Register Number……

B.E., DEGREE EXAMINATIONS: NOV/DEC 2012

Fifth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

EEE109: Control Engineering

Time: Three Hours **Maximum Marks: 100**

Answer All Questions:-

PART A (10 x 1 = 10 Marks)

1. The fundamental component of a translational mechanical system

   a) Inertia b) Torque c) Mass d) Angular displacement

2. Force- current analogy of velocity is

   a)Flux b) Resistance c) Inductance d) Voltage

3. The time required for the response to reach and stay within a specified tolerance band of its final value is known as

   a) Rise time b) Settling time c)Maximum overshoot d) Peak time

4. State the type and order of the system

   $G(s)H(s)= 200/(s^2+20s+200)$

   a) Type – 0 Order – 2 b) Type – 1 Order – 3

   c) Type – 2 Order – 0 d) Type – 2 Order – 0

5. Decade is known as an increase in frequency by a factor of

   a) 20 b) 10 c) 8 d) 5

6. The condition for system is to be stable in Nyquist criterion

   a) $\frac{kT_1T_2}{T_1+T_2} = 1$ b) $\frac{kT_1T_2}{T_1+T_2} < 1$ c) $\frac{kT_1T_2}{T_1+T_2} > 1$ d) $\frac{kT_1T_2}{T_1+T_2} = 0$

7. The loop transfer function of a feedback control is given by

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

   The number of asymptotes of its root loci is

   a) 2 b)3 c)4 d)1

8. What are the effects of adding open loop pole to root locus,
   a) System become sluggish b) Fast response
   c) System is stable d) System becomes unstable
9. What type of compensator is suitable for high frequency noisy environment?
   a) Lag compensator b) Lead compensator
   c) Lag lead compensator d) Cascade compensator

10. What is the expression for maximum phase φ_m in lead network

a) $\varphi_m = \sin^{-1}\frac{1-\propto}{1-\propto}$ b) $\varphi_m = \sin^{-1}\frac{1+\propto}{1-\propto}$

c) $\varphi_m = \sin^{-1}\frac{1-\propto}{1+\propto}$ d) $\varphi_m = \sin^{-1}\frac{1+\propto}{1+\propto}$

PART B (10 x 2 = 20 Marks)

11. Define transfer function of a system.
12. What is Mason's Gain formula?
13. What is the standard test signals employed for time domain studies?
14. Distinguish between static and dynamic error
15. What are asymptotes? Define corner frequency.
16. What is Nichols chart?
17. State the necessary and sufficient conditions of Routh Hurwitz criterion, for stability
18. State Nyquist stability criterion.
19. What are the advantages and disadvantages of the lead compensation technique?
20. What is the transfer function of lag lead compensator?

PART C (5 x 14 = 70 Marks)

21. a) (i) Find C/R for the following signal flow graph shown in Figure 1 using Mason's gain formula. (10)

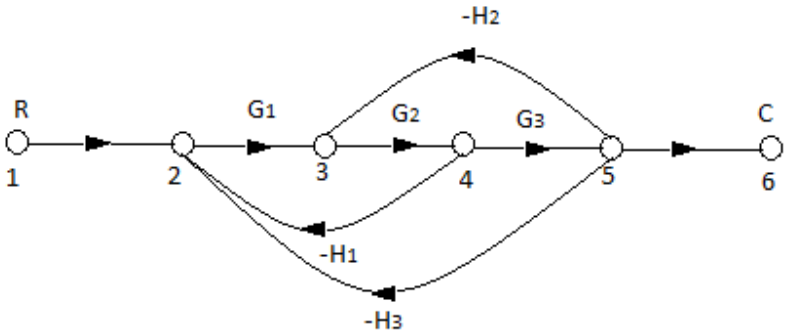


Figure 1

(ii) What is feedback? Explain the effects of feedback. (4)

(OR)

b) (i) Using block diagram reduction technique, find the closed loop transfer function for the block diagram shown in Figure 2. (10)

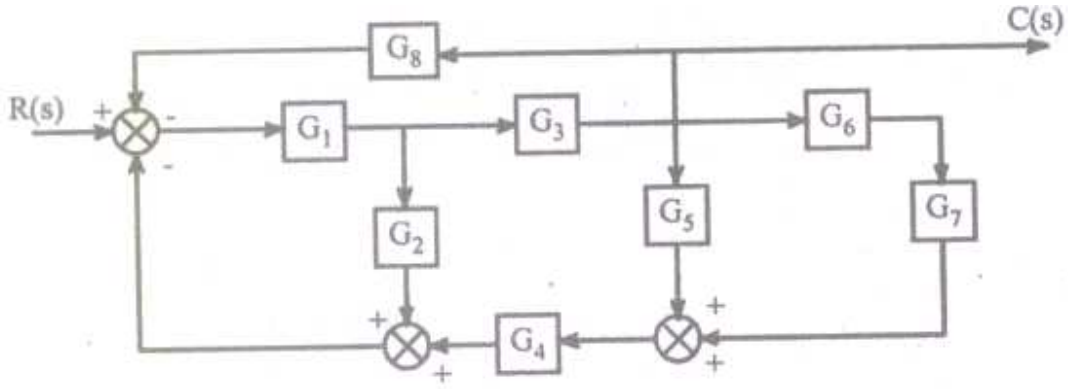


Figure 2.

(ii) What are the advantages and disadvantages of closed loop control system? (4)

22. a) (i) Derive the expression for output response of a second order system for unit step input. (10)

(ii) Derive the expression for peak overshoot for a second order system. (4)

(OR)

b) For the unity feedback system with G(s) = ——— Find the following (4+4+6)

(i) peak overshoot

(ii) Settling time for unit step input

(iii) Steady state error for an input of $(5+5t+5)\,t^2u(t)$

23. a) (i) What are the advantages of frequency response? (2)

(ii) The forward path transfer function of a unity feedback system is

———

Find the resonant peak M_r, resonant frequency and bandwidth of the closed loop system for the following values of k (i) k = 5 (ii) k = 100 (12)

(OR)

b) (i) For the following system sketch the bode plot (10)

G(s) H(s) = ————

(ii) Explain the correlation between frequency domain and time domain specifications. (4)

24. a) (i) The open loop transfer function of unity feedback system is given by

G(s) = $\frac{k}{(s+2)(s+4)(s^2+6s+25)}$.

By applying the routh criterion discuss the stability of the closed loop system as a function of k. Determine the value of k which will cause sustained oscillations in the closed loop system. What are the corresponding oscillation frequencies? (10)

(ii) Describe the basic steps for the compensation using root locus technique. (4)

(OR)

b) (i) Construct Nyquist plot for a feedback control system whose Open Loop Transfer Function is given by

G(s)H(s) = $\frac{2}{s(1-2s)}$. Comment on stability of the system (7)

(ii) Sketch the root locus for unity feedback system with open loop transfer function

G(s) = $\frac{k}{s(s^2+4)}$ (7)

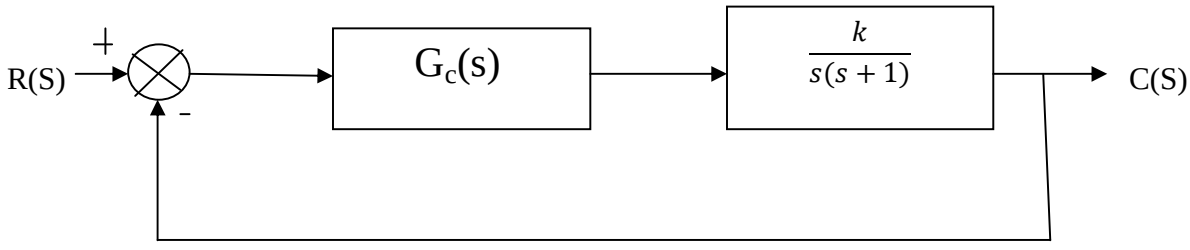
25. a) (i) Draw and describe briefly about lag - lead network (5)

(ii) Design a suitable compensator for the system whose open loop transfer function is G(s) = $\frac{10}{s(s+1)}$ so that compensated system has an un-damped natural frequency ω_n =3 rad/sec and damping ratio ζ =0.5 (9)

(OR)

b) (i) Describe the characteristics of lag lead compensator. (5)

(ii) Consider the system shown below: (9)



Design lead compensator for this system to meet the following specifications.

Damping ratio=0.7 , Settling time=1.4 sec

****