Total Marks: 50   Time: 2:00 hours
Date: 5/12/2012

Note: 1) Attempt all questions.
2) Assume suitable data if necessary.
3) Figure to right indicate marks.

Q.1   **Do as Directed:**
[a]   **Multiple choice question:-**   [5]
1.   The advantage of convolution integral in the analysis of linear network is:
     [a] It can be used for all type of function
     [b] It gives a direct method to obtain output from input
     [c] Both (a) and (b)
     [d] None

2.   The Autocorrelation at $\tau=0$ is
     [a] Maximum [b] Zero [c] Infinity [d] Minimum

3.   Memory in a discrete time system is analog of:
     [a] Energy storage in a continuous time signal
     [b] Memory in a continuous time signal
     [c] Sampled memory of Continuous time LTI system
     [d] All of these

4.   A complex-valued signal x(t) has a real part $x_1(t)$ and an imaginary part $x_2(t)$ shown in figure
     the signal x(t) is
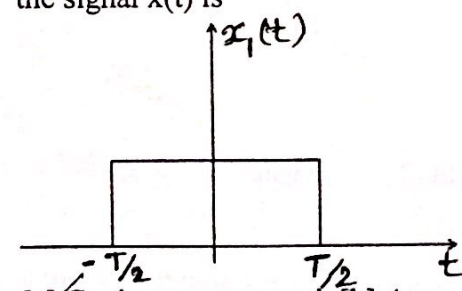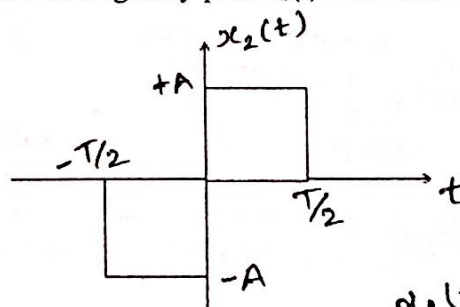
     [a] Conjugate symmetric [b] Asymmetric [c]Symmetric[d]Anti-symmetric

5.   Which method is used to perform linear filtering in DFT.
     [a] Overlap save method[b]Zero padding [c]Overlap add method[d]Correlation method

[b]   Find the impulse response of discrete time LTI system described by the difference equation   [3]
      y(n) = y (n-1) + 0.5 y (n-2) + x (n) + x (n-1)

                                      OR

[b]   Compute the 8-point DFT of x(n) = {1, 1, 0, 0, 0, 0, 0, 0}   [3]

Q.2 **Do as Directed:**

1. What is the relationship between unit-step, unit-ramp, unit-impulse, and parabolic function?
2. Show that the sinusoidal signal $x(t) = \sin(\omega_0 t + \theta)$ is periodic with period $2\pi/\omega_0$
3. The input $x[n] = \{1, 2\}$ to an LTI system produces the output $y[n] = \{2, 3, 1, 6\}$. use the deconvolution method to find the impulse response $h[n]$. accession
4. Correlate Fourier transform and z-transform.
5. Find z-transform $F(z)$ of function $f(nT) = a^{nT}$.
6. Find Nyquist rate for the signal given below:
   $3\cos 2000\pi t + 5\sin 6000\pi t + 10\cos 12000\pi t$
7. If the signal $f(t)$ has energy 'E' then find out energy for signal $f(2t)$.
8. Fourier transform of voltage function $x(t)$ is $x(f)$, then what is the unit of $|x(f)|$?

Q.3 **Do as Directed:**

1. For each of the following signal
   [a] $x(t) = e^{-3t}$
   [b] $x(t) = 3e^{j5\pi t}$
   [c] $x(t) = u(t+1)$
   Verify the following:
   [1] Causal or non-causal signal
   [2] Even or odd signal
   [3] Periodic or non-periodic signal
   [4] Energy or power signal
   [5] Deterministic or random signal

2. Check whether the following 2nd order differential equation is:

   $$\frac{d^3y(t)}{dt^3} + 2\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 3y^2(t) = x(t)$$

   [a] Static or dynamic
   [b] Linear or non-linear
   [c] Causal or non-causal
   [d] Time-invariant or time-variant

3. Examine whether the following signal, **Sin(10t+1) – 2cos(5t-2)** is periodic or not? If periodic, determine its fundamental frequency.

4. Determine whether the following signal is energy signal, power signal or neither. Also find its normalized energy and power signal.
   $x(t) = A\cos(\omega_0 t + \theta)$

Q.4 **Attempt any two:**

1. A LTI system is characterized by its impulse response, $h(n) = (1/2)^n u(n)$. Determine the spectrum and the energy density spectrum of the output signal when the system is excited by the signal $x(n) = (1/4)^n u(n)$.

2. Determine inverse DTFT of the following expression
   $X(e^{j\omega}) = 1$, for $|\omega| \leq W$
   $= 0$, for $W \leq |\omega| \leq \pi$

3. Prove the time shifting property of the Fourier transform.

[20]

Q.5   **Do as Directed:**
1. Differentiate between circular convolution and Linear Convolution. Solve the following sequence using linear convolution as analytical method and circular convolution with graphical method. And Comment on both result.

$$x(n) = \{1, 2, 3, 1\} \qquad\qquad h(n) = \{4, 3, 2, 2\}$$
    $\uparrow$ $\uparrow$

OR

Determine the second order difference equation for the following equation using direct method.
$$y(n) = 5/6\ y(n-1) - 1/6\ y(n-2) + x(n), \quad \text{for } x(n) = 2^n\ u(n)$$

2. A causal LTI system has transfer function :

$$H(z) = \frac{(1-0.5z^{-1})(1-z^{-1})}{(1+0.2z^{-1})(1+0.8z^{-1})(1-0.8z^{-1})}$$

[a] Give ROC condition. Also Show pole-zero diagram of system.
[b] Find impulse response of the system

3. For the following signal,
    $x(t) = x_1(t) + x_2(t)$, where $x_1(t) = \text{Sinc }(700t)$ and $x_2(t) = \text{Sinc }(500t)$.
    [a] Draw spectrum of both the signal.
    [b] Find the Nyquist interval for the signal $x(t)$.

4. Write wiener-khintchine theorem. Determine ESD of signal $x(n) = a^n\ u(n)$, $-1 < a < 1$