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CS/M.TECH(ECE-MVLSI)/SEM-2/MVLSI-202/2012

2012

DIGITAL SIGNAL PROCESSING & APPLICATIONS

Time Allotted : 3 Hours | Full Marks : 70

The figures in the margin indicate full marks.

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

Question No. *1* is compulsory and attempt any *four* questions from the rest.

1. i) Check for linearity

   a) $y(n) = x(n) + 1/x(n-1)$

   b) $y(n) = x(n) \cos \omega$

   ii) Check for time invariance

   a) $y(n) = x(-n)$

   b) $y(n) = e^{x(n)}$

   iii) Check for causality

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

   iv) Check for stability

   a) $y(n) = x(n)\, e^{n}$

   b) $y(n) = \cos\{x(n)\}$ 4 + 4 + 2 + 4

2. a) Define periodic and aperiodic signals with examples.

   b) Determine whether the following signals are periodic, if so, then specifiy its fundamental period :

      i) $x(n) = e^{j6\pi n}$

      ii) $x(n) = \cos\{(\pi/3)n\} + \cos\{(3\pi/4)n\}$

   c) Explain time domain sampling & frequency domain aliasing. State Nyquist Sampling Theorem. 3 + 4 + 7

3. a) Explain with examples :

      i) Real exponential signal

      ii) Complex exponential signal.

   b) Define :

      i) Energy Signal and

      ii) Power Signal.

   c) Find whether the following signal is a power signal or energy signal :

      $x(n) = \sin\{(\pi/4)n\}$ 5 + 5 + 4

4. a) Write down the physical significance of linear convolution. How linear convolution can be achieved from circular convolution ?

   b) Find the convolution of the following signals :

      $x(n) = 1$ when $n = -2, 0, 1$

      $= 2$ when $n = -1$

      $= 0$ elsewhere

      $h(n) = \delta(n) - \delta(n-1) + \delta(n-2) - \delta(n-3)$

   c) Find the convolution of two finite duration sequences :

      $x(n) = b^n\ u(n)$, $h(n) = a^n\ u(n)$

      when (i) $a \neq b$ and (ii) $a = b$ 4 + 4 + 6

5. a) Write down the physical significance of Z-transform. What is its relation with Fourier transform & how are they different ?

   b) Find the Z-transform & ROC of : $x(n) = r^n \cos n\theta\, u(n)$

   c) Find out the relationship between s-plane and z-plane.

   d) Find one sided Z-transform to determine

   $y(n)$; $n \geq 0$

   if $y(n) = (1/2)y(n-1) + x(n)$, $x(n) = (1/3)^n u(n)$, $y(-1) = 1$ 4 + 3 + 3 + 4

6. a) What are frequency domain sampling and time domain aliasing ?

   b) Determine the 8-point DFT : $x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$

   c) Determine the IDFT of $x(k) = \{1, 0, 1, 0\}$ 4 + 6 + 4

7. a) Write down the difference between DIT-FFT and DIF-FFT. What is bit reversal logic ? How the number of complex multiplications can be reduced using FFT algorithm ?

   b) Find the DFT of the following sequence using DIT-FFT algorithm : { 1, 2, 3, 4, 4, 3, 2, 1 } 6 + 8

8. a) Write down the difference between a digital and an analog filter.

b) Design an analog Butterworth filter that has a – 2dB passband attenuation at a frequency of 20 rad/sec and at least – 10dB stop band attenuation at 30 rad/sec.

c) For analog transfer function $H(S)=\{2/(s+1)(s+2)\}$ of a Butterworth filter using impulse invariant method. Assume T = 1sec. 3 + 6 + 5