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

BT-4/M-20 **36009**

CONTROL SYSTEM ENGINEERING

Paper : ECE-302E

Opt. (2)

Time : Three Hours] [Maximum Marks : 100

Note : Attempt *five* questions in all, selecting at least *one* question from each unit.

UNIT–I

1. (a) Differentiate between Open loop and Close loop control system with examples. 5

(b) Derive the transfer function of close loop system shown in Fig. 1 below : 5

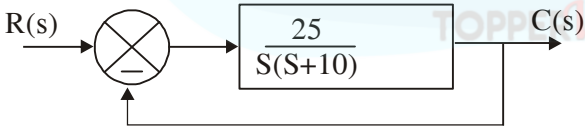

Fig. 1.

(c) Obtain the overall transfer function C/R from the signal flow graph shown in Fig. 2 : 10

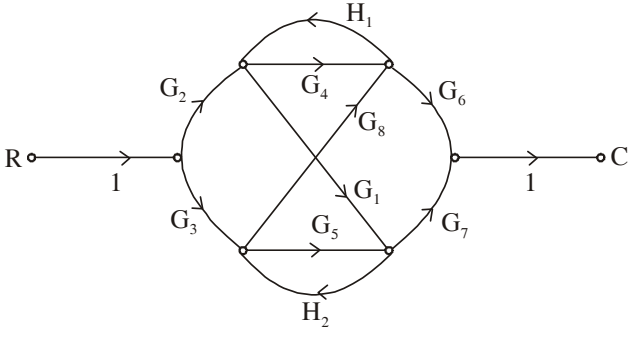

Fig. 2.

2. (a) Draw and explain Variable reluctance stepper motor. 10

(b) The negative feed-back control system has the forward path gain transfer function as

$$G(s) = \frac{10}{s(s+2)}$$

while the feed-back transfer function H(s) = 5. Determine sensitivity of close loop transfer function with respect to G and H at ω = 3 rad/sec. 10

UNIT–II

3. (a) Derive and discuss the time response of first order systems. 10

(b) Using the Routh criterion, calculate the range of values of 'K' for the system has zero, one or two poles in the right half s-plane. The open-loop transfer function of a unity feedback control system is given as

$$G(s) = \frac{K(s+1)(s+2)}{(s+0.1)(s-1)}.$$ (5+2½+2½)

4. The characteristic equation of a feedback control system is

$$s^4 + 3s^3 + 12s^2 + (K - 16)s + K = 0.$$

Sketch the root locus plot for $0 \leq K \leq \infty$ and show that the system is conditionally stable (stable for only a range of gain K). Determine the range of gain for which the system is stable. 20

UNIT–III

5. (a) Draw the Bode plot of the open loop transfer function of a unity feedback control system is

$$G(s)H(s) = \frac{200(s+10)}{s(s+5)(s+20)}$$

Determine (i) Gain margin, (ii) Phase margin, and (iii) Closed loop stability. 15

(b) Differentiate between Bode plot and Nyquist plot. 5

6. (a) Sketch the Polar plot of the open loop transfer

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

Determine whether these plots cross the real axis. If so, determine the frequency at which the plots cross the real axis and the corresponding magnitude $|G(j\omega)|$. 10

(b) Sketch the Nyquist plot of the open loop transfer function of a unity feedback control system is

$$G(s)H(s) = \frac{K}{s(s^2+s+4)}$$

If the system is conditionally stable, find the range of K for which the system is stable. 10

UNIT–IV

7. A unity feedback system has an open loop transfer function

$$G(s) = \frac{K}{s(1+s)(1+0.2s)}$$

Design phase-lag compensation for the system has velocity error constant K_v = 8 sec^{-1}, phase margin = 40°. Also compare the cross-over frequency of the uncompensated and compensated systems. 20

8. A feedback system has a closed loop transfer function

$$\frac{C(s)}{U(s)} = \frac{10(s+4)}{s(s+1)(s+3)}$$

Construct three different state models for this system, and give block diagram representation for each state model. 20