B. TECH.

THEORY EXAMINATION (SEM–VI) 2016-17

DIGITAL SIGNAL PROCESSING

Time : 3 Hours ***Max. Marks : 100***

Note : *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

SECTION – A

1. Attempt the following questions: 10 x 2 = 20

(a) Define digital signal processing.

(b) Draw the block diagram of digital signal processing.

(c) Explain the basic elements required for realization of digital system.

(d) Define linear convolution and its physical significance.

(e) What is the fundamental time period of the signal x(t)=sin15πt.

(f) Draw a transformation matrix of size 4x4 and explain the properties of twiddle factor.

(g) Differentiate between IIR and FIR filters

(h) Enumerate the Advantages of DSP over ASP.

(i) Write the expression for computation efficiency of an FFT.

(j) Calculate the DFT of the sequence s(n) = {1,2,1,3}.

SECTION – B

2. Attempt any five of the following questions: 5 x 10 = 50

(a) Obtain the Parallel form realization for the transfer function H(z) given below:

$$H(z)=\frac{2+z^{-1}+\frac{1}{4}z^{-2}}{(1+\frac{1}{2}z^{-1})(1+z^{-1}+\frac{1}{2}z^{-2})}$$

(b) Calculate the DFT of x(n) = Cos an

(c) Drive and draw the flow graph for DIF FFT algorithm for N=8.

(d) Determine H(z) using the impulse invariant technique for the analog system function

$$H(s)=\frac{1}{(s+0.5)(s^2+0.5s+2)}$$

(e) Determine H(z) for a Butterworth filter satisfying the following constraints

$$\sqrt{0.5}\le \left|H(e^{j\omega})\right|\le 1 \qquad 0\le\omega\le\frac{\pi}{2}$$
$$\left|H(e^{j\omega})\right|\le 0.2 \qquad \frac{3\pi}{4}\le\omega\le\pi$$

with T=1sec. Apply impulse invariant transformation.

(f) Given x(n) $=2^n$ and N=8 find X(K) using DIT FFT algorithm. Also calculate the computational reduction factor.

(g) Design a low-pass filter with the following desired frequency response

$$H_d(e^{jw})=\begin{cases} e^{-j2\omega}, & \frac{-\pi}{4}\le\omega\le\frac{\pi}{4} \\ 0, & \frac{\pi}{4}<|\omega|<\pi \end{cases}$$ and using window function

$$w(n)=\begin{cases}1, & 0\le n\le 4\\ 0, & otherwise\end{cases}$$

(h) Convert the analog filter with system function $H(s) = \dfrac{s+0.1}{(s+0.1)^2+9}$ into digital filter with a resonant frequency of $\omega_r = \dfrac{\pi}{4}$ of using bilinear transformation.

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SECTION – C

Attempt any two of the following questions: **2 x 15 = 30**

3 (i) Obtain the ladder structure for the system function H(z) given below.

$$H(z) = \frac{2+8z^{-1}+6z^{-2}}{1+8z^{-1}+12z^{-2}}$$

(ii) Compute the Circular convolution of two discrete time sequences $x_1(n)$ = {1, 2, 1, 2} and $x_2(n)$ = { 3, 2, 1, 4 }

4 (a) Determine the 4-point discrete time sequence from its DFT X(k) = { 4, 1-j, -2, 1+j }

(b) Explain the following phenomenon: (i) Gibbs Oscillations, (ii) Frequency wraping

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

(b) Design a digital Chebyshev filter to satisfy the constraints

$$0.707 \le |H(e^{j\omega})| \le 1 \qquad 0 \le \omega \le 0.2\pi$$
$$|H(e^{j\omega})| \le 0.1, \qquad 0.5\pi \le \omega \le \pi$$

Using bilinear transformation with T=1s