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BIEL-010

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

Term-End Examination

June, 2019

BIEL-010 : DIGITAL SIGNAL PROCESSING

Time : 3 hours *Maximum Marks : 70*

Note : *(i) Attempt **any seven** questions.*

*(ii) **All** questions carry **equal** marks.*

(iii) Use of scientific calculator is permitted.

(iv) Missing data, if any, may be suitably assumed.

1. (a) Compute the DFT of the sequence $x(n) = \{1, j, -1, -j\}$ for $N = 4$ using linear transformation matrix. **4**

   (b) Derive the relationship between DFT and the Fourier series coefficients of a periodic sequence. **6**

2. (a) Determine the output response $y(n)$ if **5**

   $h(n) = \left\{\underset{\uparrow}{1,1,1}\right\}$ and $x(n) = \left\{\underset{\uparrow}{1,2,3,1}\right\}$ by

   using Circular Contribution Method.

   (b) Discuss Goertzel Algorithm and state its application. **5**

3. (a) Calculate the percentage saving in calculations in a 512-point radix-2 FFT when compared to direct computation of DFT. **6**

   (b) Draw and explain the basic butterfly diagram or flow graph of DIT radix-2 FFT and DIF radix-2 FFT. **4**

4. Using the Decimation In Frequency (DIF) FFT flow graph compute FFT of the finite durate sequence. **10**

$x(n) = \cos\left(n\pi/4\right)$ for $0 \leq n \leq 7$.

5. (a) Find the IDFT of the sequence **6**
$X(K) = \{10, -2+j2, -2, -2-j2\}$
using DIT FFT algorithm.

(b) Give the advantages of FFT algorithm over direct computation of DFT. **4**

6. Develop radix-2 DIT FFT algorithm for $N = 8$ and draw the signal flow diagram. Explain the term "bit reversal" as applied in DIT FFT algorithm. **10**

7. The specification of the desired low pass filter is : **10**

$H_d(e^{j\omega}) = 0.8 \leq |H(\omega)| \leq 1.0 \quad 0 \leq \omega \leq 0.2\pi$

$|H(\omega)| \leq 0.2 \quad 0.32\pi \leq \omega \leq \pi$

Design Chebhyshev digital filter using bilinear transformation method.

8. (a) What is aliasing problem in impulse invariant method of designing digital filter ? Why it is absent in bilinear transformation ? **6**

(b) Obtain the impulse response of digital filter correspond to an analog filter with impulse response $ha(t) = 0.3e^{-2t}$ and with a sampling rate of 1.0 kHz using impulse invariant method. **4**

9. A low pass filter is to be designed with the following desired frequency response : 10

$$H_f\left(e^{j\omega}\right)=\begin{cases} e^{-j2\omega} & -\pi/4 \le \omega \le \pi/4 \\ 0 & \pi/4 \le |\omega| \le \pi \end{cases}$$

Determine the filter coefficient $h_f(n)$ if window function

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

10. (a) Obtain the direct form I and direct form II structures for the following systems. 5

$y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252\ x(n-2)$.

(b) Consider a causal IIR system function 5

$$H(z) = \frac{1+2z^{-1}+3z^{-2}+2z^{-3}}{1+0.9z^{-1}-0.8z^{-2}+0.5z^{-3}}.$$

Determine the equivalent ladder structure.