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5E3257

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5E3257
B. Tech. V Sem. (Main/Back) Examination Dec 2012
Computer Science
5CS6.2 Digital Signal Processing
Common for CS & IT

Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five question** selecting **one question** from **each unit**. All Questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used / calculated must be stated clearly.*

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. **Nil** 2. **Nil**

UNIT - I

Q.1 (a) The following are the impulse responses of discrete time LTI systems. Determine whether each system is causal and / or stable.

(i) $h[n] = \left(\frac{1}{5}\right)^n u[n]$ (ii) $h[n] = \left(\frac{1}{3}\right)^n u[n-1]$

[4+4=8]

(b) Show that the complex exponential sequence $x(n) = e^{i\Omega_0 n}$ is periodic only if $\frac{\Omega_0}{2\pi}$ is a rational number. [8]

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OR

Q.1 Compute and plot the convolution

$$y(n) = x(n) * h(n)$$

For an LTI system whose impulse response h(n) and input x(n) are given below

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

$$x(n) = \left(\frac{1}{3}\right)^{-n} u(-n-1)$$ [16]

UNIT - II

Q.2 (a) Prove the following theorem of DTFT :-

(i) The Modulation theorem [5]

(ii) Parseval's Theorem [5]

(b) Consider a causal LTI system whose input x(n) and output y(n) are related by the difference equation :-

$$y(n) = \left(\frac{1}{4}\right) y(n-1) + x(n)$$

Determine y(n) if x(n) = S(n-1) [6]

OR

Q.2 When the input to an LTI system is

$$x(n) = \left(\frac{1}{3}\right)^{n} u(n) + (2)^{n} u(-n-1)$$

the corresponding output is

$$y(n) = 5\left(\frac{1}{3}\right)^{n} u(n) - 5\left(\frac{2}{3}\right)^{n} u(n)$$

(a) Find the system function H(z) of the system. Plot poles and zeros of H(z) and indicate Region of convergence. [7+3=10]

(b) Find the impulse response h[n] of the system. [6]

UNIT - III

Q.3 (a) State sampling theorem. [2]

(b) Explain interpolation techniques for the reconstruction of a continuous time signal from its samples. [8]

(c) What do you mean by aliasing effect? How can it be eliminated? [6]

OR

(a) Given the continuous time signal.

$x(t) = 5 \cos 200\pi t$

Determine

(i) Nyquist rate [2]

(ii) If sampling frequency f_S = 400 Hz, What is the discrete time signal x(n) obtained after sampling? [3]

(iii) If sampling frequency f_S = 150 Hz, What is the discrete time signal x(n) obtained after sampling? [3]

(iv) What is the frequency $0 < f < \left(\frac{f_s}{2}\right)$ of sinusoidal that yields samples identical to those obtained in part (iii)? [3]

(b) Explain the impulse train sampling of discrete time signal. [5]

UNIT - IV

Q.4 Consider an L T I system whose impulse response h(n) and sequence x(n) are given.

$$x(n) = \begin{cases} 1, & n = 0 \\ 0.5, & n = 1 \\ 0, & otheriwse \end{cases} \qquad h(n) = \begin{cases} 0.5, & n = 0 \\ 1, & n = 1 \\ 0, & otheriwse \end{cases}$$

compute y(n) = x(n) * h(n) using DFT techniques. [16]

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OR

Q.4 (a) Determine the DFT of the sequence

$$x(n) = \sin\left(\frac{n\pi}{2}\right)$$

using DIT FFT algorithm. [8]

(b) Find x(k) for the given sequence

x(n) = n+1

and N = 8 using DIF FFT algorithm. [8]

UNIT - V

Q.5 Explain basic structures for IIR and FIR system. [16]

OR

Q.5 (a) A digital filter with a 3 dB bandwidth of 0.25π is to be designed from the analog filter whose response is

$$H_s = \frac{\Omega_c}{s + \Omega_c}$$

Use bilinear transformation and obtain H(z). [8]

(b) Explain the procedure for designing an FIR filter using the rectangular window. [8]
