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BIEL-010

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

Term-End Examination

December, 2015

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) Derive the relationship between Discrete Fourier Transform (DFT) and Z-transform. *6*

(b) What are 'twiddle factors' of the DFT ? Give the significance of it. *4*

2. (a) Using circular convolution, find the output of system, if input x(n) and impulse response h(n) is given by

$$x(n) = 2u(n) - u(n-2) - u(n-4),$$

$$h(n) = 3\delta(n) - 2\delta(n-1) + \delta(n-2).$$ *7*

(b) State and prove the 'circular shifting' property of DFT. *3*

3. Derive and explain Radix-2 Decimation in time FFT algorithm (all stages) for N = 8. Draw the signal flow graph and comment on the computational complexity and in-phase computation. *10*

4. Using Decimation in Frequency FFT algorithm, perform circular convolution of

$$x_1(n) = \{1, 2, 3, 4\}, \; x_2(n) = \{4, 3, 2, 1\}.$$ *10*

5. How does the problem of frequency warping occur in Bilinear Transformation method of IIR filter design ? How is it compensated ? Explain the design steps of BLT method. *10*

6. Determine the order and poles of low pass Butterworth filter having 3 dB attenuation at 500 Hz and attenuation of 40 dB at 1000 Hz. *10*

7. Design a digital Chebyshev filter using bilinear transformation method to meet the following constraints : *10*

$$0{\cdot}707 \leq |H(e^{j\omega})| \leq 1, \quad 0 \leq \omega \leq 0{\cdot}25\pi$$

$$|H(e^{j\omega})| \leq 0{\cdot}3, \quad 0{\cdot}45\pi \leq \omega \leq \pi$$

8. Consider the causal LTI system with function

$$H(z) = \frac{\left(1 - \frac{1}{5} z^{-1}\right)}{\left(1 - \frac{1}{2} z^{-1} + \frac{1}{3} z^{-2}\right)\left(1 + \frac{1}{4} z^{-1}\right)}.$$

Draw the signal flow graph for implementation of the system in

(a) Cascade form using first and second order direct form II sections.

(b) Parallel form using first and second order direct form II sections. *10*

9. Design a low pass digital FIR filter having the following specification :

$$0{\cdot}99 \leq |H(e^{j\omega})| \leq 1{\cdot}01, \quad 0 \leq |\omega| \leq 0{\cdot}19\pi$$

$$|H(e^{j\omega})| \leq 0{\cdot}01, \quad 0{\cdot}21\pi \leq |\omega| \leq \pi$$

Using Hamming window, assume $\omega_c = 0{\cdot}2\pi$. Also express the impulse response in $h_f(n)$. *10*

10. What is the reason that FIR filters are always stable ? Also write the properties of FIR filter. Explain the parallel and cascade form realization of IIR filters. *10*
