Total number of printed pages – 7 **B. Tech**

CPEC 5302

Fifth Semester Examination – 2008

DIGITAL SIGNAL PROCESSING

Full Marks – 70

Time – 3 Hours

Answer Question No. 1 which is compulsory and any five from the rest.

The figures in the right-hand margin indicate marks.

1. A signal is represented as : 2×10

$$x(n)=\begin{cases}1+\frac{n}{2}, & -2\le n\le -1\\ 1, & 0\le n\le 2\\ 0, \textit{ elsewhere} & \end{cases}$$

(a) Determine its values and sketch the signal $x(n)$.

(b) Sketch the signal that results if $x(n)$ is first folded and then delayed by three samples.

(c) Express $x(n)$ in terms of $\delta(n)$.

(d) Sketch $x(-n+4)$.

(e) Give the direct form I realization of the equation defined as

$$y(n) = -a_1 y(n-1) + b_0 x(n) + b_1 x(n-1)$$

(f) State and prove the convolution property of the z-transform.

(g) What is the approximate transition width of main lobe in the rectangular window ? What happens to it if you double the filter length ?

(h) State and prove the circular time shift property of DFT.

(i) What is a periodogram ? What is its utility ?

(j) How may real multiplications and real additions are required for the computation of an N-point DFT ?

2. Find out the autocorrelation of the signal $x(n) = a^n u(n), 0<a<1$. Plot the resulting signal. When does the autocorrelated signal becomes the highest ? Why ? 6+2+1+1

3 (a) Compute the convolution $y(n)$ of two signals defined as $x_1(n) = \{2,-3,2\}$ and

$x_2(n) = \begin{cases} 1, 0 \le n \le 4 \\ 0, elsewhere \end{cases}$. Plot $y(n)$ 6

(b) Determine the step response of the system $y(n) = ay(n-1) + x(n), -1 < a < 1$ with the initial condition $y(-1) = 1$. 4

4. (a). Find out the impulse response of the system

$y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$. Locate its poles and zeros. Is the system stable ? 6

(b) Compute the DFT of two sequences given as $x_1(n) = \left\{1, \underset{\uparrow}{2}, 3, 2\right\}$ and $x_2(n) = \left\{2, \underset{\uparrow}{3}, 4, 5\right\}$. Plot it. 4

2. (a) Determine the impulse response for the given system described by difference equation. 6

$y(n) - 4y(n-1) + 4y(n-2) = x(n) - x(n-1)$

(b) Compute and sketch the step response of the system. 4

$$y(n) = \frac{1}{M} \sum_{k=0}^{N-1} x(n-k).$$

3. (a) Determine convolution of the following pairs of signal by means of ZT. 6

$x_1(n) = 0.5^n u(n)$, $x_2(n) = \cos \pi n\, u(n)$.

(b) Consider the Fir filter represented as $y(n) = x(n) + x(n-4)$. Compute and sketch the magnitude and phase spectrum. 4

4. (a) Let x(n) be a real valued N point sequence. Develop a method to compute a N point DFT x'(k), which contains only the odd harmonics by using a real N/2 point DFT. 5

(b) Perform linear convolution of the following sequence by overlap add method. 5

$x(n) = \{1, -1, 2, -2, 3, -3, 4, -4\}$

$h(n) = \{-1, 1\}$.

(b) Determine the magnitude response of the filter. 5

8. Describe the nonparametric method of power spectrum estimate. 10