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10TE52

Fifth Semester B.E. Degree Examination, June/July 2018
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is DFT? What is the difference between DTFT and DFT. **(06 Marks)**

b. If $y(n) = \frac{x(n) + x(-n)}{2}$ find y(k) if x(k) = {0.5, 2 + J, 3 + J2, J, 3, – J , 3 – J2, 2 – J} **(04 Marks)**

c. Determine 8-point DFT of the signal. x(n) = {1, 1, 1, 1, 1, 1, 0, 0}. Also sketch its magnitude and phase. **(10 Marks)**

2 a. A discrete time LTI system has impulse response h(n) = δ(n) + 2δ (n – 1) + 3δ (n – 2) + 4 δ(n – 3). Determine the output (circular convolution of the system is the input is x(n) = 2 δ(n) + δ(n – 1) + 2δ (n – 2) + δ(n – 3) using DFT and IDFT method. **(06 Marks)**

b. Compute the 4-point DFT of the following sequence $x_1(n)$ = {1, 2, 3, 2} and $x_2(n)$ = {3, 2, 1, 2} using a time shifting property given that $x_2(n) = x_1(n-2)_4$. **(06 Marks)**

c. Explain with necessary diagrams and equations, the concept of overlap save method for linear filtering. **(08 Marks)**

3 a. What is inplace computation? Bring out the similarities and differences between DIF- FFT and DIF – FFT algorithms. **(10 Marks)**

b. Compute the 8-point DFT of the following sequence x(n) = {1, 1, 1, 1, 1, 1, 1, 1} using DIT – FFT algorithms. **(10 Marks)**

4 a. Use FFT and IFFT. Find the output of a system y(n) if i/p x(n) and h(n) are given by x(n) = {2, 2, 4,} and h(n) = {1, 1} find y(n) using DIF-FFT algorithm. **(10 Marks)**

b. Compute DFT of sequence x(n) = {1, 0, 1, 0} using Goertzel algorithm, assuming K = 2, and N = 4. **(06 Marks)**

c. Explain the following properties of twiddle factors W_N
   i) Symmetry
   ii) Periodicity **(04 Marks)**

PART – B

5 a. Derive an expression for order of a low pass Butterworth filter and also show how to find the order of filter and cut-off frequency. **(10 Marks)**

b. Design an analog Chebyshev with following specifications : **(10 Marks)**

Passband ripple : 1 db for $0 \leq \Omega \leq 10$ rad/sec
Stop band attenuation : – 60 db for $\Omega \geq 50$ rad/sec

6 a. Determine direct forms I and II for the second order filter given by $y(n) = 2b \cos w_0 \, y(n-1) - b^2 y(n-2) + x(n) - b \cos w_0 \, x(n-1)$. **(10 Marks)**

b. Realize an FIR filter structure where transfer function is given by $H(z) = 1 - 3z^{-1} + 2z^{-2} - z^{-3} - z^4$ in direct form and cascade form. **(10 Marks)**

7 a. Design a symmetric FIR low pass filter where desired frequency response is given as

$$H_\alpha(w) = \begin{cases} e^{-jwp}, & \text{for } |w| \le w_c \\ 0 & \text{other wise} \end{cases}$$

The length of the filter should be 7 and w_c = rad/sample use rectangular window. **(10 Marks)**

b. Design a normalized linear phase FIR filter having the delay of T = 4 and at least 40db attenuation in the stopband. Also obtain the magnitude/frequency response of the filter. **(10 Marks)**

8 a. What is bilinear transformation? Obtain the transformation formula for bilinear transformation. **(10 Marks)**

b. Convert the following transfer function

$M(s) = \dfrac{s+a}{(s+a)^2 + b^2}$ in to a digital filter with Infinite Impulse Response (IIR) by the use of Impulse Invariance Mapping Technique. **(10 Marks)**

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