NEW SCHEME

USN

Third Semester B.E. Degree Examination, January/February 200[illegible]

EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.] [Max.Marks: 100]

Note: 1. *Answer any FIVE full questions.*
2. *Assume missing data if any suitably.*
3. *Mention the assumtions made.*

1. (a) Sketch the following signals and determine their even and odd compo... and sketch them.

   (i) $r(t+2) - r(t+1) - r(t-2) + r(t-3)$

   (ii) $u(n+2) - 3u(n-1) + 2u(n-5)$. (... Marks)

   b) Given the signal $x(t)$ as shown in fig 1.b, sketch the following:

   i) $x(-2t+3)$

   ii) $x(\frac{t}{2} - 2)$ (4 Marks)

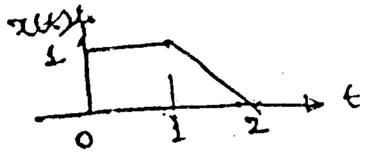


Fig.1(b)

   (c) Check the system given below for linearity. Give reasons for your an...

   $$\frac{dy(t)}{dt} + 10y(t) + 5 = x(t)$$ (4 Marks)

2. (a) Check whether the following singnals are periodic or not. If periodic, determine their fundametal period.

   i) $x(n) = Cos(\frac{\pi n}{\text{[illegible]}}) sin(\frac{\pi n}{\text{[illegible]}})$

   ii) $x(t) = (2cos^2(\frac{\pi t}{2}) - 1)Sin\pi t cos\pi t$ (6 Marks)

Contd.... 2

(b) Determine the power in the following signal shown in Fig 2(b).

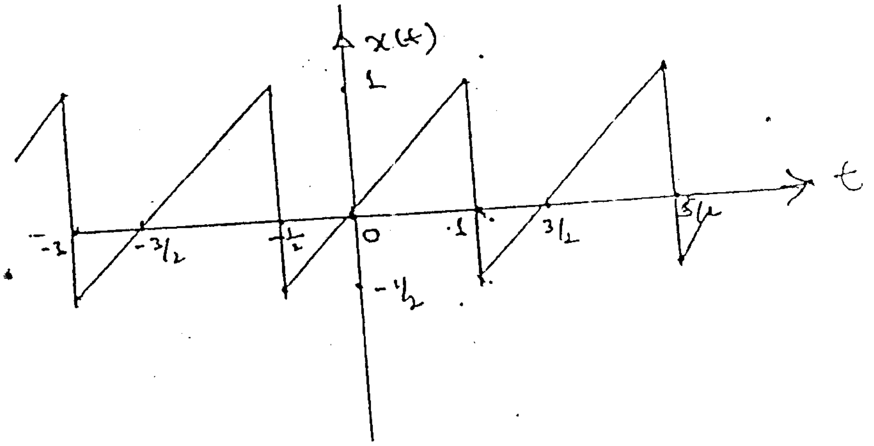


Fig2(b)

(c) Determine the output y(t) of a LTI system with impulse response
$h(t) = u(t+1) - 2u(t) + u(t-1)$
and input $x(t) = \quad 1 \mid t \mid \leq 2.$
$= \quad 0 \mid t \mid > 2$

(10 Mar

Sketch the signals $x(t), h(t) and y(t)$.

3. (a) Determine the complete response of jthe system described by
$\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} + y(t) = x(t) + 2\frac{dx(t)}{dt}$ for the input $x(t) = 2e^{-t}u(t)$ wi
initial conditions y(o)=1. $\frac{dy(t)}{dt}|_{t=0} = 1$. Comment on the stability of t
system (10 Mar

(b) Draw the direct form I & II realization for the following system.

i) $y(n) - \frac{1}{2}y(n-1) + \frac{1}{4}y(n-2) = x(n) + 2x(n-1)$ (10 Mar

ii) $2\frac{d^3y(t)}{dt^3} + \frac{dy(t)}{dt} + 3y(t) = x(t)$

4. (a) Derive the DTFS representation for a discrete time periodic signal $x(n)$ using t
mean square error (MSE) criterion. (10 Mar

(b) Determine the signal $x(n)$ given its Fourier representation as

$$x(j\omega) = j\frac{d}{d\omega}\left[\frac{1}{2+j(w-\frac{\pi}{2})}\right]$$

(c) Starting from signal $x(t)$ definded as
$x(t) = 1 \quad |t| \leq 1$
$= 0 \quad |t| > 1$

Determine fourier transform of signal g(t) shown fig 4(c). Express g(t) in term of x(t).

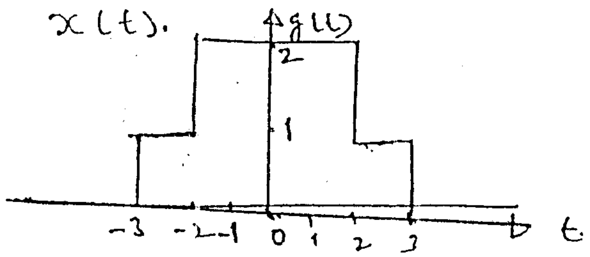


Fig 4(c)

(5 Marks)

5. (a) Determine the time domain signal given:

i) $x(j\omega) = e^{|\omega|}$

ii) $x(e^{j\Omega}) = \frac{6}{e^{-j2\Omega} - 5e^{-j\Omega} + 6}$

iii) $x(j\omega) = \frac{4sin^2\omega}{\omega^2}$

(12 Marks)

(b) Show that a real and odd continous time non periodic signal has purely imaginary Fourier transform.

(4 Marks)

(c) Explain the reconstruction of CT signals implemented with zero-order device.

(4 Marks)

6. (a) Consider the system depicted in fig 6a. The FT of the input signal is given by

$$x(j\omega) = \begin{cases} (1 - (|\frac{\omega}{\pi}|) & |\omega| \leq \pi \\ 0 & |\omega| > \pi \end{cases}$$

The signals $\omega(t)$ and $h(t)$ are given by $\omega(t) = cos5\pi t, h(t) = \frac{Sin6\pi t}{\pi t}$ and $y(j\omega) \longleftrightarrow$ y(t) Determine and sketch $y(j\omega)$.

(10 Marks)

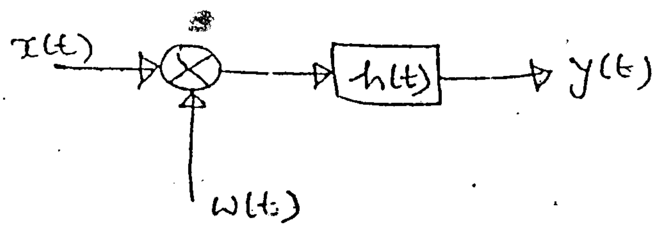


Fig 6(a)

(b) Find both the DTFS and DTFT representation for the periodic signal.

(10 Marks)

$$x(n) = 2cos(\frac{3\pi n}{8} + \frac{\pi}{3}) + 4sin(\frac{\pi}{2}n)$$

7. (a) Specify the properties of ROC

(4 Marks)

(b) Determine the Z-transform of the following signals.

i) $x(n) = \alpha^{|n|}$

ii) $x(n) = n(\frac{1}{3})^{n+3}u(n+3)$

iii) $x(n) = n(\frac{1}{2})^{n}u(n) * (\delta(n) - \frac{1}{2}\delta(n-1))$ (4+6+6=16 Marks)

8. (a) A casual stable discrete time system is defined by

$y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n) - 2x(n-1)$. Determine:

i) System function H(Z) and magnitude response at zero frequency.

ii) Impulse response of the system.

iii) output $y(n)$ for $x(n) = (\delta(n) - \frac{1}{3}\delta(n-1))$ (12 Marks)

(b) State and prove differentiation property of Z-transform. Determine the signal $x(n)$, given. (8 Marks)

$$X(Z) = \frac{\frac{5}{2}}{(1-\frac{1}{2}Z^{-1})(1+\frac{1}{3}Z^{-1})} \qquad |Z| > \frac{1}{2}.$$

** * **

NEW SCHEME

USN 4 S 0 0 2 E C 0 5

~~Third~~ Semester B.E. Degree Examination, January/February 2004

EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Define a signal and a system. Explain any two properties of a LTI system. (6 Marks)

   (b) Find and sketch the even and odd components of the following

   i) $x[n] = e^{-(n/4)}\, u[n]$

   ii) $x(t) \begin{cases} = t & 0 \leq t \leq 1 \\ = 2-t & 1 \leq t \leq 2 \end{cases}$ (6 Marks)

   (c) Find the periodicity of the signal $x[n] = cos\left(\frac{2\pi n}{5}\right) + cos\left(\frac{2\pi n}{7}\right)$ (3 Marks)

   (d) A rectangular pulse $x(t) \begin{cases} = A & 0 \leq t \leq T \\ = 0 & elsewhere \end{cases}$

   is applied to an integrator circuit. Find the total energy of the output $y(t)$ of the integrator. (5 Marks)

2. (a) Given the impulse response of system $h[n]$ as $\beta^n\, u[-n]$ $\beta > 1$, find the response of the system for the input $u[-n]$ (7 Marks)

   (b) The impulse response of a system is $h(t) = e^{2t}\, u(t-1)$. Check whether the system is stable, causal and memoryless system. (7 Marks)

   (c) Find the overall impulse response of a cascade of two systems having identical impulse responses $h[t] = 2\{u(t) - u(t-1)\}$ (6 Marks)

3. (a) Obtain the block diagram representation (direct from I and II) for a system modelled by the equation

   $$4\frac{d^3y(t)}{dt^3} - 3\frac{dy(t)}{dt} + y(t) = x(t) + \frac{dx(t)}{dt}$$ (7 Marks)

   (b) Find the total response of an LTI system described by the equation $4y[n] + 4y[n+1] + y[n+2] = x[n]$ with input $x[n] = 4^n\, u[n]$, initial conditions being $y[-1] = 0,\ y[-2] = 1$ (7 Marks)

   (c) Find the natural response for the system described by the equation

   $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 4e^{-3t}$ for $t \geq 0$. Also $y(0) = 3$ $y'(0) = 4$. (6 Marks)

4. (a) Determine the complex Fourier coefficients for the signal

   $x(t) \begin{cases} = t+1 & -1 \leq t \leq 0 \\ = 1-t & 0 \leq t < 1 \end{cases}$ which repeats periodically with T=2 units. Plot the amplitude and phase spectra of the signal. (8 Marks)

Contd.... 2

(b) State and prove the following of Fourier transform

i) Time shifting property

ii) Time differentiation property

iii) Parsedval's theorem. (12 Marks)

5. (a) Using convolution theorem, find inverse Fourier transform of

$$X(\omega) = \frac{1}{(a+j\omega)^2}$$

(6 Marks)

(b) The transfer function of a system is $H(\varphi) = \frac{16}{4+j\omega}$

Find time domain response y(t) for input $x(t) = u(t)$. (7 Marks)

(c) Define the DTFT of a signal. Establish the relation between DTFT and Z transform of a signal. (7 Marks)

6. (a) Determine the DTFT of the following signals

(i) $x[n] = (0.5)^{n+2}\ u[n]$

(ii) $x[n] \begin{cases} = 1 & -5 \le n \le 5 \\ = 0 & \text{elsewhere} \end{cases}$ Plot $X(\Omega)$ (7 Marks)

(b) Define and prove the following for DTFS representation of signals.

i) Modulation of two signals ii) Convolution of two signals. (7 Marks)

(c) Define and explain Nyquist sampling theorem with relevant figures. (6 Marks)

7. (a) Determine Z transform, ROC, pole-zero locations of the following functions :

i) $a^n cos(\Omega_0 n)\ u[n]$. for $\Omega_0 = 2\pi$ get pole zero plot.

ii) $(0.2)^n\ \{u[n] - u[n-4]\}$ (10 Marks)

(b) Prove the following properties of Z transform mentioning ROC

i) Time shifting property

ii) Time reversal property

iii) Differentiation in z domain. (10 Marks)

8. (a) Determine inverse Z transform of sequence $X(z) = sinZ$. (4 Marks)

(b) A LTI system is represented by its system function $H(z) = \frac{z^2}{z^2 - \frac{z}{6} - \frac{1}{6}}$. Find system response when the input $x[n] = 4u[n]$. Assume initial conditions as $y[-1] = 0,\ y[-2] = 12$ (8 Marks)

(c) Consider a system described by the difference equation

$$y[n] - 2y[n-1] + 2y[n-2] = x[n] + \tfrac{1}{2}x[n-1]$$

Find system function $H(z)$ and unit sample response $h[n]$ of the system. Also find the stability of the system. (8 Marks)

** * **

NEW SCHEME

EC36

USN | | | | | | | | | | |

4th ~~Third~~ Semester B.E. Degree Examination, July/August 2004

EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) A continuous, causal Linear Time Invariant System is shown in Fig 1.a.

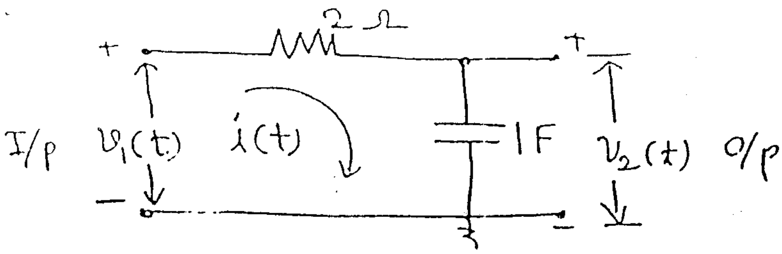


Fig 1.a.

Determine the unit impulse and step response of this system. Plot the response. Also verify whether the system is causal and stable. **(10 Marks)**

(b) Find $x(t) * y(t)$ for the signals shown and also sketch the convolved signal

(i) $x(t) = \delta(t) - 2\delta(t-1) + 8\delta(t-2)$
$y(t) = 2, \quad -1 \leq t \leq 1$

(ii) $x(t) = 2, \quad for -1 \leq t \leq 1$
$y(t) = t, \quad -2 \leq t \leq 2$ **(10 Marks)**

2. (a) A discrete LTI system is characterized by the following difference equation
$y(n) - y(n-1) - 2y(n-2) = x(n)$
with $x(n) = 6u(n)$ and initial conditions
$y(-1) = -1, \; y(-2) = 4$

i) Find the zero-input response, zero-state response, and total response.

ii) How does the total response change if $y(-1) = -1, y(-2) = 4$ as given, but $x(n) = 12u(n)$

iii) How does the total response change if $x(n) = 6u(n)$ as given, but $y(-1) = -2$ and $y(-2) = 8$. **(10 Marks)**

(b) State and prove frequency convolution and modulation property of Fourier transform of a CT signal. **(10 Marks)**

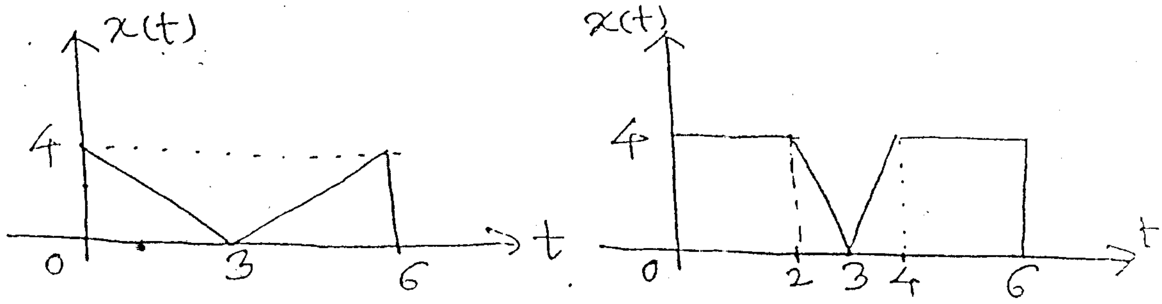
3. (a) i) Consider a linear shift - invariant system with unit - sample response $h(n) = \alpha^n u(n)$, where α is real and $0 < \alpha < 1$. If the input is $x(n) = \beta^n u(n)$ for $0 < |\beta| < 1$, determine the output $y(n)$ in the form $y(n) = (K_1\alpha^n + K_2\beta^n)u(n)$ by explicitly evaluating the convolution sum.

ii) By explicitly evaluating the transforms $x(e^{jw})$, $H(e^{jw})$ and $y(e^{jw})$ corresponding to $x(n), h(n)$ and $y(n)$ specified in part (i), show that

$$y(e^{jw}) = H(e^{jw}).X(e^{jw})$$ **(10 Marks)**

Contd.... 2

(b) Find the Fourier transform of the following signals shown in fig (3b) showing uproperties of the Fourier transform.



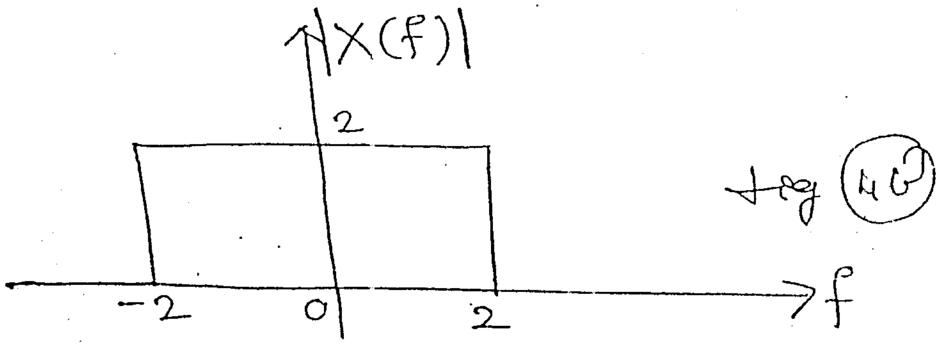
(10 Marks)

4. (a) An LTI system is described by

$$H(f) = \frac{4}{2+j2\pi f}$$

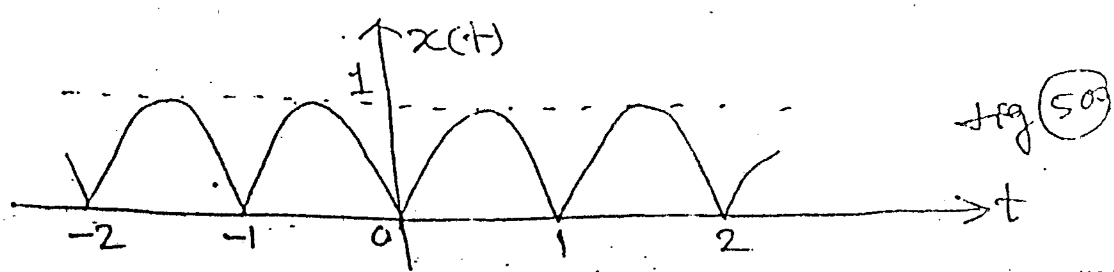
Find its response $y(t)$ if the input is $x(t) = u(t)$. (10 Marks)

(b) State and prove Parseval's theorem for CT signals. Using this theorem determine the range of frequencies $(-f_1, f_1)$ where 50% of the signals energy lies. The spectrum of the signal is shown in fig.4.b.



(10 Marks)

5. (a) Determine the exponential Fourier series representation for the full rectified sinewave shown in Fig 5. (a). Also plot the line spectrum.



(10 Marks)

(b) Show that the Fourier transform of a train of impulses of unit height, separated by T secs, is also a train of impulses of height $\omega_0 = \frac{2\pi}{T}$, separated by $\omega_0 = \frac{2\pi}{T}$. (10 Marks)

6. (a) State and prove the sampling theorem for low pass signals. Give the significance of this theorem. (10 Marks)

No... 1

NEW SCHEME

EC36

USN

~~Third~~ 4th Semester B.E. Degree Examination, July/August 2005

EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.] [Max.Marks : 100

Note: 1. *Answer any FIVE full questions.*
2. *Make any suitable assumptions for missing data.*
3. *Indicate the question number and subdivisions clearly.*

1. (a) For each of the systems, state whether the system is linear, shift-invariant, stable, causal, invertible :

i) $y(n) = log(x\,|\,n\,|)$ ii) $y(n) = x(n^3)$ (5+5 Marks)

(b) Determine whether or not the following signals are periodic. FInd the period, if they are periodic

i) $x(t) = v(t) + v(-t)$ where $v(t) = sin(t)\, u(t)$

ii) $cos\left[\frac{1}{5}\pi n\right] \; sin\left[\frac{1}{3}\pi n\right]$

(c) Given $x(n) = \{0,0,0,\underset{\uparrow}{1},2,3,2,1,0,0,0\}$, plot $x[-2n-1]$, $x\left[\frac{n}{2}\right]$ (2+2 Marks)

2. (a) Fig Q.2(a) shows parts of the signal $x(t)$ and its even part for $t \geq 0$ only. $x(t)$ and even part for $t < 0$ is not shown. Complete the plots of $x(t)$ and $x_e(t)$. Also obtain the odd part of $x(t)$.

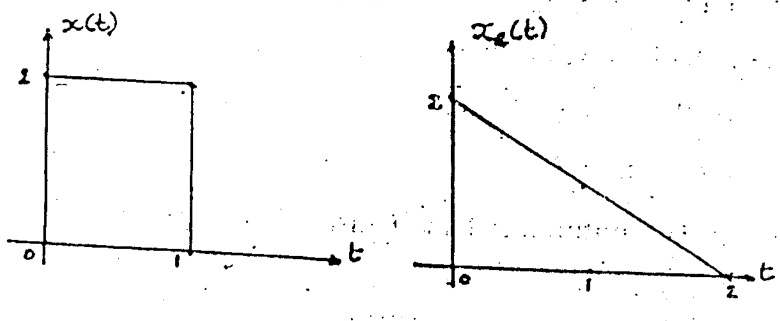


Fig. Q 2(a)

(b) Determine the energy or power as applicable for the following signals.

i) $e^{j\left(\frac{\pi}{2}n+\frac{\pi}{6}\right)}$ Peri

ii) $\left[\frac{1}{3}\right]^n u(n)$ Non periodic (2+2 Marks)

(c) Determine graphically, the output of an LTI system whose impulse response is $h(t) = 3u(t-1) - 3u(t-3)$ and input is $x(t) = u(t+1) - 2u(t-1) + u(t-3)$ (8 Marks)

Contd.... 2

3. (a) Determine the convolution of two given sequences $x(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$ and $h(n) = \{\underset{\uparrow}{1}, 1, 3, 2\}$ (6 Marks)

(b) There LT1 systems are interconnected as shown in Fig Q3(b). If $h_1(n) = u(n-2)$, $h_2(n) = nu(n)$ and $h_3(n) = \delta(n-2)$, find the overall impulse response.

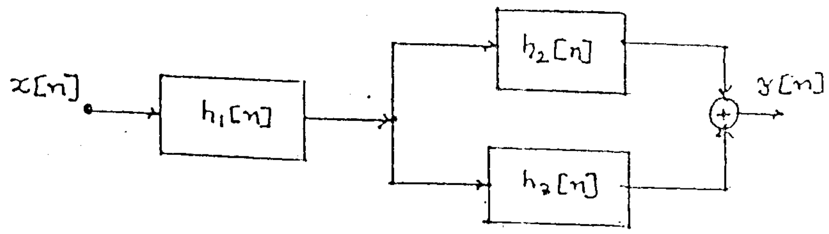


Fig. Q3(b)

(6 Marks)

(c) The differential equation of the system is given as

$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = x(t)$, with $y(0) = 3$, $\frac{dy}{dt}|_{t=0} = -5$. Determine the total response of the system for a step input. (8 Marks)

4. (a) Draw the direct form II block diagram of the system given by the difference equation $y(n) - 0.25y(n-1) - 0.125y(n-2) - x(n) - x(n-2) = 0$. How many delay elements, adders and multipliers are used ? (3+3 Marks)

(b) A discrete time signal is defined by $x(n) = sin[\pi n/8]$. Sketch the magnitude and phase of the Discrete Time Fourier Transform of $x(n-2)$. (8 Marks)

(c) Using the Parseval's theorem find the signal energy of

i) $x(t) = 4sinc(t/5)$

ii) $x(t) = 2sinc^2(3t)$ (3+3 Marks)

5. (a) Obtain the Continuous Time Fourier Transform (CTFT) of

$$x(t) = \begin{cases} \frac{1}{2}[1-|t|] & -1 < 1 < 1 \\ 0 & elsewhere \end{cases}$$

using the integral property of CTFE. Also indicate the CTFT of $x(t-1) - \frac{1}{2}$ (5+3 Marks)

(b) A periodic signal with a period of 4sec is described over one fundamental period by $x(t) = 3 - t$, $0 < 1 < 4$. Plot the signal and find the exponential Fourier series. Plot the amplitude and phase spectrum. Obtain the average value of $x(t)$. (2+6+2+2 Marks)

Contd....

6. (a) Obtain the impuse response of the network shown in Fig Q6.a). Determine the frequency response $H(j\omega)$ of the network. Determine the frequency at which $|H(j\omega)|$ falls to $1/\sqrt{2}$. Find the corresponding phase.

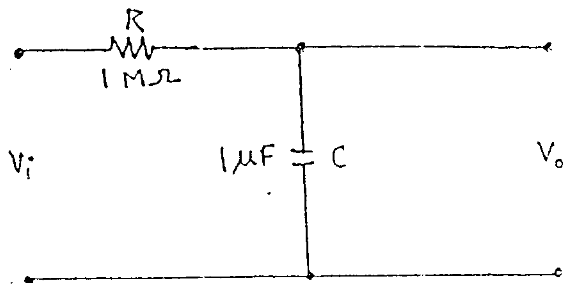


Fig Q6(a)

(3+6+3 Marks)

(b) Find the Nyquist rate for each of the following signals :

i) $x(t) = 25e^{j500\pi t}$

ii) $x(t) = [1 + 0.1 sin(200\pi t)] \, cos(2000\pi t)$

iii) $10 sinc(5t)$

iv) $2 sinc(50t) \, sin(5000\pi t)$ (2+2+2+2 Marks)

7. (a) The spectrum $X(j\omega)$ of a signal as shown in fig Q 7(a). Draw the spectrum of the sampled signal at i) twice the Nyquist rate and ii) half the Nyquist rate. Mark the frequency values clearly in the figure.

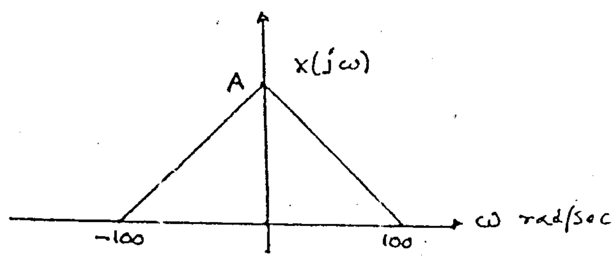


Fig. Q7(a)

(3+3 Marks)

(b) Find the Z-transform and also given ROC

i) $x(n) = 2^n u(n) + 3^n u(-n-1)$

ii) $e^{\frac{-n}{10}} \, sin\left[\frac{2\pi n}{8}\right] u(n)$ (3+3 Marks)

(c) Obtain the complete response of the system given in linear difference equation form using Z - transform. Assume the system to have zero initial conditions.

$$y(n) + y(n-1) - 2y(n-2) = u(n-1) + 2u(n-2)$$ (8 Marks)

Contd.... 4

8. (a) The signal $x(t) = e^{-at}$ is sampled every T sec beginning at $t = 0$. Find the Z-transform of the sampled signal. Give two different values of (a, T) such that Z - transforms of the sampled signals are same. (6+2 Marks)

(b) A causal system has $4H(z) = \frac{8}{z^{-2} - 6z^{-1} + 8}$. Determine the pole locations is the system stable ? Obtain the impulse response $h(n)$. What will be impulse response of the system. If the system is known to be anti-causal ? (2+2+6+2 Marks)

** * **

NEW SCHEME

Reg. No. [ ]

~~Third~~ Semester B.E. Degree Examination, January/February 2006

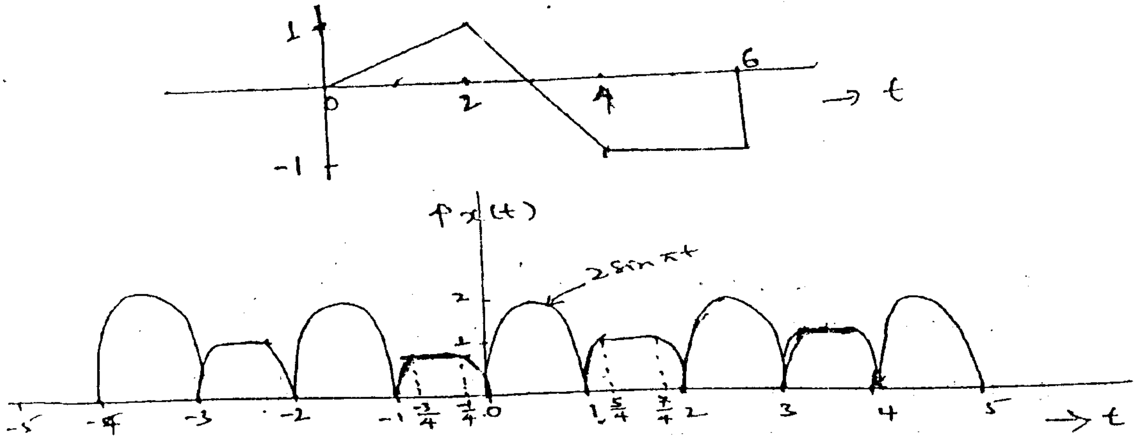
EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.) (Max.Marks : 100

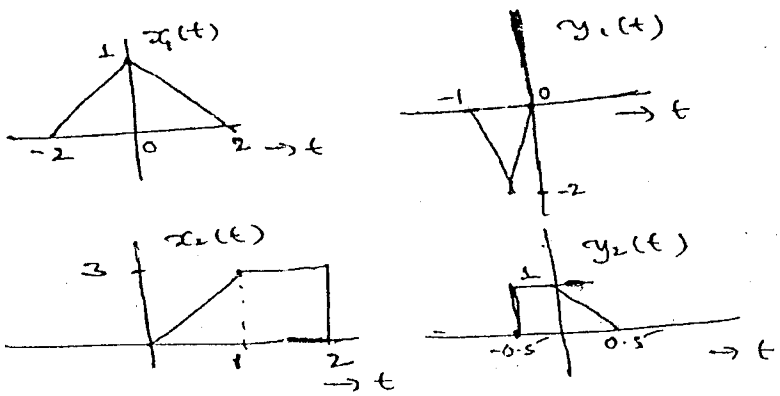
Note: *1. Answer any FIVE full questions.*
2. Missing data may be suitably assumed with proper justification.

1. (a) Is the signal shown in fig 1a is power or energy signal? Give reasons for your answers and further determine its energy/power.



(10 Marks)

(b) Explain the significance of time compression and expansion. Determine the relationship between the signals $x_1(t)$ & $y_1(t)$ and $x_2(t)$ & $y_2(t)$ shown in fig 1b.



(10 Marks)

2. (a) Determine whether the following signals are periodic, If periodic determine the fundamental period.

i) $x(t) = cos2t + sin3t$ ii) $x(n) = cos(\frac{1}{5}\pi n)sin(\frac{1}{3}\pi n)$ (6 Marks)

(b) Determine whether the system shown below is memoryless, stable, causal, linear and time invariant.

i) $y(n) = x(n)\sum_{k=-\infty}^{\infty}\delta(n-2k)$ ii) $y(t) = \frac{d}{dt}\{e^{-t}x(t)\}$ (14 Marks)

Contd.... 2

3. (a) A LTI system has impulse response $h(t) = tu(t) + (10-2t)u(t-5) - (10-t)u(t-10)$ determine the output for each of the following inputs:

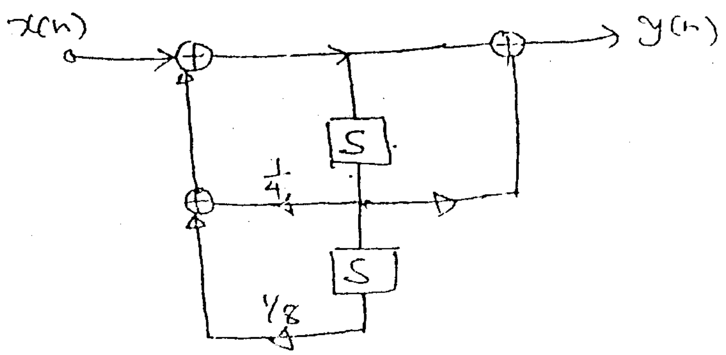
   i) $x_1(t) = \delta(t+2) + \delta(t-5)$ ii) $x_2(t) = 2\delta(t) + \delta(t-5)$ (14 Marks)

   (b) Draw the direct form I and direct form II implementation if the following system:

$$\frac{d^3}{dt^3}y(t) + 2\frac{d^2}{dt}y(t) + 3y(t) = x(t) + 3\frac{d^2}{dt^2}x(t)$$

(6 Marks)

4. (a) Determine the output response of the following system given the input and initial condition as $x(n) = 2^n u(n)$ $y(-1) = 2$ $y(-2) = -1$



(12 Marks)

   (b) Explain the characteristics of systems described by differential equations. (6 Marks)

   (c) Obtain an expression for impulse response of a LSI system in terms of its step response. (2 Marks)

5. (a) Determine the time domain expression given the following:

   i) $X(e^{j\Omega}) = \dfrac{6-\frac{2}{3}e^{-j\Omega}-\frac{1}{6}e^{-j2\Omega}}{-\frac{1}{6}e^{-j2\Omega}+\frac{1}{6}e^{-j\Omega}+1}$

   ii) $X(j\omega) = \dfrac{2j\omega+1}{(j\omega+2)^2}$

   iii) $X(j\omega) = 4\dfrac{Sin^2(\omega)}{\omega^2}$ (12 Marks)

   (b) Evaluate the following quantities

   i) $\int_{-\infty}^{\infty} \frac{4}{(\omega^2+1)^2} d\omega$ ii) $\int_{-\infty}^{\infty} \frac{sin^2(\pi t)}{\pi t^2} dt$ (8 Marks)

6. (a) Prove the following properties:

   i) Convolution property of periodic discrete time sequences.

   ii) Time shift property of discrete time aperiodic sequences.

   iii) Parseval relationship for the FS. (10 Marks)

   (b) A LTI system has impulse response $h(t) = 2\frac{sin\pi t}{\pi t}cos(4\pi t)$. Use the FT to determine the system output if the input is given by fig 6b. (10 Marks)

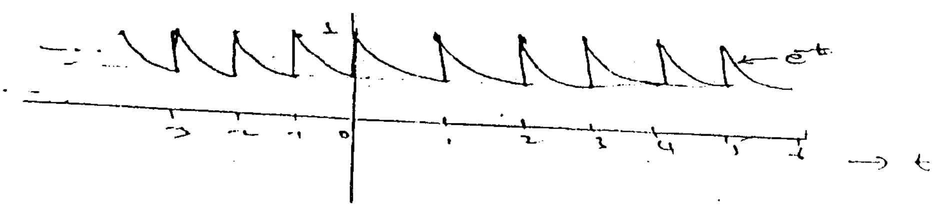


Fig 6.b

Cont'd.... 3

USN 4-S 0 0 5 E C 0

NEW SCHEME

~~Third~~ 4th Semester B.E. Degree Examination, Dec.06 / Jan.07
Electronic and Communication Engineering
Signals and Systems

Time: 3 hrs.] [Max. Marks:100

Note: ***1. Answer any FIVE full questions.***
2. Justify any assumptions made.

1 a. Determine and sketch the even and odd parts of the signal shown in figure Q1 (a). **(05 Marks)**

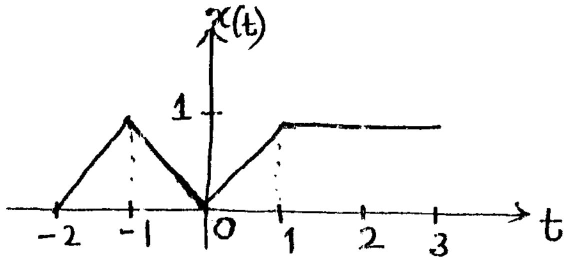


Fig. Q1 (a)

b. Determine whether the discrete-time signal $x(n) = \cos\left(\frac{\pi n}{5}\right)\sin\left(\frac{\pi n}{3}\right)$ is periodic. If periodic, find the fundamental period. **(05 Marks)**

c. Determine whether the following signals are power signals or energy signals or neither:

i) $e^{-at}; t \geq 0$

ii) $2e^{j3n}$ **(06 Marks)**

d. Determine if each of the following signals is invertible. If it is, construct the inverse system. If it is not, find the two input signals that have the same output.

i) $y(t) = \int_{-\infty}^{t} x(\tau)d\tau; y(-\infty) = 0$

ii) $y(n) = nx(n)$ **(04 Marks)**

2 a. Determine whether the system given by the following relation is,

i) Linear

ii) Time-invariant and

iii) Stable.

$$y(n) = x(n)\sum_{k=-\infty}^{\infty}\delta(n-2k)$$ **(06 Marks)**

b. Figure Q2 (b)-1 shows a staircase-like signal $x(t)$ that may be viewed as a superposition of four rectangular pulses. Starting with the rectangular pulse shown in figure Q2(b)-2, construct this waveform and express $x(t)$ in terms of $g(t)$. **(06 Marks)**

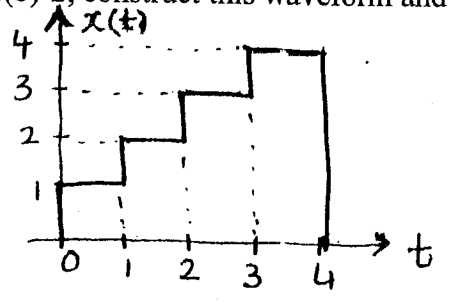


Fig Q 2(b)(i)

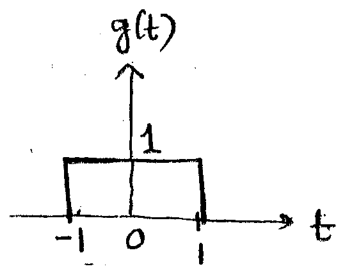


Fig Q 2(b)(ii)

Contd....2

2 c. Find the convolution of two finite duration sequences,

$h(n) = a^n u(n)$ for all n

$x(n) = b^n u(n)$ for all n

i) When $a \neq b$ ii) When $a = b$ **(08 Marks)**

3 a. Find the step response of a system whose impulse response is given by, $h(t) = u(t+1) - u(t-1)$ **(05 Marks)**

b. Determine the output of the system described by the difference equation,

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = 2x(n).$$

with input $x(n) = 2u(n)$ and initial conditions $y(-1) = 1$, $y(-2) = -1$ **(08 Marks)**

c. Draw the direct form I and direct form II implementations of the system represented by the differential equation,

$$\frac{d^3y(t)}{dt^3} + 2\frac{dy(t)}{dt} + 3y(t) = x(t) + 3\frac{dx(t)}{dt}$$ **(07 Marks)**

4 a. Determine the complex fourier coefficients for the signal shown in figure Q4 (a). **(08 Marks)**

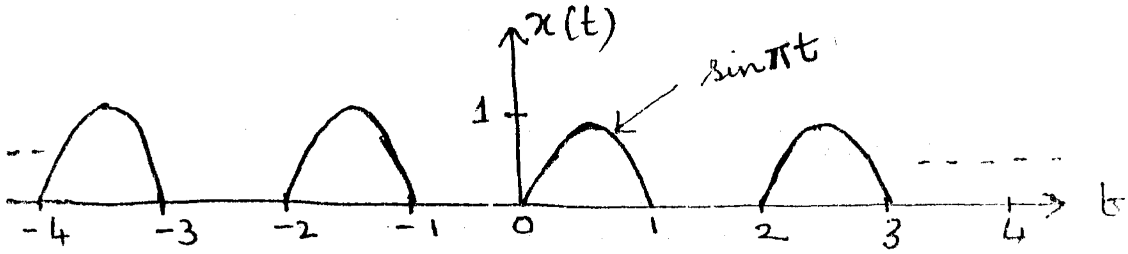


Fig. Q4 (a)

b. State and prove Parseval's theorem as applied to Fourier series. **(06 Marks)**

c. Evaluate the DTFT of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n-4)$. **(06 Marks)**

5 a. Determine the time domain signal corresponding to $X(e^{j\Omega}) = |\sin(\Omega)|$. **(06 Marks)**

b. Use appropriate properties to determine the inverse FT of

$$x(j\omega) = \frac{j\omega}{(2+j\omega)^2}.$$ **(07 Marks)**

c. Use the duality property of Fourier representation to evaluate the following :

i) $x(t) \xleftrightarrow{FT} e^{-2\omega}u(j\omega)$

ii) $\frac{1}{1+t^2} \xleftrightarrow{FT} X(j\omega)$ **(07 Marks)**

6 a. Determine the frequency response and impulse response for the system described by the differential equation,

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}.$$ **(06 Marks)**

b. Determine the difference equation description for the system with the following impulse response:

$$h(n) = \delta(n) + 2\left(\tfrac{1}{2}\right)^n u(n) + \left(-\tfrac{1}{2}\right)^n u(n).$$ **(06 Marks)**

Contd....3

c. Specify the Nyquist rate and Nyquist intervals for the following signals :

i) $g_1(t) = \operatorname{sin}c(200t)$

ii) $g_2(t) = \operatorname{sin}c^2(200t)$

iii) $g_3(t) = \operatorname{sin}c(200t) + \operatorname{sin}c^2(200t)$ (08 Marks)

7 a. Specify the important properties of ROC of Z-transform. (06 Marks)

b. Find the Z-transform of the signal,

$x(n) = n\sin\left(\frac{\pi}{2}n\right)u(-n)$. (06 Marks)

c. Find the time domain signals corresponding to the following Z-transforms.

i) $X(Z) = \frac{1}{1 - Z^{-2}}; |Z| > 1$

ii) $X(Z) = \cos(2Z); |Z| < \infty$ (08 Marks)

8 a. The output of a discrete-time LTI system is $y(n) = 2\left(\frac{1}{3}\right)^n$ when the input $x(n)$ is $u(n)$.

i) Determine the impulse response $h(n)$ of the system.

ii) Determine the output when the input is $\left(\frac{1}{2}\right)^n u(n)$. (13 Marks)

b. Use unilateral Z-transform to determine the forced response, the natural response and the complete response of the system described by the difference equation,

$y(n) - \frac{1}{2}y(n-1) = 2x(n)$

with the input $x(n) = 2\left(-\frac{1}{2}\right)^n u(n)$ and initial condition $y(-1) = 3$. (07 Marks)

*****

USN

06EC44

Fourth Semester B.E. Degree Examination, June/July 08

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions choosing at least two from each part.***

Part A

1 a. Determine and sketch the even and odd components of,

i) $x(n) = e^{-n/4}u(n)$

ii) $x(t) = \begin{cases} t, & 0 \le t \le 1 \\ 2-t, & 1 \le t \le 2 \end{cases}$ **(08 Marks)**

b. Distinguish between power and energy signals. Categorise each of the following signals as power or energy signals and find the energy or power of the signal.

i) $x(n) = \left(\frac{1}{2}\right)^n u(n)$

ii) $x(t) = \cos^2 \omega_0 t$ **(08 Marks)**

c. Starting from the pulse g(t) shown in figure Q1 (c) construct the wave form x(t) and express x(t) in terms of g(t). **(04 Marks)**

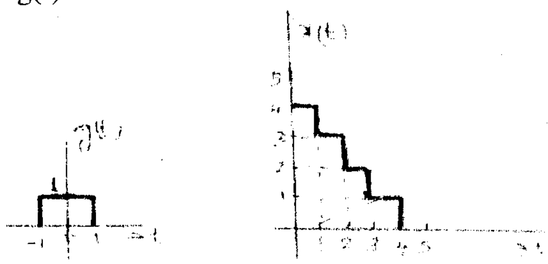


Fig. Q1 (c)

2 a. Explain the difference between the following relationships:
$x(n).\delta(n-n_0) = x(n_0)$ and $x(n) * \delta(n-n_0) = x(n-n_0)$ **(06 Marks)**

b. Given the impulse response of the system as $h(t) = e^{-t} \cdot u(t)$ and input to the system as $x(t) = e^{-3t}(u(t) - u(t-2))$ determine the output of the system. Sketch the various cases. **(14 Marks)**

3 a. Given the impulse response of a system as $h(n) = n\left(\frac{1}{2}\right)^n .u(n)$, determine if the system is causal and stable. **(04 Marks)**

b. Determine the complete response of a system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{d(t)}, \text{ with } y(0) = 0, \left.\frac{dy(t)}{dt}\right/_{t=0} = 1$$

and $x(t) = e^{-2t}.u(t)$. **(12 Marks)**

c. Draw the Form – I and Form – II structures for a system described by the following difference equation:

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{4}y(n-3) = x(n) + \frac{2}{3}x(n-2)$$ **(04 Marks)**

4 a. Determine the DTFS coefficients for the periodic signal shown in figure Q4 (a). (08 Marks)

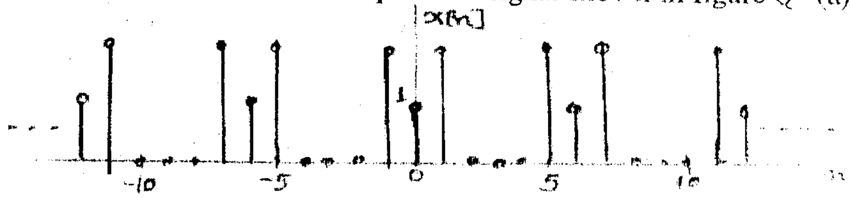


Fig. Q4 (a)

b. Determine the Fourier Series representation for the square wave shown in figure Q4 (b). Draw typical plot of X[k]. (12 Marks)

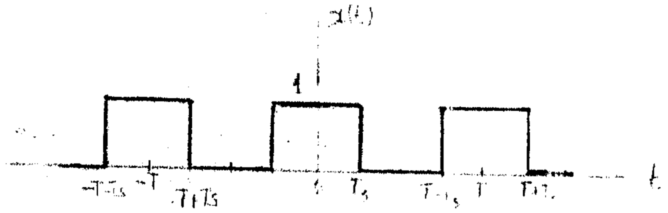


Fig. Q4 (b)

Part B

5 a. Obtain the Fourier transform of the signal $e^{-at} \cdot u(t)$ and plot its magnitude and phase spectrum. (14 Marks)

b. Determine the DTFT of unit step sequence $x(n) = u(n)$ (06 Marks)

6 a. Determine the H(w) and impulse response of the system described by the following differential equation,

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$$ (10 Marks)

b. The impulse response of a continuous time system is $h(t) = \frac{1}{RC} e^{-\frac{t}{RC}}.u(t)$. Determine its frequency response and plot the magnitude and phase plots. (10 Marks)

7 a. Determine z-transform of $x(n) = \cos(\Omega_0 n).u(n)$. (08 Marks)

b. State and prove initial value theorem for z-transforms. (04 Marks)

c. Determine using partial fraction expansion, inverse z-transform of

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}, \ ROC |z| < 0.5$$ (08 Marks)

8 a. A system is described by the difference equation,

$y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$

What will be the output when excitation is $x(n) = nu(n)$? Is the system stable? (14 Marks)

b. Solve the difference equation,

$y(n) - 3y(n-1) - 4y(n-2) = 0, \ n \geq 0$; given $y(-1) = 5$ and $y(-2) = 0$. (06 Marks)

*****

USN | | | | | | | | | |

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note : *Answer FIVE full questions choosing at least two full questions from each part.*

Part A

1 a. Determine even and odd component of following signals,

i) $x(t)=1+t\tan t+t^2\tan^2 t$ ii) $x(n)=n^2\left(\frac{1}{2}\right)^{n-2}$ **(06 Marks)**

b. Determine energy in the signal $x\left(-\frac{1}{2}t+3\right)$ given the signal x(t) as below, **(08 Marks)**

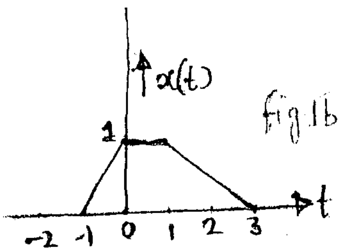


Fig. Q1 (b)

c. Verify the following system for i) Linerity ii) Time-invariance iii) Causal iv) Memory less.

$$y(n)=x(n)+\sum_{K=-\infty}^{n-1}x(k)$$ **(06 Marks)**

2 a. A LTI system has an impulse response $h(t)=e^{-|t-2|}$. Find the output of the system for the input $x(t)=e^{-3t}u(t)$. **(10 Marks)**

b. A discrete time system which is linear and time-invariant has impulse response $h(n)=\left(\frac{1}{2}\right)^n(u(n)-u(n-7))$. If the impulse is $x(t)=\left(\frac{1}{3}\right)^n \quad 0\ge n\ge 9$

$= 0 \quad$ otherwise

Determine the output and obtain closed form expression in each region. **(10 Marks)**

3 a. A system is described by $\dfrac{d^2y(t)}{dt^2}+3\dfrac{dy(t)}{dt}+2y(t)=\dfrac{dx(t)}{dt}$.

With initial conditions $y(0)=-1 \quad \left.\dfrac{dy(t)}{dt}\right|_{t=0}=2$

If the input is $x(t)=2e^{-2t}u(t)$, determine the output (do not use any transforms). **(10 Marks)**

b. Determine the step response of the LTI system whose impulse response is given by $h(n)=\left(-\frac{3}{4}\right)^n u(n)$. **(04 Marks)**

c. Draw the direct form – I and direct form – II implementation of the system given by, $y(n)-\frac{1}{2}y(n-1)+\frac{1}{3}y(n-3)=x(n)+3x(n-1)$. **(06 Marks)**

4 a. State and prove Parseval's theorem for continuous time periodic signals x(t). Using the same evaluate the following :

$$\sum_{k=-\infty}^{\infty}\frac{\sin^2\left(\frac{k\pi}{4}\right)}{k^2}.$$ **(10 Marks)**

4 b. Determine the time-domain signal given the DTFS coefficients,
$x(k) = \cos\left(\frac{10\pi}{21}k\right) + j\sin\left(\frac{4\pi}{21}k\right)$. (04 Marks)

c. Determine Fourier series representation of the signal x(n) shown below, and sketch its magnitude spectra. (06 Marks)

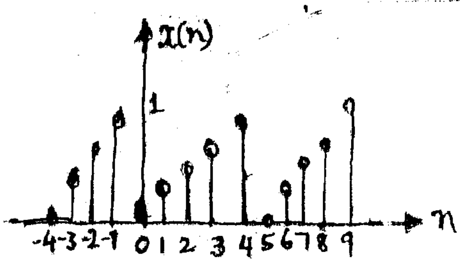


Fig Q4 (c)

Part B

5 a. Determine the DTFT of the following signals,

i) $x(n) = a^{|n-2|}, \quad |a| < 1$ ii) $x(n) = \left(\frac{1}{2}\right)^n u(n-2)$ iii) $x(n) = 2^n[u(n) - u(n-6)]$. (10 Marks)

b. Determine the time-domain signal given its FT as follows:

i) $x(j\omega) = \dfrac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$ ii) $x(j\omega) = \begin{cases} 1 & -\pi/2 \le \omega \le \pi/2 \\ 0 & |\omega| > \pi/2 \end{cases}$

iii) $x(j\omega) = \begin{cases} 2\cos\omega & |\omega| \le \pi \\ 0 & |\omega| > \pi \end{cases}$ (10 Marks)

6 a. Determine the frequency response and impulse response of a system described by $\dfrac{d^2y(t)}{dt^2} + 5\dfrac{dy(t)}{dt} + 6y(t) = -\dfrac{dx(t)}{dt}$. (07 Marks)

b. Explain the process of sampling and concept of aliasing as applicable to continuous time signals. (06 Marks)

c. Determine the frequency response H(jω) of a system which has impulse response of $h(t) = \dfrac{\sin(\pi t)}{\pi t}\cos(3\pi t)$ using the modulation property. Plot the magnitude and phase response of H(jω). (07 Marks)

7 a. Determine the z-transform of the following sequences along with their ROC. Plot the poles and zeros:

i) $x(n) = \left(\frac{3}{4}\right)^n u(n) + (2)^n u(-n-1)$. ii) $x(n) = (n-3)^2\left(\frac{1}{3}\right)^{n-3} u(n-3)$. (10 Marks)

b. Determine output of the LTI system where $h(n) = \left(\frac{1}{2}\right)^n u(n)$ and $x(n) = n\left(-\frac{1}{2}\right)^n u(n)$ using z-transform techniques. (10 Marks)

8 a. A stable system is described by the difference equation,
$y(n) - y(n-1) + \frac{1}{4}y(n-2) = x(n) + \frac{1}{4}x(n-1) - \frac{1}{8}x(n-2)$. Determine its impulse response. If $x(n) = \left(\left(\frac{1}{4}\right)^n + \left(-\frac{1}{2}\right)^n\right)u(n)$ determine the output. (10 Marks)

b. Determine forced response, the natural response and comlete response of the system described by,
$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = 2x(n)$
$y(-1) = 1, \quad y(-2) = -1, \quad x(n) = u(n)$
using unilateral z-transform. (10 Marks)

*****

USN | | | | | | | | | |

06EC44

Fourth Semester B.E. Degree Examination, June-July 2009
Signals and Systems

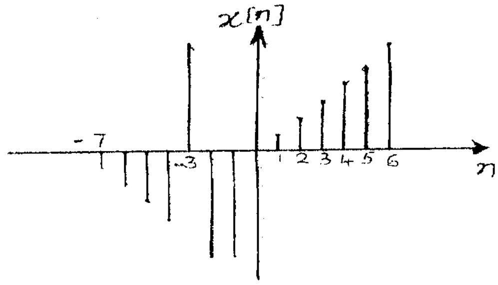
Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

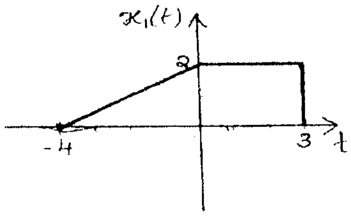
1 a. A function x[n] is defined by

$$x[n]=\begin{cases}-(n+8) & \text{for } -8<n<-3\\ 6 & \text{for } n=-3\\ -6 & \text{for } -3<n<0\\ n & \text{for } -1<n<7\\ 0 & \text{otherwise}\end{cases}$$



Sketch $y[n] = 3.x[n/2 + 1]$ **(04 Marks)**

b. Perform the following operations (addition & multiplication) on given signals. Fig.1(b).
(i) $y_1(t) = x_1(t) + x_2(t)$ (ii) $y_2(t) = x_1(t) . x_2(t)$



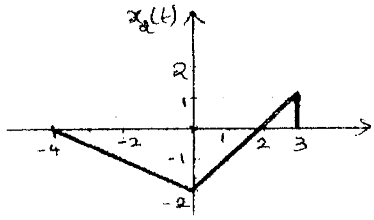


Fig.1(b) **(04 Marks)**

c. Distinguish between i) Energy signal & power signal ii) Even & odd signal. **(06 Marks)**

d. Explain the following properties of systems with suitable example:
i) Time invariance ii) Stability iii) Linearity. **(06 Marks)**

2 a. Find the convolution integral of x(t) & h(t) and sketch the convolved signal:
$x(t) = \delta(t) + 2\delta(t-1) + \delta(t-2)$, $h(t) = 3, \quad -3 \le t \le 2.$ **(08 Marks)**

b. Determine the convolution sum of the given sequence
$x(n) = \{3, 5, \underset{\uparrow}{-2}, 4\}$ and $h(n) = \{3, 1, 3\}$ **(06 Marks)**

c. Show that i) $x(t) * \delta(t - t_0) = x(t - t_0)$

ii) $x(n) = \sum_{k=-\infty}^{\infty} x(k).\delta(n-k)$ **(06 Marks)**

3 a. The impulse response of the system is $h(t) = e^{-4t}u(t-2)$. Check whether the system is stable, causal and memoryless. **(06 Marks)**

b. Draw the direct form-I & direct form-II implementation of the following difference equation. $y(n) - \frac{1}{4}y(n-1) + y(n-2) = 5x(n) - 5x(n-2)$ **(06 Marks)**

c. Find the forced response of the system shown in Fig.3(c), where x(t) = const. **(08 Marks)**

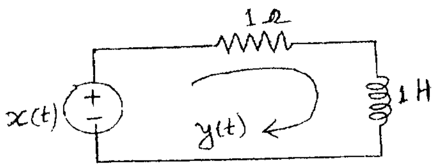


Fig.3(c)

4 a. State the condition for the Fourier series to exist. Also prove the convergence condition [Absolute integrability]. (06 Marks)

b. Prove the following properties of Fourier series. i) Convolution property ii) Parsevals relationship. (06 Marks)

c. Find the DTFS harmonic function of $x(n) = A\cos(2\pi n/No)$. Plot the magnitude and phase spectra. (08 Marks)

PART – B

5 a. State and prove the following properties of Fourier transform.
i) Time shifting property ii) Differentiation in time property iii) Frequency shifting property. (09 Marks)

b. Plot the Magnitude and phase spectrum of $x(t) = e^{-|t|}$ (06 Marks)

c. Determine the time domain expression of $X(jw) = \dfrac{2jw+1}{(jw+2)^2}$ (05 Marks)

6 a. The spectrum X(jw) of signal is shown in Fig.6(a). Draw the spectrum of the sampled sig at i) half the Nyquist rate ii) Nyquist rate and iii) Twice the Nyquist rate. Mark the frequenc values clearly in the figure. (12 Marks)

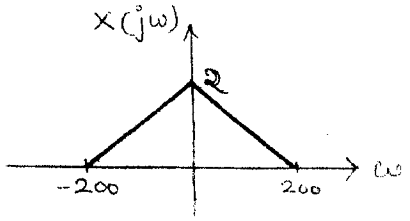


Fig.6(a)

b. Define and explain Nyquist sampling theorem with relevant figures. Give significance of this theorem. (08 Marks)

7 a. Describe the properties of Region of convergence and sketch the ROC of two sided sequences, right sided sequence and left sided sequence. (10 Marks)

b. Find the inverse Z-transform of

$$X(z) = \frac{1}{(z^2 - 2z + 1)(z^2 - z + \frac{1}{2})}$$ using partial fraction method. (10 Marks)

8 a. Solve the difference equation $y(n+2) - \frac{3}{2}y(n+1) + \frac{1}{2}y(n) = \left(\frac{1}{4}\right)^n$ for $n \geq 0$ with initial conditions y(0) = 10 and y(1) = 4. Use z-transform. (12 Marks)

b. Explain how causality and stability is determined in terms of z-transform. Explain the procedure to evaluate Fourier transform from pole zero plot of z-transform. (08 Marks)

* * * * *

USN | | | | | | | | | | |

06EC44

Fourth Semester BE Degree Examination, Dec.09-Jan.10
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. Standard notations are used.
3. Missing data be suitably assumed.

PART – A

1 a. Sketch :
i) $y(t) = r(t+1) - r(t) + r(t-2)$
ii) $z(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$. **(04 Marks)**

b. i) Is the signal $y(t) = \cos(20\pi t) + \sin(50\pi t)$ periodic? What is the period of y (t)?
ii) What is the power and energy of the signal, $x(t) = A\cos(wt + \theta)$? **(04 Marks)**

c. Determine the properties of the capacitive system, if the voltage across it $v_c(t) = \frac{1}{C}\int_{-\infty}^{t} i(z)\,dz$, considering i(t) as the input and $v_c(t)$ as output. **(06 Marks)**

d. A discrete time system is given by $y[n] = x[n]\, x[n-1]$. Determine its properties. **(06 Marks)**

2 a. The impulse response is given by $h(t) = u(t)$. Determine the output of the system, if $x(t) = e^{-\alpha t}u(t)$. State any assumptions made. **(06 Marks)**

b. Determine the natural response and forced response of a system described by the relationship: $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$

$y(0) = 0$; $\frac{dy(t)}{dt}(0) = 1$; $x(t) = e^{-2t}u(t)$. **(08 Marks)**

c. Obtain the direct form I and II block representation of a system described by the input-output relationship, $\frac{d^2y(t)}{dt^2} + y(t) = 3\frac{dx(t)}{dt}$. **(06 Marks)**

3 a. The impulse response of an LTI system is given by $h[n] = u[n]$. Determine the output if $x[n] = 3^n u[-n]$. **(08 Marks)**

b. If the output of an LTI system is given by: $y[n] = x[n+1] + 2x[n] - x[n-1]$, determine impulse response and comment on the system causality and stability. **(06 Marks)**

c. Determine the step response of a relaxed system whose input output relationship is given by: $y[n] + 4y[n-1] + 4y[n-2] = x[n]$. **(06 Marks)**

4 a. Determine the FS representation of the square wave shown in Fig.4(a). **(07 Marks)**

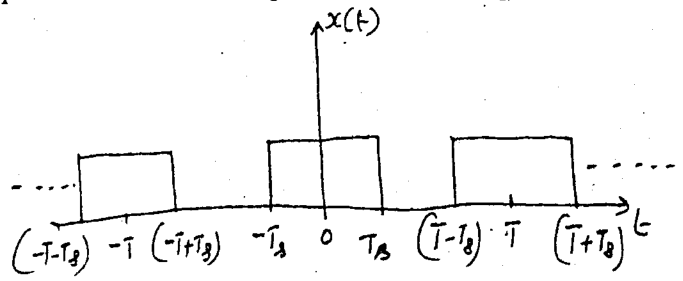


Fig.4(a)

b. If the FS representation of a signal x (t) is x [k], derive the FS of a signal x (t – to) [time shift property of FS]. (06 Marks)

c. Determine the DTFS for the sequence $x[n] = \text{Cos}^2\left[\frac{\pi}{4}n\right]$. (07 Marks)

PART – B

5 a. Show that the Fourier Transform of a rectangular pulse described by:
$x(t) = 1 \;;\; -T \le t \le T$
$= 0 \;;\; |t| > T$
is a sinc function. Plot the magnitude and phase spectrum. (07 Marks)

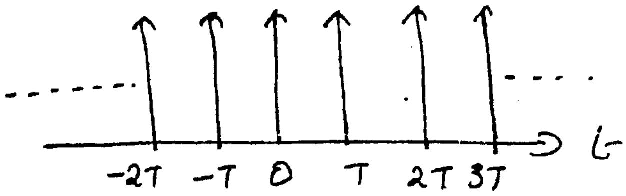
b. If $y(t) = \frac{dx(t)}{dt}$, where x (t) is a non-periodic sigal, find the Fourier Transform of y (t) in terms of x (jw). (06 Marks)

c. Determine the PTFT of the signal, $x[n] = \{1, 1, \underset{\uparrow}{1}, 1, 1\}$ and sketch the spectrum $x(e^{j\Omega})$ over the frequency range $-\pi \le \Omega \le \pi$. (07 Marks)

6 a. The input $x(t) = e^{-3t}u(t)$ when applied to a system, results in an output $y(t) = e^{-t}u(t)$. Find the frequency response and impulse response of the system. (07 Marks)

b. Find the FT of a train of unit impulses as shown in Fig.6(b). (07 Marks)

Fig.6(b)



c. Find the FT pair corresponding to the discrete time periodic signal: $x[n] = \text{Cos}\left[\frac{2\pi}{N}n\right]$. (06 Marks)

7 a. Find the z - transform and RoC of $x[n] = \alpha^{|n|}$. What is the constraint on α? (06 Marks)

b. Using properties of z – transform, find convolution of $x[n] = \left[\underset{\uparrow}{1}, 2, -1, 0, 3\right]$ and $y[n] = \left[\underset{\uparrow}{1}, 2, -1\right]$. (06 Marks)

c. Determine x [n] if $x(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$ for i) RoC of $|z| < \frac{1}{2}$ and ii) RoC of $1 < |z| < 2$. (08 Marks)

8 a. Find x [n] if $x(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$; RoC : $|z| > \frac{1}{2}$. (06 Marks)

b. Prove the time shift property of unilateral z-transform. (06 Marks)

c. Determine the transfer function and difference equation if the impulse response is $h[n] = \left[\frac{1}{3}\right]^n u[n] + \left[\frac{1}{2}\right]^{n-2} u[n-1]$. (08 Marks)

* * * * *

USN | | | | | | | | | |

06EC44

Fourth Semester B.E. Degree Examination, May/June 2010
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Give the classification of signals. **(08 Marks)**

b. Determine and sketch the even and odd part of the signals shown in Fig.Q1(b). **(12 Marks)**

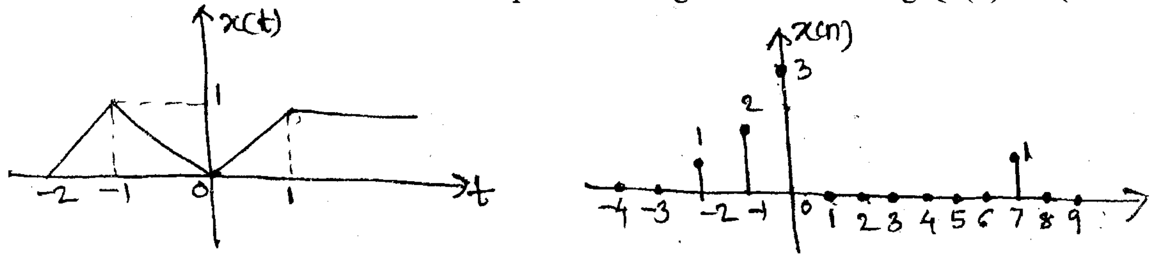


Fig.Q1(b)

2 a. Derive the expression for convolution integral. **(05 Marks)**

b. Verify which of the following systems are linear, causal and invertible:

i) $y(t) = ax(t) + b$ ii) $y(t) = x^2(t)$ iii) $y(n) = \sqrt{x(n)}$ iv) $y(n) = x(4n + 1)$. **(10 Marks)**

c. For a discrete LTI (DLTI) system to be BIBO stable,

Show that $S \triangleq \sum_{K=-\infty}^{\infty} |h(k)| < \infty$ **(05 Marks)**

3 a. By direct evaluation of convolution sum, determine the step response of a discrete system whose unit impulse response $h(n) = (½)^{-n} u(-n)$. Sketch the response and hence verify whether the system is stable and causal. **(08 Marks)**

b. Obtain $x(t) * y(t)$ for the signals

$x(t) = u(t) - u(t-2)$

$y(t) = t\,[u(t) - u(t-1)]$

Sketch the convolved signal $x(t) * y(t)$. **(08 Marks)**

c. Draw block diagram representations for causal LTI systems whose input output relation is

i) $y(n) = \frac{1}{3}y(n-1) + \frac{1}{2}x(n)$ ii) $y(n) = \frac{1}{3}y(n-1) + x(n-1)$

iii) $y(t) = -\frac{1}{2}\frac{dy(t)}{dt} + 4x(t)$ iv) $\frac{dy(t)}{dt} + 3y(t) = x(t)$ **(04 Marks)**

4 a. Give the significance of time and frequency domain representation of signals. Give examples. **(04 Marks)**

b. Find the CT exponential FS of the signal shown in Fig.Q4(b). **(10 Marks)**

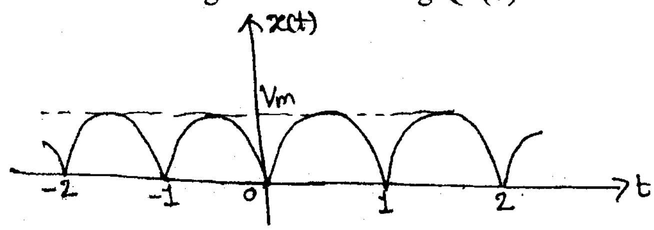


Fig.Q4(b)

c. State and prove the periodic time shift and periodic time convolution properties of DTFS (Discrete time Fourier series). (06 Marks)

PART – B

5 a. Obtain the DTFT of the following DT aperiodic sequences:
i) $x(n) = \delta(n) - 3\delta(n-3) + 2\delta(n-4)$ ii) $x(n) = (1/2)^n u(n) - (1/3)^n u(-n-3)$
iii) $x(n) = nu(n) - u(n-1)$ iv) $x(n) = \cos w_o n\, u(n)$ (04 Marks)

b. State and prove the Parseval's relation for DTFT. What is the significance of this relation? (06 Marks)

c. Using the time differentiation property of CTFT, find the spectrum of the following signals as shown in Fig.Q5(c). Plot the spectrum. (10 Marks)

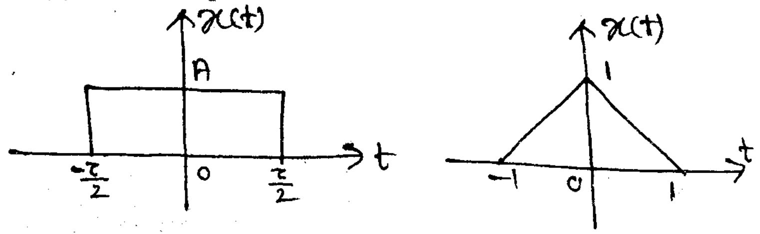


Fig.Q5(c)

6 a. A particular discrete-time system has input x(n) and output y(n). The Fourier transforms of these signals are related by the equation $Y(e^{jw}) = ZX(e^{jw}) + e^{-jw}X(e^{jw}) - \frac{dX(e^{jw})}{dw}$.
Is the system linear? Clearly justify your answer. What is y(n) if $x(n) = \delta(n)$? Is the system causal? (06 Marks)

b. Consider a causal and state LTI system S having frequency response $H(w) = \frac{jw+4}{6-w^2+5jw}$.
i) Obtain the differential equation for the system.
ii) Determine the impulse response h(t) of S
iii) What is the output of S when the input is $x(t) = e^{-4t}u(t) - te^{-4t}u(t)$ (10 Marks)

c. If $x(t) \leftrightarrow X(f)$
Show that $x(t)\cos w_0 t \leftrightarrow ½\,[X(f-f_0) + X(f+f_0)]$ where $w_0 = 2\pi f_0$. (04 Marks)

7 a. What is region of convergence of X(z), where X(z) is the z-transform of x(n). State all the properties of R.O.C. (05 Marks)

b. Determine the Z-transform of the following sequences including R.O.C.
i) $\delta(n+5)$ ii) $\left(\frac{1}{2}\right)^{n+1} u(n+3)$ iii) $\left(-\frac{1}{3}\right)^{n} u(-n-2)$
iv) $2^n u(-n) + \left(\frac{1}{4}\right)^n u(n-1)$ v) $\alpha^{|n|}$ for $o < \alpha < 1$. (15 Marks)

8 a. State and prove time reversal property. Find value theorem of Z-transform. Using suitable properties, find the Z-transform of the sequences
i) $(n-2)\left(\frac{1}{3}\right)^{n-2} u(n-2)$ ii) $(n+1)\left(\frac{1}{2}\right)^{n+1} \cos w_0(n+1)u(n+1)$ (10 Marks)

b. Consider a system whose difference equation is $y(n-1) + 2y(n) = x(n)$
i) Determine the zero-input response of this system, if $y(-1) = 2$.
ii) Determine the zero state response of the system to the input $x(n)=(1/4)^n u(n)$.
iii) What is the frequency response of this system?
iv) Find the unit impulse response of this system. (10 Marks)

* * * * *