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BIEL-010

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

Term-End Examination

00369

December, 2017

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, if any, may be suitably assumed.*

1. (a) Explain Discrete Fourier Series (DFS). What is the relationship between Discrete Fourier Transform (DFT) and DFS ? *4*

(b) The five samples of a 9-point DFT are given as follows :

$X(0) = 23, X(1) = 2{\cdot}242 - j, X(4) = -6{\cdot}379 + j4{\cdot}121$

$X(6) = 6{\cdot}5 + j259, X(7) = -4{\cdot}153 + j0{\cdot}264$

Determine the remaining samples of the DFT if the corresponding time domain sequence is real. *6*

2. (a) Compute the circular convolution of the following sequences using IDFT and DFT : *6*

$x_1(n) = \{1, 2, 3, 1\}$ and $x_2(n) = \{4, 3, 2, 2\}$

(b) State and prove the following properties of DFT : *4*

(i) Circular time shift

(ii) Periodicity property

3. (a) In terms of computational complexity, compare the direct computation of DFT and FFT. *6*

(b) Explain in detail, the Goertzel algorithm for Fast Fourier Transform. *4*

4. Determine the DFT of the following sequence using DIF-FFT algorithm : *10*

$x(n) = \{1, 1, 1, 0, 0, 1, 1, 1\}$

5. Explain with the help of neat butterfly diagram, radix-2 DIT-FFT algorithm. Explain how calculations are reduced. *10*

6. Design a digital butterworth low pass filter that satisfies the following condition :

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

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

Use the impulse invariance method. *10*

7. (a) Derive the transformation formula for the bilinear transformation method. *4*

(b) An analog filter has the following system function. Convert this filter into a digital filter using impulse invariant method.

$$H(s) = \frac{36}{(s + 0{\cdot}1)^2 + 36}$$

The digital filter must have a resonant frequency of $\omega_r = 0{\cdot}2\,\pi$. *6*

8. The desired frequency response of a low pass filter is given by

$$H_f(e^{j\omega}) = \begin{cases} e^{-j3\omega}, & -3\pi/4 \le \omega \le 3\pi/4 \\ 0, & 3\pi/4 < |\omega| \le \pi \end{cases}$$

Find $H(e^{j\omega})$ for M = 7 using rectangular window. *10*

9. (a) What is the condition for the impulse response of an FIR filter to satisfy for constant group and phase delay and for only constant group delay ? *4*

(b) What are the different types of window functions ? How are they defined ? *6*

10. (a) Obtain FIR linear-phase and cascade realization of the system function

$$H(z) = \left(1 + \frac{1}{2} z^{-1} + z^{-2}\right)\left(1 + \frac{1}{4} z^{-1} + z^{-2}\right). \quad 5$$

(b) Obtain the cascade and parallel form realization of the following IIR digital filter transfer function : 5

$$H(z) = \frac{3\,(2z^2 + 5z + 4)}{(2z + 1)\,(z + 2)}$$