Printed Pages : 2 Roll No. | | | | | | | | | | | NEC011

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 $x(t)=\sin 15\pi t$.
- **(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

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

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

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

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

(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.

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

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

Using bilinear transformation with T=1s