SVKM's NMIMS

MUKESH PATEL SCHOOL OF TECHNOLOGY MANAGEMENT & ENGINEERING

Programme: B. Tech (Computer) Year: III Semester: V
Batch: 2013-2014

Academic Year: 2015-2016

Subject: Digital Signal Processing

Date: 27/11/2015

Marks : 100
Time : 2.00 pm to 5.00 pm
Duration: 3 (hrs)

Re-Examination

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover of the answer book, which is provided for their use

1. Question No. 1 is compulsory
2. Out of the remaining questions, attempt any four questions
3. In all 5 questions to be attempted
4. Answer to each question must be started on a new page
5. Figures on the right indicate full marks

Q1

a. Determine whether the following are energy or power signals — 5

i. $x[n] = Ae^{j\omega n}$

ii. $x[n] = (-0.5)^n u[n]$

b. Explain Frequency warping effect in bilinear transformation? — 5

c. A designer has available a number of eight point FFT chips. Show explicitly how he should interconnect three such ships in order to compute a 24-point DFT. — 5

d. Compute the convolution of $x[n] = \{1, 1, \underset{\uparrow}{0}, 1, 1\}$ and $h[n] = \{\underset{\uparrow}{1}, 2, 3, 4\}$ — 5

Q2

a. If $x[n] = \{\underset{\uparrow}{1}, 2, 3, 4\}$, find $X[k]$. Using this result and not otherwise, find the DFT of — 10

$$x[n] = \{\underset{\uparrow}{4}, 1, 2, 3\}$$

b. Find the impulse response for the causal system — 10

$$y[n] - y[n-1] = x[n] + x[n-1]$$

Q3

a. Design a digital Butterworth filter that satisfies the following constraint using Bilinear Transformation. Assume $T = 1s$. — 10

$$0.707 \le |H(e^{j\omega})| \le 1 \qquad 0 \le \omega \le \pi/2$$

$$|H(e^{j\omega})| \le 0.2 \qquad 3\pi/4 \le \omega \le \pi$$

b. Prove a LTI system is stable if its impulse response is absolutely summable and hence determine the range of values of the parameter a for which the LTI system with impulse response — 10

$$h[n] = a^n u[n]$$

is stable

Q4

a. Compute DFT of the following sequence using DIF-FFT algorithm. — 10

$$x[n] = \{\underset{\uparrow}{3}, 1, 3, 1, 3, 1, 3, 1\}$$

b. Determine the z-transform of the signal — 10

$$x[n] = -a^n u[-n-1]$$

Q5 a. Perform circular convolution for the following sequences using DFT/IDFT 10

$$x[n] = \{\underset{\uparrow}{1}, 1, 0, 0\}$$

$$y[n] = \{\underset{\uparrow}{1}, 2, 1, 2\}$$

b. Find DF-I, DF-II, Cascade and Parallel form for the following difference equation 10

$$y[n] = -0.1y[n-1] + 0.72y[n-2] + 0.7x[n] + 0.252x[n-2]$$

Q6 a. A low pass filter is to be designed with the following specifications 10

$$H_d(\omega) = \begin{cases} e^{-j2\omega} & -\pi/4 \le \omega \le \pi/4 \\ = 0 & \pi/4 \le |\omega| \le \pi \end{cases}$$

Determine the filter coefficient $h[n]$, if the window function is defined as

$$w[n] = \begin{cases} 1 & 0 \le n \le 4 \\ = 0 & otherwise \end{cases}$$

Determine the frequency response $H(\omega)$ of the designed filter.

b. Find $x[n]$ considering all possible region of convergence 10

$$X[z] = \frac{10z}{(z-1)(z-2)}$$

Q7 a. Computer the correlation for the following pair of signal and comment on the result obtained 10

i. $x_1[n] = \{\underset{\uparrow}{1}, 2, 3, 4\}$ $\qquad h_1[n] = \{\underset{\uparrow}{4}, 3, 2, 1\}$

ii. $x_2[n] = \{\underset{\uparrow}{1}, 2, 3, 4\}$ $\qquad h_2[n] = \{\underset{\uparrow}{1}, 2, 3, 4\}$

b. Consider the following analog sinusoidal signal 10

$$x_a(t) = 3\sin(100\pi t)$$

i. Sketch the signal $x_a(t)$ for $0 \le t \le 30\text{ms}$

ii. The signal $x_a(t)$ is sampled with a sampling rate $F_s = 300$ sampes/s. Determine the frequency of the discrete-time signal, $x[n] = x_a[nT], T = \frac{1}{F_s}$, and show that is it periodic.

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