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

Total number of printed pages – 3

B. Tech

PCEC 4304

Sixth Semester Examination – 2013

DIGITAL SIGNAL PROCESSING

BRANCH : AEIE / ICE / IEE / EIE

QUESTION CODE : A174

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 : 2×10

   (a) Determine the z-transform of $x(n) = 2^n$ where $|n| \leq 2$.

   (b) Determine the region of convergence of a right sided sequence and a left sided sequence.

   (c) Find the circular convolution of $x(n) = \{2, -4, 1\}$ and $y(n) = \{-1, 0, 2\}$.

   (d) Express DFT of $x(n)$ as a linear transformation.

   (e) Write the major factors that influence the choice of specific realization of Discrete-Time system.

   (f) What is transposition theorem ?

   (g) Draw the Direct form I structure of the filter $H(z) = \dfrac{2+z^{-1}+5z^{-2}}{1+2z^{-1}-3z^{-2}}$.

   (h) Write the two properties of DFT which is used in FFT for efficient computation of DFT.

P.T.O.

(i) What is radix of the FFT algorithm ?

(j) What is the meaning of computation done in place in FFT algorithm ?

2. (a) Express the z-transform of $y(n) = \sum_{k=-\infty}^{n} x(n)$. 3

(b) Determine z-transform of the signal $x(n) = a^n u(n) + b^n u(-n-1)$. Find its ROC for $|a| > |b|$ & $|b| > |a|$. 4+3

3. (a) Prove that $x(n) = \frac{1}{2\pi j} \oint_c X(z) z^{n-1} \, dz$. 4

(b) If $x_1(n) \overset{z}{\leftrightarrow} X_1(z)$ & $x_2(n) \overset{z}{\leftrightarrow} X_2(z)$

then $x_1(n) x_2(n) \overset{z}{\leftrightarrow} \frac{1}{2\pi j} \oint_c X_1(v) X_2\left(\frac{z}{v}\right) v^{-1} dv$ prove it. 4

(c) From (b) find Parseval's relation. 2

4. (a) Find the output the FIR filter of impulse response h (n) = {1, –1, 0, 1} for input x (n) = {1, 3, –1, 0, 4, 2, 1, –5, 1, 2, 0, 1, –3} using overlap-save method. 6

(b) Find the DFT of the discrete sequence $x(n) = \left\{ \underset{\uparrow}{1}\ 0\ 1\ 1 \right\}$. 4

5. (a) Draw the structure of discrete-time system with transfer function

$$H(z) = 2(1-\{1+2j\}z^{-1})(1-\{1-2j\}z^{-1})\left(1-\left\{\frac{1}{1+2j}\right\}z^{-1}\right)\left(1-\left\{\frac{1}{1-2j}\right\}z^{-1}\right).$$

So that the computational complexity is minimum. 5

(b) How the bilinear transformation overcome the limitation of the impulse invariance transformation. Convert the analog filter with system function $\frac{s+0.1}{(s+0.1)^2+9}$ into a digital IIR filter of resonant frequency $\omega_r = \frac{\pi}{2}$ using bilinear transformation. 5

6. (a) FIR filter has linear phase. Prove it with suitable example. 3

(b) Design a high pass-linear phase FIR filter using hanning window,

$$\omega(n)=\frac{1}{2}\left(1-\cos\left(\frac{2\pi n}{M-1}\right)\right).$$

The desired frequency response of the filter is given by

$$H_d(\omega)=\begin{cases} e^{-j\omega\tau} & |\omega_c|\le\omega_c\le\pi \\ 0 & \text{otherwise} \end{cases}.$$

The length of the filter is 9 & ω_c = 1 rad/sec. 7

7. (a) Draw the flow diagram of a Eight-point radix2 DIT FFT algorithm. Describe all steps. 5

(b) Compute the DFT of x (n) = {1, 1, 1, 1, 0, 0} using radix2 DIT FFT algorithm. 5