BE ETC 7th Semester Examination 2013
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.

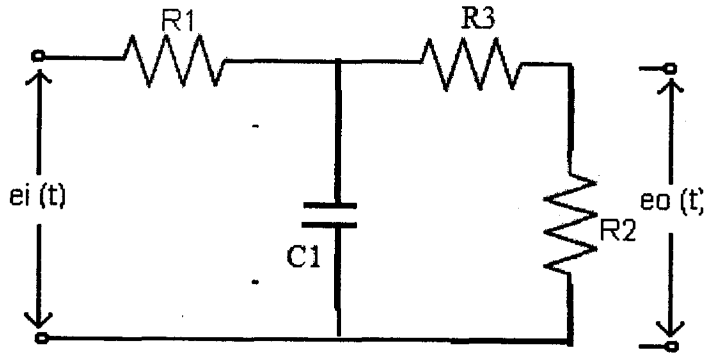

Fig.1

b) Obtain the transfer function of the signal flow graph in Fig.2. Represent the same in block diagram.

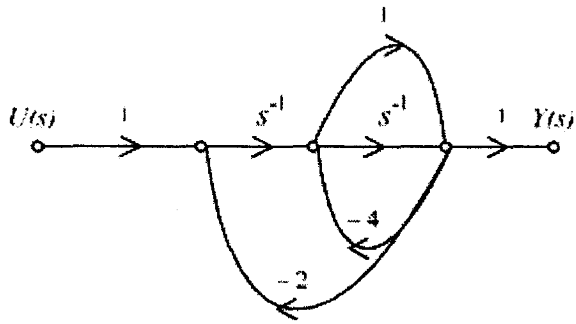

Fig.2

(7+7)

2a) What are the effects of incorporating derivative and integral controller in the forward path on the transient and steady state performance of the system?.

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

c) The system shown in Fig.3 has the specifications: undamped natural frequency is 6rad/sec and damping ratio =0.5. Find the values of k and k_f to meet the given specifications of the system.

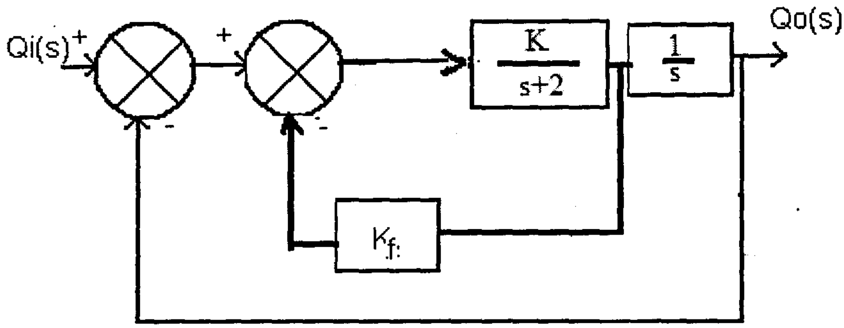

Fig.3

(5+5+4)

3a) For a unity feedback control system with forward path transfer function $G(s)=k/(s(1+0.6s)(1+0.4s))$, determine

i) the range of values of k for stability
ii) marginal values of k
iii) Frequency of sustained oscillations

b) Derive the expression for resonant peak and resonant frequency and hence establish the correlation between time response and frequency response.

c)Mention two significant advantages of Bode plot based analysis?

(6+6+2)

4a) Draw the Bode plot for the transfer function

$$G(s)H(s) = 2(s+0.25)/(s^2(s+1)(s+0.5))$$

b) Design a lead compensator for a system having open loop transfer function as $G(s)H(s)=K/(s^2(1+0.05s))$ such that acceleration error constant $=100sec^{-2}$ and phase margin $=20^0$.

(6+8)

5a) Discuss the significance of gain margin and phase margin in analyzing the stability of the system.

b) Establish the two basic rules for the construction of root locus.

c) Sketch the root loci for $G(s) = K/(s(s^2+4s+5))$, $H(s)=1$

(5+2+7)

6a) State Nyquist stability criteria. The open loop transfer function of an unity feedback control system is $G(s)= k/(s(s+3)(s+5))$. Sketch complete Nyquist plot and find the range of k for stability.

b) Modify a first order low pass filter circuit to incorporate a lead and lag compensator separately in the forward path of the block diagram.

(8+6)

7a) Show that the loci of constant phase angle of a closed loop system with unity feedback is a series of circles whose center is at $x_0= -1/2$, $y_0=1/(2N)$ and radius $r_0=\sqrt{(N^2+1)}/2N$. Sketch the loci in the s-plane for different angles.

b) What is the advantage of state space representation of a system over transfer function based representation?

Consider the system given below:

$$\dot{X}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}X+\begin{bmatrix}0\\ 1\end{bmatrix}U, \quad X(0)=\begin{bmatrix}1\\ 1\end{bmatrix}, \qquad Y=[1\ 0]\,X$$

Compute the state transition matrix and explain its significance in obtaining the time domain response.

(7+7)

8a) Obtain the state model of the system whose transfer function is given by $T(s) = 2/(s^3+6s^2+11s+6)$. Determine whether or not the system is controllable and observable.

b) Explain the method of incorporating a lead and lag compensator by root locus technique.

(8+6)