BE ETC 7th Semester Examination 2012
Control Systems ETC 702

Answer any 5 questions

Time: 3 hrs　　　　　　　　　　　　　　　　　　FM: 70

1a) Draw the detailed block diagram of the following circuit (Fig.1) and obtain the response instantaneously after switching.

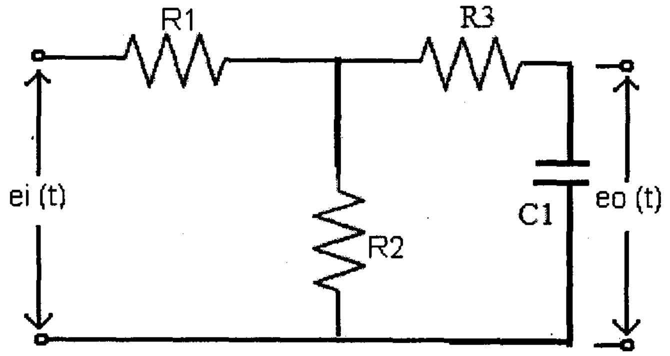

Fig.1

b) Obtain the signal flow graph representation for a system whose block diagram is given in Fig.2 and use Mason's gain formula to obtain C/R.

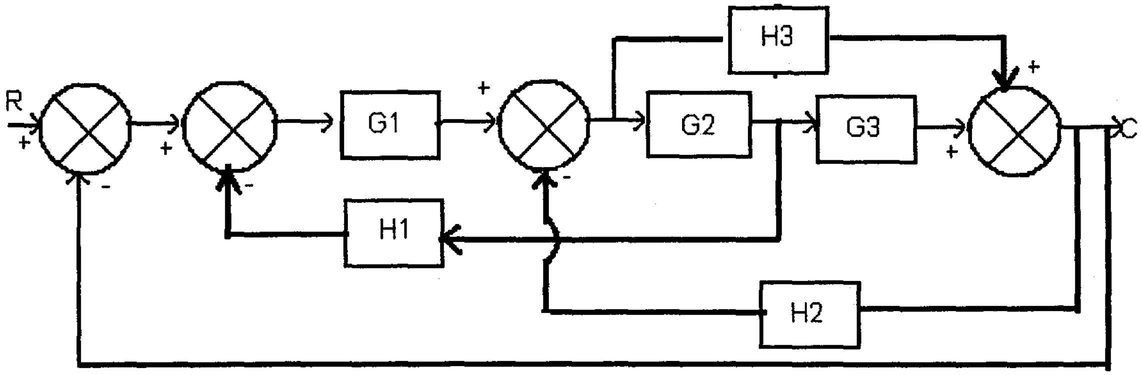

Fig.2

c) Mention three important limitations of transfer function based analysis.

(5+6+3)

2a) What is the meant by dynamic error coefficients of a system. Find the dynamic error coefficients of the unity feedback system whose forward transfer function is G(s)= 200/{s(s+5)}. Also obtain the steady state error of the system for the input $4t^2$.

Please provide semilog and mm graph papers.

b) Modify a first order low pass filter circuit to incorporate a derivative controller in the forward path. Obtain the steady and transient response with and without the controller and analyze.

c) For a unit feedback control system with characteristic polynomial as $F(s)=s^4+22s^3+10s^2+s+k$. Obtain the marginal value of *k* and the frequency of oscillations of that value of *k*.

(5+5+4)

3a) The system shown in Fig.3 has the specifications: undamped natural frequency is 4rad/sec and damping ratio =0.7. Find the values of *k* and k_f to meet the given specifications of the system.

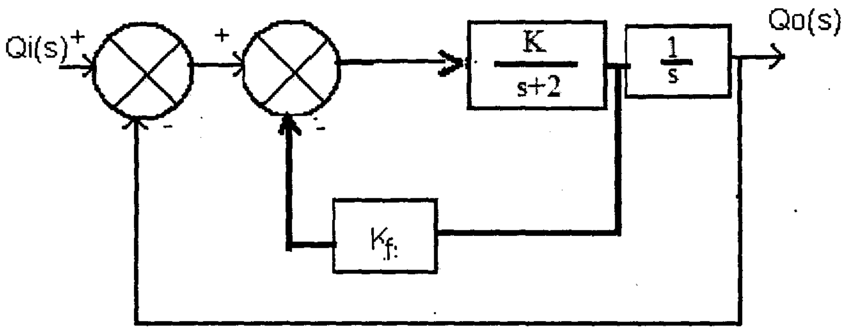

Fig.3

3b) Mention two significant advantage of Bode plot based analysis? Discuss the method of incorporating a cascade lead network with the help of Bode plot.

(6+8)

4a) Sketch the gain (in dB) vs frequency of

$$G(s) = 16(1+0.5s)/(s^2(1+0.125s)(1+0.1s))$$

b) A unity feedback system has the forward transfer function $G(s)=K(2s+1)/(s(5s+1)(s+1)^2)$. The input 1+6t is applied to the system. Determine the value of K for a steady state error to be less than 0.1.

c) Discuss the significance of gain margin and phase margin in analyzing the stability of the system.

(5+4+5)

5a) Establish the two basic rules for the construction of root locus.
b) Define breakaway point of a root locus plot and derive the expression for the same.
c) Sketch the root loci for $G(s) = K(s+12)/(s^2(s+20))$, $H(s)=1$

(3+5+6)

6a) State Nyquist stability criteria. The open loop transfer function of a feedback control system is $G(s)H(s)= k/(s(s+2))$. Sketch complete Nyquist plot and find the range of *k* for stability.

Please provide semilog and mm graph papers.

b) Consider a lag lead network defined by

$G_c(s) = K\{(s+1/T_1)(S+1/T_2)\}/\{(s+\beta/T_1)(s+1/\beta T_2)\}$

Show that at frequency ω_1 where $\omega_1 = 1/(T_1 T_2)^{1/2}$, the phase angle of $G_c(\omega_1)$ becomes zero.

(8+6)

7a) For the system shown in Fig.4, obtain the state equations.

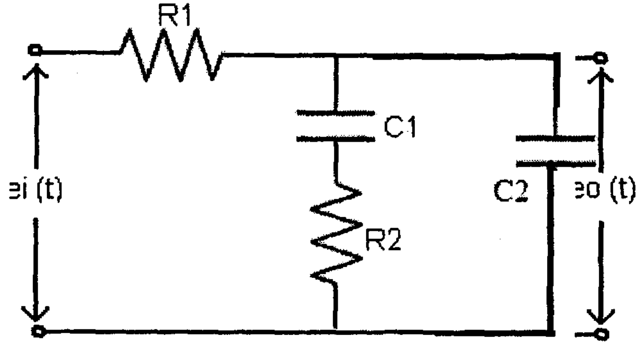

Fig.4

b) An open loop transfer function is given by $G(s)=4/\{s(s+2)\}$. Design a lead compensator such that undamped natural frequency is 4rad/sec and damping ratio =0.5.

(6+8)

8a) Explain the motivation and technique behind the development of Nichol's chart. How the closed loop frequency response is obtained from the Nichol's chart?

b) Show how the response of a system with non-zero initial condition is obtained from state space representation using state transition matrix.

c) Suggest a method for predicting the behavior of a highly complex non-linear system whose mathematical model cannot be developed.

(5+4+5)