Registration No. : | | | | | | | | | | |

Total number of printed pages – 2

B. Tech

CPEC 5302 (Old)

Sixth Semester (Back) Examination – 2013

DIGITAL SIGNAL PROCESSING

BRANCH : CSE, EEE, ELECTRICAL, ICE, IEE, IT

QUESTION CODE : B343

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. Answer the following questions : 2×10

(a) Draw the exponential signal

$x(n) = a^n$ for all n, $a > 1$ & $-1 < a < 0$. where a is real.

(b) For the discrete signal $x(n) = \{2 \quad -1 \quad 1 \quad 3 \quad 1 \quad 2\}$ find the even and odd components.

(c) Find the convolution sum of the signals

$x(n) = \{-1 \quad \underset{\uparrow}{1} \quad 1 \quad 2 \quad -1\}$ and $y(n) \{1 \quad 2 \quad -1 \quad \underset{\uparrow}{1}\}$.

(d) Find the Z -transform of $x(n) = (1+n)\,u(n)$.

(e) The first five points of a eight point DFT are {14.000, 2.1213 – 5.1213i, –1.0000 – 1.0000i, –2.1213 + 0.8787i, 4.0000 }. Find the rest three points.

(f) If X(k) is the DFT of the sequence x(n), determine the N-point DFT of the sequence

$x(n) \cos \frac{2\pi kn}{N} \qquad 0 \le n \le N - 1$

(g) Write the divide – and – conquer algorithm used in computing DFT.

(h) What is linear phase characteristic of FIR filter.

P.T.O.

(i) What is transposed structure of a Discrete-Time system ? Explain taking a signal flow graph.

(j) Draw the Cascade-Form structure of $H(z)=(1-6z^{-1}+3z^{-2})(2+z^{-1}+3z^{-2})$.

2. (a) Prove that a LTI system is stable if its impulse response is absolutely summable. 3

(b) Using direct method determine the total solution y(n), $n>0$ of the linear constant coefficient difference equation $y(n)-8y(n-1)=x(n)$ where x(n) is a unit step function. 7

3. (a) Realize the FIR system $y(n)=\frac{1}{M+1}\sum_{k=o}^{M}x(n-k)$ Recursively and Non-recursively. Derive the necessary expression. 5

(b) Prove that the autocorrelation sequence of a signal attains its maximum value at zero lag. 5

4. (a) Prove the inverse Z-transform i.e $x(n)=\frac{1}{2\pi f}\oint_c X(z)z^{n-1}dz$. 4

(b) State and prove the shifting property(Time delay and Time advance) of one-sided z- transform. 6

5. (a) Derive the relation between z-transform and DFT of a discrete-time sequence x(n).

(b) Using DFT & IDFT, determine the response of the FIR filter with impulse response $h(n)=\left\{\begin{matrix}1 & -1 & 1\\ \uparrow & & \end{matrix}\right\}$ for input sequence $x(n)=\left\{\begin{matrix}1 & 2 & 1\\ & \uparrow & \end{matrix}\right\}$.

6. Find the DFT of a sequence x(n) {1,3, –1,2,4,1,2} using DIT algorithm. 10

7. (a) Design a single pole lowpass digital filter with a 3-dB bandwidth of 0.2π, using the bilinear transformation applied to the analog filter $H(s)=\frac{\Omega_c}{s+\Omega_c}$ where is the 3dB Bandwidth of the analog filter. 6

(b) Ideal filters are not physically realizable. Justify . 4

8. (a) The variance of the Bartlett power spectrum estimate is reduced by the factor K. Derive. 6

(b) Explain the difference between the parametric and nonparametric estimation for power spectrum estimation. 4
