HERITAGE INSTITUTE OF TECHNOLOGY

1st Semester M.TECH Examination. 2014   Session   : 2014-2015

Discipline   : M.TECH COMMUNICATION (ECE)

Paper Code : ECEN5102   Paper Name :Advanced DSP

Time Allotted : 3 hrs   Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1.   Choose the correct alternative for the following: 10 x 1=10

(i)   The discrete time system described by $y(n)=x(n^2)$ is
       (a) Causal, linear and time- variant   (b) Causal, non-linear and time –variant
       (c) Non-causal, linear and time- invariant   (d) Non-causal, linear and time-variant

(ii)   The ROC of sequence $x(n)= u(-n)$ is
       (a) $|z|>1$ (b) $|z|<1$
       (c) no ROC   (d) $-1<|z|<1$

(iii) The system described by the difference equation $y(n)-2y(n-1)+y(n-2) = x(n)-x(n-1)$
       has $y(n)=0$ for $n<0$. If $x(n)=\delta(n)$ then $y(2)$ will be
       (a) 2   (b) 1   (c) 0   (d) ∞

(iv)   In an N point sequence (N=16), the total number of complex additions and
       multiplications using Radix -2FFT are
       (a) 64 and 80   (b) 80 and 64
       (c) 64 and 32   (d) 24 and 12

(v)   The convolution of $u(n)$ and $u(n-4)$ at $n=5$ is
       (a) 5   (b) 2
       (c) 1   (d) 0

(vi)   The signal $x(n) = a^n u(n)$, $| a | < 1$, is applied to a decimator that reduces the rate
       by a factor of 2. The spectrum of the output signal will be identical to the
       spectrum of the signal
       (a) $x(n)$ (b) $x(0.5n)$ (c) $x(2n)$ (d) $x(4n)$

(vii) If $X(f)$ represents the Fourier transform of a signal $x(t)$ which is real and odd
       symmetric in time ,then $X(f)$ is
       (a) complex   (b) imaginary   (c) real   (d) real and non-negative

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(viii)   The DFT of the sequence $x(n) = \delta(n-n_0)$ is
    (a) 1   (b) $e^{j2\pi k n o}$ (c) $e^{-j2\pi k n o/N}$ (d) $e^{j2\pi k n o/N}$

(ix)   If $h(n) = -5^n u(-n-1)$ then H(z) is equal to
    (a) $-z/z-5$ (b) $z/z-5$ (c) $-z^{-1}/z-5$ (d) $z^{-1}/z-5$

(x)   If $X(z) = z^{-1}(1-z^{-4})/(4(1-z^{-1})^2)$ then its final value is
    (a) 1/4   (b) 0   (c) 1   (d) ∞

Group - B

2.(a)   Write down the condition of energy and power signal. Determine the energy and power of the signal $x(n) = (1/4)^n u(n)$.

(b)   Obtain the value of following summation $\sum \delta(n-4)\sin(2n-2)$. Determine whether the sequence $x(n) = a^n u(-n-1)$ is causal or not.

(c)   If the Fourier transform of x(t) is $X(j\omega)$ then, prove that $x(at) = (1/|a|) X(j\omega/a)$.

(d)   State the Weiner-Khinchine theorem.   4+3+3+2=12

3.(a)   What is 'Z' transform & how do you define ROC?

(b)   Find out the Z transform of $x(n) = na^n \cos(\omega n) u(n)$.

(c)   What is inverse 'Z' transform? Find out the inverse 'Z' transform of
    $X(z) = z / (3z^2 - 4z + 1)$, with ROC (i) $|z| < 1/3$ (ii) $|z| > 1$.   2 + 4 + 6 = 12

Group - C

4.   A linear time invariant system is described by the following difference equation
    $y(n) = ay(n-1) + bx(n)$ where $0 < a < 1$.
(a)   Determine the impulse response h(n) of the system.

(b)   Determine the frequency response $H(\omega)$ of the system

(c)   Choose the parameter 'b' so that the maximum value of $H(\omega)$ is unity.

(d)   Determine the output of the system to the input signal $x(n) = 12 \sin(\pi n/2)$.   3+3+3+3+=12

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5.(a)   State invertibility of linear time invariant system.

(b)   Determine the inverse of the system with impulse response
$$h(n) = \delta(n) - \delta(n-1).$$

(c)   What is the input signal x(n) that will generate the output sequence
y(n) = {1, 5, 10, 11, 8, 4, 1} for a system with impulse response h(n) = {1, 2, 1}.

(d)   What do you mean by Homomorphic deconvolution.   2+3+5+2=12

Group - D

6.(a)   What is FFT? How do you get the Radix 2 FFT algorithm?

(b)   Derive the expression of DIF algorithm.

(c)   Determine 8 point DFT of x(n) = {1, 2, 3} using butterfly structure.   2 + 3 +7 = 12

7.(a)   What are the advantages and disadvantages of FIR filter over IIR filter.

(b)   Design a low pass FIR filter (using Hamming window technique) with 11 filter coefficients for the following specifications.
    Pass band frequency edge = 0.25 kHz
    Sampling frequency   = 1 kHz   4+8=12

Group - E

8.(a)   Explain sampling rate conversion by a rational factor 1/D.   (6) + (6) = 12

(b)   How can you design a filter for implementation of sampling rate conversion?

9.   Write short notes on:
    (a) Discrete Wavelet transform
    (b) Bi-orthogonal decomposition   (2x6)= 12