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BIEL-010

B.Tech. – VIEP – ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

Term-End Examination

00896

June, 2016

BIEL-010 : DIGITAL SIGNAL PROCESSING

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted. Missing data may be suitably assumed.*

1. (a) Compute the N-point DFT of each of the following sequences :

(i) $x_1(n) = \delta(n - n_0)$ where $0 \leq n_0 < N$ *2*

(ii) $x_2(n) = \alpha^n \quad 0 \leq n < N$ *2*

(b) Prove that linear convolution is obtained using circular convolution property of DFT. *6*

2. Explain in brief, the method to reduce complexity in computation of FFT. Give practical consideration in reducing (a) memory size for storage of coefficients, and (b) computation time. *10*

3. (a) Determine IDFT of the sequence

$$X(k) = \{2, 1 + j, 0, 1 - j\}.$$ *5*

(b) A 4-point DFT of sampled data sequence $\{2, 0, 0, 1\}$ is $\{3, 2 + j, 1, 2 - j\}$.

Verify

(i) $X(7) = X(3)$

(ii) $X(12) = X(0)$ *5*

4. If $x(n) = \cos\left(\frac{\pi n}{4}\right)$, $0 \le n \le 7$, obtain X(k) using Decimation-in-frequency FFT algorithm. *10*

5. Determine the total number of twiddle factors required to compute N-point DFT using Radix-2 Decimation-in-time FFT algorithm and compare it with that of direct computation of N-point DFT. *10*

6. The transfer function of an analog filter is $H(s) = \frac{3}{(s + 2)(s + 3)}$ with $T_s = 0{\cdot}1$ sec. Design the digital IIR filter using BLT (Bilinear Transformation Method). *10*

7. Find the order and cut-off frequency of a digital Butterworth filter with the following specification :

$$0{\cdot}89 \le |H(e^{j\omega})| \le 1, \qquad 0 \le \omega \le 0{\cdot}4\pi$$

$$|H(e^{j\omega})| \le 0{\cdot}18, \qquad 0{\cdot}6\pi \le \omega \le \pi$$

Use impulse invariance method. Draw its poles also. *10*

8. Design a digital FIR filter with

$$H_f(e^{j\omega}) = \begin{cases} 1 & 2 \le \omega \le \pi \\ 0, & \text{otherwise} \end{cases}$$

Use Hamming window with N = 7. Also draw the frequency response. *10*

9. Compare the frequency domain characteristics of difference window functions used in design of FIR filters. *10*

10. Write short notes on any ***two*** of the following : *2×5=10*

(a) Overlap-Save Method

(b) Lattice and Parallel Realization for Discrete Time Systems

(c) Goertzel Algorithm