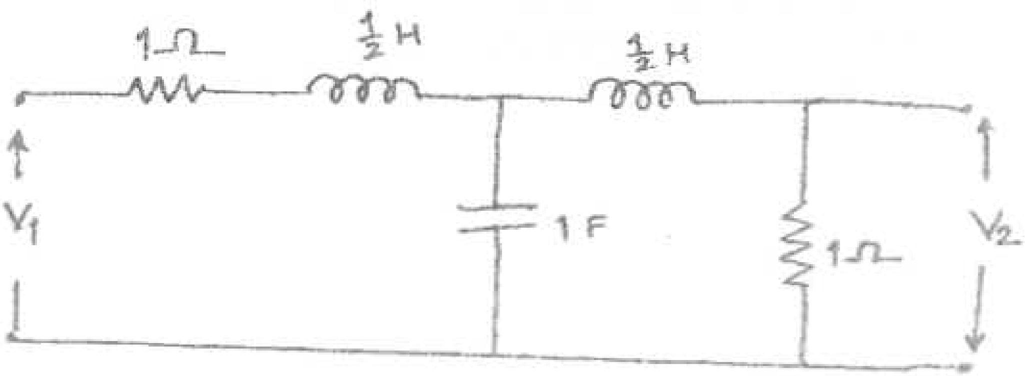
TE EXTC -V
filter theory

Con. 3421–11. RK–4998

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory.**
(2) Attempt any **four** questions from the remaining **six** questions.
(3) Assume any **suitable** data and **state** it.
(4) **Figures** to the **right** indicate **full** marks.

1. Attempt any **four** :– **20**
   (a) List the properties of the Butterworth function.
   (b) Determine the order of the Butterworth filter to meet the following requirements :–
   (i) Pass-Band extends from W = 0 to W = 1000 rads/sec. Pass-Band attenuation K_p = 0·1 dB.
   (ii) Stop Band extends from W ≥ 2000 rads/sec. Stop Band attenuation = 40 dB.
   (c) Prove that for Chebyshev response function, the Chebyshev polynomial of order 'n' can be expressed by –
   $$2\,C^2_n(w) = C_{2n}(w) + 1.$$
   (d) Derive the expression for the equivalent resistance of a switched capacitor 'C', switched at a frequency 'f'.
   (e) Find the voltage transfer function of the following circuit.



2. (a) Realize the Chebeshev low pass filter to meet the following specifications :– **10**
   W_p = 1 rad/sec ; K_p = 0·5 dB
   W_s = 2·5 rad/sec ; K_s = 20 dB.
   Draw the filter circuit for the normalized values, and convert it in to a high pass filter with cutoff frequency = 1000 Hz.
   (b) Synthesize the circuits for the following driving-point impedance, by any methods – **10**
   (i) $$Z_{(s)} = 4\,\frac{(s^2+1)\,(s^2+9)}{s(s^2+4)}$$
   (ii) $$Z_{(s)} = \frac{s^4+3s^2+1}{s\,(s^2+1)}$$

[TURN OVER

3. (a) From the normalized 3rd order Butterworth filter design a band-pass filter with centre frequency of 5 kHz. Draw also the circuit diagram. **10**
   (b) Draw the neat circuit diagram of Sallen and key high pass filter and derive its voltage transfer function. Obtain the expressions for W_n, Q and H_o in terms of circuit parameters. **10**

4. (a) Design the Tow-Thomas circuit for Q = 100 and f_n = 10 kHz. Choose $C_1 = C_2 = 0{\cdot}5$ micro farads. **10**
   (b) Draw the neat circuit diagram for Tow-Thomas filter using switched capacitors. **10**

5. (a) Derive the expressions for L.P., B.P. and H.P. outputs for 3-Op-Amp. State variable filter. Draw the neat circuit diagram. **10**
   (b) Draw the neat circuit diagram of Äkerberg-Mossberg filter and derive its voltage transfer function. **10**

6. (a) Draw the neat circuit diagram of positive-negative feedback single amplifier filter, and derive its voltage transfer function. Assume equal capacitors. $C_1 = C_2$ and unequal resistors R_1 and R_2. Feed-back reistors are R_A and R_B. **10**
   (b) Using switched capacitors, explain the implementation of inverting and non-inverting integrators. Draw the neat circuit diagrams. **10**

7. (a) Draw the neat circuit diagram of generalized impedance converter and derive the expression for its driving point impedance. State how will you realize the circuit in to a negative resistance. **10**
   (b) Explain how to develop the 'leap frog' filter. **10**

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TE EXTC V
Random Signal Analysis

Con. 3748-11. **RK-2130**

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.

1. (a) State and explain :– 5
   (i) Independent Events.
   (ii) Joint and conditional probabilities of events.
   (b) Define probability density function. State and prove any two properties of probability density function (p.d.f.). 5
   (c) Explain how a random process can be describe by a set of indexed random variables. 5
   (d) Define poisson Process. Prove that Poisson process is Markov process. 5

2. (a) A box I contains 5 white balls and 6 black balls. Another box II contains 6 white balls and 4 black balls. A box is selected at random and then a ball is drawn from it. 8
   (i) What is the Probability that the ball drawn will be white ?
   (ii) Given that the ball drawn is white, what is the probability that it came from Box I ?
   (b) The joint probability distribution of a two dimensional random variable (x, y) is given by $f(x,y) = k \times y\ e^{-\left(x^2+y^2\right)}$; $x \geq 0, y \geq 0$ 12
   Find–
   (i) The value of k.
   (ii) The marginal density functions of x and y.
   (iii) The conditional density function of Y given that X = x and the conditional density function of X given that Y = y.
   (iv) Check for independence of X and Y.

3. (a) If X is continuous random variable and Y = a X + b then, prove that– 6

$$f_y(y) = \frac{1}{|a|} f_x\left(\frac{y-b}{a}\right)$$

   (b) Let X be a continuous random variable with uniform p.d.f. in $(0, 2\pi)$. Find the probability density function of Y= cos X. 4
   (c) Find the characteristic function of Poisson distribution and find its mean and variance. 10

[TURN OVER

4. (a) Suppose X and Y are two random variables. Define covariance and correlation coefficient of X and Y. 10
When do we say that X and Y are :–
(i) Orthogonal
(ii) Independent and
(iii) Un correlated
Are un correlated variables independent ?
(b) Find the autocorrelation function and power spectral density of the random process $X(t) = a \cos(bt + Y)$ 10
Where a, b are constants and Y is a random variable uniformly distributed over $(-\pi, \pi)$.

5. (a) Explain wide sense stationary process (WSS) A random process is given by $X(t) = A \cos(w_0 t + \phi)$ where A, w_0 are constants and ϕ is random variable uniform in $(-\pi, \pi)$. Show that X(t) is WSS. 10
(b) Explain power spectral density. State its important properties and prove any one property. 10

6. (a) State and prove Chapman-Kolmogorov equation. 8
(b) Define Central Limit Theorem and give its significance. 4
(c) Three boys A, B, C are throwing a ball to each other. A always throws ball to B. B is as likely to throw the ball to C as to A. The probability that C will throw the Ball to A is 2/3. Write transition probability matrix and show that process is Markovian. 8

7. (a) The transition probability matrix of Markov Chain is– 10

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \end{array}\begin{array}{c} \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{bmatrix} 0.5 & 0.4 & 0.1 \\ 0.3 & 0.4 & 0.3 \\ 0.2 & 0.3 & 0.5 \end{bmatrix} \end{array}$$

Find the limiting probabilities.
(b) Define Markov Chain giving an example. 4
(c) Explain in brief– 6
(i) Gaussian process.
(ii) Ergodic process.

T.E. EXTC V
R.F. Circuit Design.

130-mk : 1stHf-11.

Con. 3636-11. **RK-2133**

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from Question Nos. **2** to **7**.
(3) Assume **suitable** data if **necessary**.

1. (a) A typical PCB substrate consists of Al_2O_3 with a relative dielectric constant of 10 and a loss tangent of 0·0004 at 10 GHz. Find the conductivity of substrate. 5
   (b) Starting with basic definition for the Standing Wave Ratio (SWR) :— 5

$$SWR = \frac{|V_{max}|}{|V_{min}|} = \frac{|I_{max}|}{|I_{min}|}$$

   Show that it can be re-expressed as,

$$SWR = \frac{1+|\Gamma_0|}{1-|\Gamma_0|}$$

   (c) For GaAs we find at T = 300 °K the effective densities of state $N_C = 4{\cdot}7 \times 10^{17}\ cm^{-3}$, $N_V = 7{\cdot}0 \times 10^{18}\ cm^{-3}$. Assuming that the band gap energy of 1·42 eV remains constant, 5
      (i) Find the intrinsic carrier concentration at room temperature.
      (ii) Compute n_i at T = 400 °K.
   (d) Explain simplified Ebers-Moll model for forward active mode of transistor. 5

2. (a) A 100 Ω microstrip line is connected to a 75 Ω line. Determine Γ, SWR, percentage power reflected, return loss, percentage power transmitted and insertion loss. 10
   (b) Derive expressions for internal, external and loaded quality factors for the standard series and parallel resonance circuit. 10

3. (a) An abrupt pn-junction made of S_i has the acceptor and donor concentrations of $N_A = 10^{18}\ cm^{-3}$ and $N_D = 5 \times 10^{15}\ cm^{-3}$, respectively. Assuming that the device is at room temperature. Determine — 10
      (i) barrier voltage
      (ii) the space charge width in the p and n type semiconductors.
   (b) An unknown load impedance is connected to a 0·3 λ long, 50 Ω lossless transmission line. The SWR and phase of the reflection coefficient measured at the input of line are 2·0 and –20 °, respectively. Using the Smit chart, determine the input and load impedances. 10

4. (a) An N = 3 Chebyshev bandpass filter is to be designed with a 3 dB passband ripple for a communication link. The centre frequency is at 2·4 GHz and the filter has to meet a bandwidth requirement of 20 %. The filter has to be inserted into a 50 Ω characteristic line impedance. Find inductive and capacitive elements. Show the attenuation response from 1 to 4 GHz. 12
   (b) Explain Schottky diode with cross sectional view and circuit model. 8

5. (a) Obtain the h-parameter representation for a BJT in common base configuration, neglecting base, emitter and collector resistances (r_B, r_E and r_C). 10
   (b) Explain construction and functionality of High Electron Mobility Transistor. 10

6. (a) Prove the first three Kuroda's identities by computing the appropriate ABCD matrices. 10
   (b) A radio transmitter is capable of producing 3 W output power. The transmitter is connected to an antenna having characteristic impedance of 75 Ω. The connection is made using lossless co-axial cable with a 50 Ω characteristic impedance. Calculate the power delivered to antenna if the source impedance is 45 Ω and cable length is 11 λ. 10

7. Write short notes on :—
   (a) RF behaviour of resistor 5
   (b) Micro strip Transmission Lines 5
   (c) Butterworth filter 5
   (d) Measurements of AC parameters of BJT. 5

Table Chebyshev filter coefficients; 3 dB filter design (N = 1 to 10)

N	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	g_{10}	g_{11}
1	1.9953	1.0000									
2	3.1013	0.5339	5.8095								
3	3.3487	0.7117	3.3487	1.0000							
4	3.4389	0.7483	4.3471	0.5920	5.8095						
5	3.4817	0.7618	4.5381	0.7618	3.4817	1.0000					
6	3.5045	0.7685	4.6061	0.7929	4.4641	0.6033	5.8095				
7	3.5182	0.7723	4.6386	0.8039	4.6386	0.7723	3.5182	1.0000			
8	3.5277	0.7745	4.6575	0.8089	4.6990	0.8018	4.4990	0.6073	5.8095		
9	3.5340	0.7760	4.6692	0.8118	4.7272	0.8118	4.6692	0.7760	3.5340	1.0000	
10	3.5384	0.7771	4.6768	0.8136	4.7425	0.8164	4.7260	0.8051	4.5142	0.6091	5.8095

1/6/2011

TE EXTC V (Rev)
Microprocessors & Microcontrollers I

P4 Exam May 11 201
Con. 3197–11.

RK-2139

(3 Hours) [Total Marks : 100

N.B: (1) Question NO.1 is compulsory.
(2) Answer any four out of remaining six questions.
(3) Assume suitable data, wherever required with justification.

1. Design a 8085 based system as per following specifications: **20**
   (a) CPU at 6 MHz.
   (b) EPROM of 16 KB using 8 KB chips.
   (c) RAM of 8 KB using 4 KB chips.
   (d) One 8255 at address 10H.
   (e) One 8259 at address 20H.

Show complete decoding and write a program to send a data 99H on port A of 8255.

2. (a) Draw and explain the Timer and Counters of 8051. 10
(b) Draw and explain the interfacing circuit to interface a seven segment LCD display. 10

3. (a) Explain the following instructions of 8051 :- 10
(i) LCALL
(ii) MOV @R0,*iram addr*
(iii) MUL
(iv) CJNE @ Rp, #n, radd
(v) DJNZ Rn, radd
(b) Write a program to generate square wave of 500Hz using 8051 Timer. Assume system frequency of 6 MHz. 10

4. (a) Draw and explain the architecture of ARM processor. 10
(b) Explain Arithmetic, Logical and Branching instructions of ARM processor 10

5. (a) Compare features of 89C51,89C52,89C2051 and 89C2051. 10
(b) Draw and Explain Timing diagram of memory read, memory write instructions of 8085. 10

6. (a) Write a program to multiply two 8 bit numbers using 8085 instructions. 10
(b) Draw and explain the port structure of all the ports of 8051. 10

7. Write notes on any **four** of the following :- **20**
(a) Serial communication in 8051
(b) Interrupt system of 8085.
(c) Serial communication in 8085
(d) Internal memory organization of 8051
(e) Addressing modes of ARM processor.

TE EXTC V (Rev)
Signals & systems.

Con. 3831-11. **RK-2142**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of the remaining **six** questions.
(3) Assume **suitable** data if **required**.

1. (a) Determine whether the following signals are periodic or non periodic ? If periodic, find fundamental period. 20

(i) $x(t) = 2\cos t + 3\cos\frac{t}{3}$

(ii) $x[n] = e^{j[\pi/4]n}$.

(b) Determine whether the following signals are energy signals or power signals? Calculate their energy or power.

(i) $x(t) = \cos^2 w_0 t$

(ii) $x[n] = [1/2]^n u[n]$

(c) Explain Gibb's phenomenon ?

(d) Check whether following systems are :
Static or dynamic, Shift invariant or shift variant, Linear or non linear, Causal or non causal, Stable or unstable.

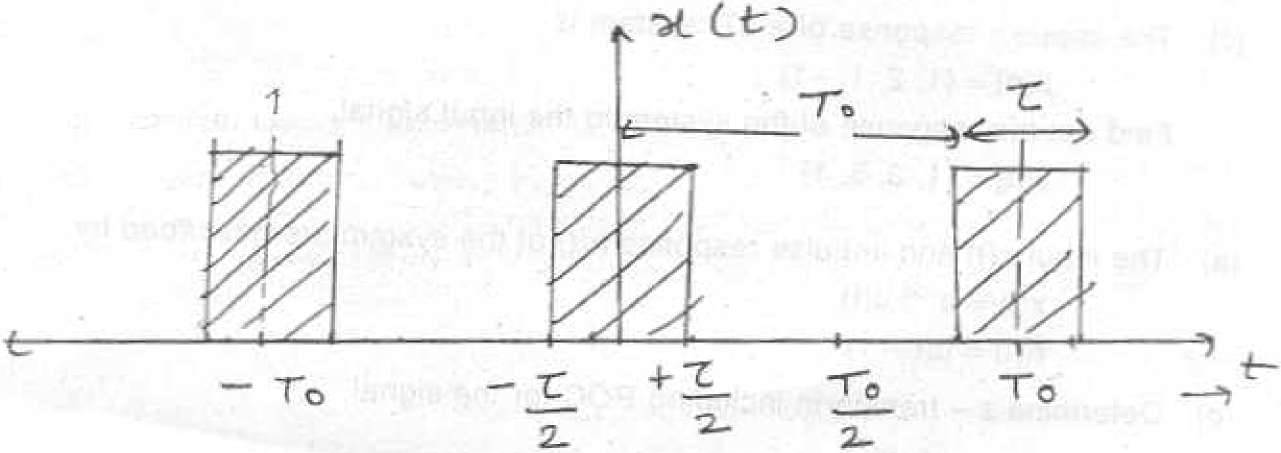
(i) $y(t) = 10\,x(t) + 5$

(ii) $y[n] = x[n]\cos[w_0 n]$

(e) Find and sketch the even and odd components of the following :-

$$x(t) = \begin{cases} t & 0 \le t \le 1 \\ 2-t & 1 \le t \le 2 \end{cases}$$

2. (a) Determine the complex exponential Fourier series for periodic rectangular pulse train as shown in **figure**. Also determine trigonometric Fourier series for the same signal. 10



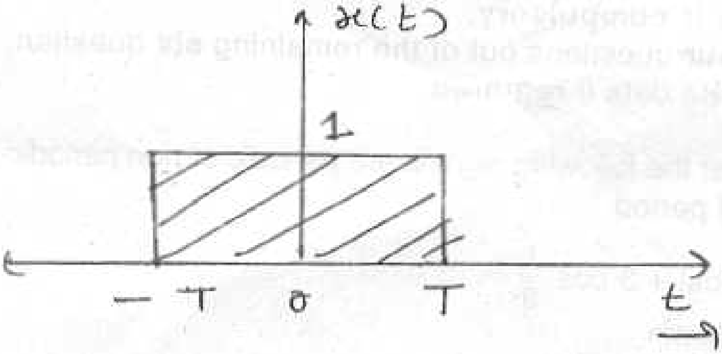
(b) What is orthogonal function space or signal space ? Explain with sketches. Assuming that an arbitrary function f(t) is approximated by a orthogonal set of functions gr(t) , r = 0, 1, 2, 3, ... 10

$$f(t) \approx \sum_{r=0}^{n} c_r g_r(t)$$

Derive an expression for the general coefficients Cr.

[TURN OVER

3. (a) Obtain the Fourier transform of a rectangular pulse shown. 6



(b) Determine the output response of the system h(t) = u(t) to an input 8

$$x(t) = e^{-at}u(t), \ a > 0$$

(c) Explain and prove time shifting and Frequency shifting property of Fourier Transform. 6

4. (a) Obtain inverse z - transform of the following x (z) 8

$$x(z) = \frac{1}{(1 + z^{-1})(1 - z^{-1})}, \ \text{ROC } |z| > 1$$

(b) Prove that LTI system is stable if its impulse response is absolutely summable. 8

(c) Compare Discrete Time Fourier Transform and continuous time Fourier. 4

5. (a) Determine the system function and unit sample response of the system describe by the difference equation. 6

$$y[n] - \frac{1}{2}y[n-1] = 2x[n], \ y[-1] = 0$$

(b) Explain the relationship between Laplace Transform and Fourier Transform. 7

(c) The impulse response of a LTI system is 7

$$h[n] = \{1, 2, 1, -1\}$$

Find out the response of the system to the input signal.

$$x[n] = \{1, 2, 3, 1\}$$

6. (a) The input x(t) and impulse response h(t) of the system are described by 8

$$x(t) = e^{-3t}\,u(t)$$

$$h(t) = u(t-1)$$

(b) Determine z – transform including ROC for the signal 8

$$x[n] = \left[\frac{1}{2}\right]^n \{u[n] - u[n-10]\}$$

(c) List and state properties of Laplaces Transform. 4

7. (a) The transfer function of the system is given as 8

$$H(s) = \frac{s^2+s+5}{s^3+6s^2+8s+4}$$

Obtain the state variable model.

(b) Using a suitable method obtain the state transition matrix e^{At} for the following system $A = \begin{bmatrix} 0 & -3 \\ 1 & -4 \end{bmatrix}$ 8

(c) State properties of state transition matrix. 4

15/6/2011 TE (EXTC) Sem-V (Rev)
Principals of control Systems

103 : 1st half.11-PH(I)

Con. 3238-11. **RK-2136**

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.

1. (a) The signal flow graph of two systems are shown below. State whether **Figure 1** and **Figure 2** represent equivalent system. Give reason. 5

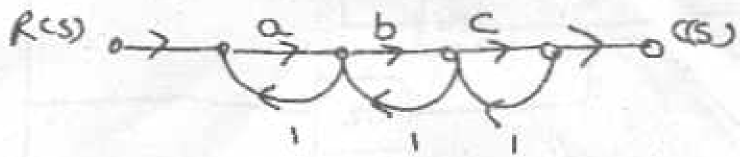


Fig. 1

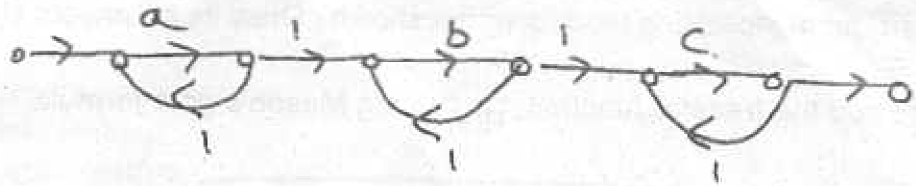
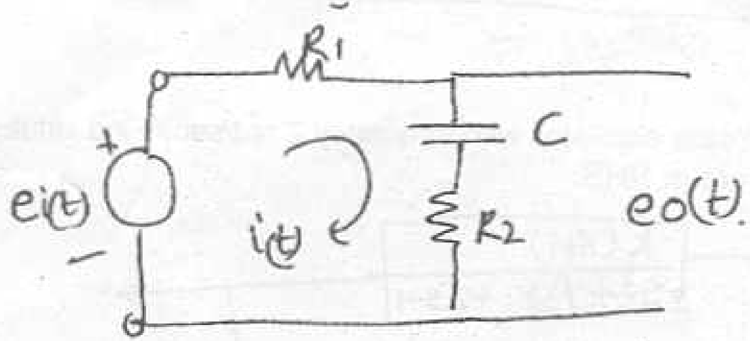


Fig. 2

(b) Define damping ratio and draw waveforms of the system with $\xi = 0$, $\xi < 1$ and $\xi > 1$. 5
(c) Define Gain Margin and phase Margin and state condition for stable system. 5
(d) Define : (i) Transfer function 5
(ii) Type of system.

2. (a) For the given electrical system– 10



Determine–

(i) Transfer function model

(ii) State variable model.

(b) The response of a second order under damped system to a unit step g/p is given by– 10

$$(t) = 1 - \frac{e^{-\xi wn\, t}}{\sqrt{1-\xi^2}} \sin(wd\,t + \theta)$$

where $\theta = \tan^{-1}\sqrt{\frac{1-\xi^2}{\xi}}$

$wd = wn\ \sqrt{1-\xi^2}$

Derive the expression for T_P and M_P.

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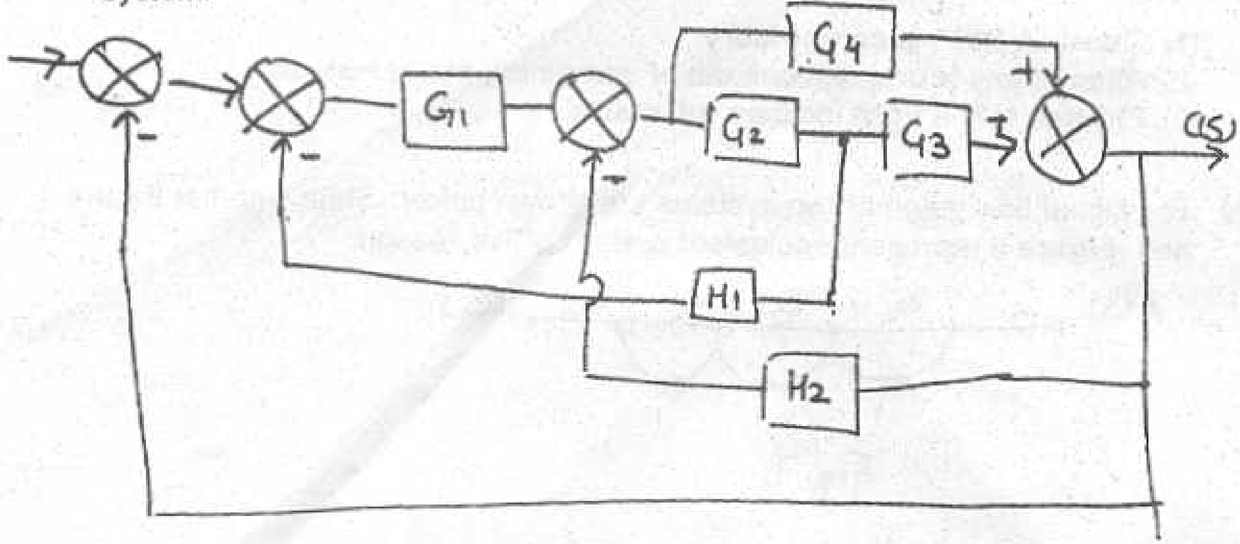
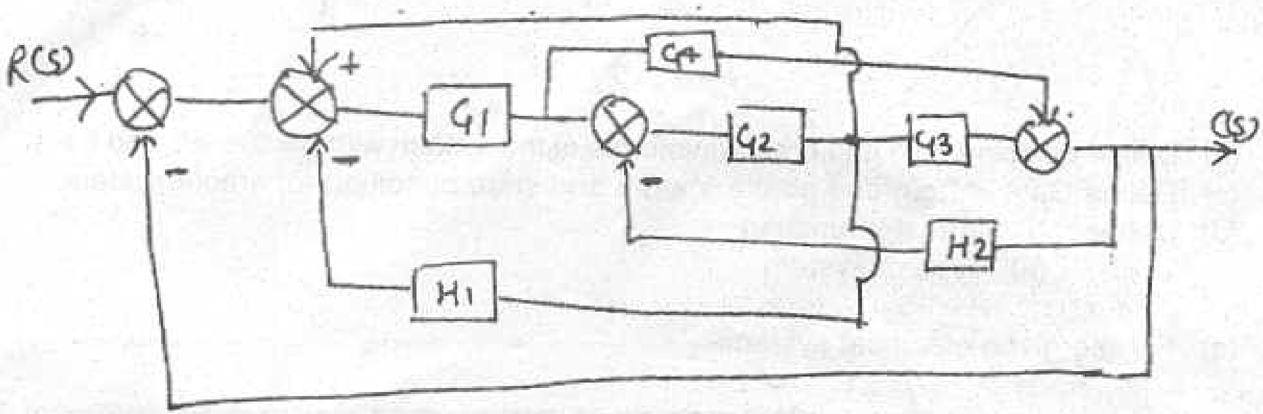
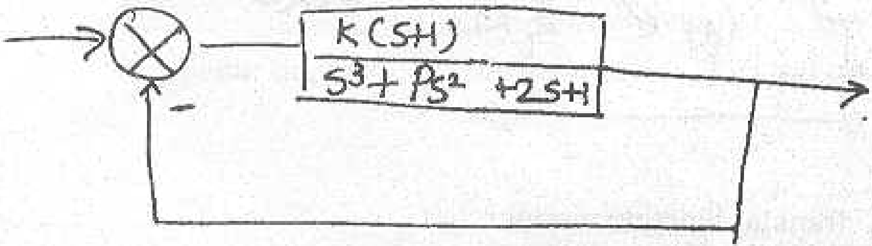
3. (a) Using block diagram reduction method. Obtain the transfer function of the given system. **10**



(b) Consider the following block diagram shown. Draw its equivalent signal flowgraph and find the transfer function $\frac{C(s)}{R(s)}$ using Mason's gain formula. **10**



4. (a) The system shown below oscillates with frequency 2 rad/sec. Find values of 'K_{mor}' and 'P'. No poles are in RHS. **10**



(b) Draw a complete root locus for the given open loop transfer function.

$$G(s)\ H(s) = \frac{K}{s(s+3)\ (s^3 + 3s + 3)}$$

5. (a) For the given open loop transfer function – **10**

$$G(s)\ H(s) = \frac{K}{s(1+0.5s)1+0.1s)}$$

Determine the value of K to obtain–

(i) Phase Margin = 30°

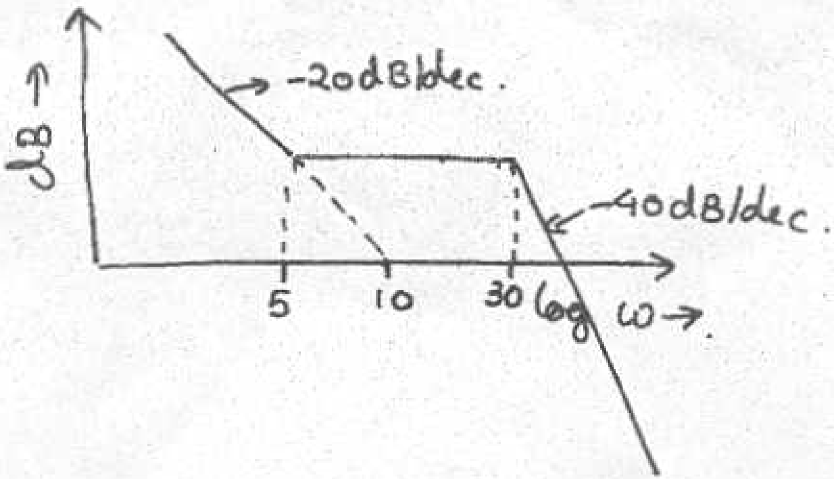
(ii) Gain Margin = 12 dB

(b) Draw the Nyquist plot for a feed back system with open loop transfer function– **10**

$$G(s)\ H(s) = \frac{K(s+3)}{s(s-1)}.$$

And comment on stability.

6. (a) Determine the transfer function for the magnitude plot shown below :- 10



(b) Discuss steady state error for various inputs and system types. 10

7. Write short notes on any **two** :- 20
   (a) Stepper Motor
   (b) AC servo motors
   (c) Tacho generators.