Peak over shoot.

(ii) Settling time for unit step input.

(iii) Steady state error for an input of 5tu(t).

(iv) Steady state error for an input of $5t^2u(t)$. (8)

(b) For a system with, $F(s) = s^4 + 22s^3 + 10s^2 + s + k = 0$. Obtain the marginal value of k and the frequency of oscillations of that value of k. (7)

4. Draw Bode plot for the function G(s). Find gain margin, phase margin and comment on stability.

$$G(s) = \frac{2(s+0.25)}{s^2(s+1)(s+0.5)}.$$ (15)

5. (a) Sketch the root locus for a unity feedback system whose open loop transfer function is :

$$G(s) = \frac{k}{s(s+2)(s^2+2s+2)}$$ (9)

(b) Test the stability of the unit feedback system

$$\frac{k}{(s-1)^2(s+5)}$$ (6)

6. (a) Draw and explain Lag-Lead Network realization using Op-Amps. (7)