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10EC52

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. Derive the DFT expression from the DTFT expression. **(06 Marks)**

b. Compute 5-point DFT of x(n) = {1, 1, 1}. **(07 Marks)**

c. Find IDFT for the sequence, X(K) = {5, 0, (1-j), 0, 1, 0, (1+j), 0} **(07 Marks)**

2 a. State and prove circular time shift and frequency shift property of DFT. **(05 Marks)**

b. Determine N-point circular correlation of $x_1(n)$ and $x_2(n)$, given $x_1(n) = \cos\frac{2\pi}{N}n$ and $x_2(n) = \sin\frac{2\pi}{N}n$. **(08 Marks)**

c. Compute circular convolution of x(n) = {1, 2, 3, 4} and h(n) = {1, 2, 2} using time domain approach. **(07 Marks)**

3 a. Find the output y(n) of a filter whose impulse response h(n) = {1, 2} and the input signal to the filter is, x(n) = { 1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1} using overlap – save method. **(08 Marks)**

b. Find 4-point DFT of two real sequences using a single 4-point DFT, given g(n) = {1, 2, 0, 1} and h(n) = {2, 2, 1, 1}. **(08 Marks)**

c. State and prove (i) Symmetry and (ii) Periodicity property of a twiddle factor. **(04 Marks)**

4 a. Develop Radix-2, DITFFT algorithm to compute DFT of a sequence, draw the signal flow graph, for N = 8. **(08 Marks)**

b. Obtain 8-point DFT of a sequence $x(n) = (n+1)[u(n) - u(n-8)]$, using DIF-FFT algorithm, show all the intermediate results. **(08 Marks)**

c. Write a note on Geortzal algorithm. **(04 Marks)**

PART – B

5 a. Derive an expression for order and cutoff frequency of a Butterworth low pass filter. **(06 Marks)**

b. Design an analog Chebyshev filter having following specifications:
(i) Passband ripple of 3 dB at 500Hz.
(ii) Attenuation of 15 dB at 750 Hz. **(10 Marks)**

c. Compare Butterworth and Chebyshev filters. **(04 Marks)**

6 a. Obtain the cascade and parallel form realization of,
$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}.$$ **(10 Marks)**

b. A FIR filter is described by Transfer function, $H(z) = 1 + \frac{2}{5}z^{-1} + \frac{3}{4}z^{-2} + \frac{1}{3}z^{-3}$,
(i) Draw Lattice structure.
(ii) Obtain its difference equation.
(iii) Draw Direct form structure. **(10 Marks)**

7 a. Derive an expression for frequency response of a symmetric FIR filter, for N = odd. **(08 Marks)**

b. Design a LPF with the frequency response, $H_d(j\omega) = \begin{cases} e^{-j2\omega}, & |\omega| < \frac{\pi}{4} \\ 0, & \frac{\pi}{4} < |\omega| < \pi \end{cases}$

using rectangular window. Also find its impulse response and frequency response. **(08 Marks)**

c. Explain the frequency sampling design of FIR filters. **(04 Marks)**

8 a. Derive the expression for the bilinear transformation, to transform an analog filter to digital filter, explain the characteristics of mapping from s-plane to z-plane. **(08 Marks)**

b. Given the analog transfer function, $H(z) = \frac{s+2}{(s+1)(s+3)}$, find H(z) using matched z-transform. **(04 Marks)**

c. Design a digital lowpass filter using Bilinear transformation to satisfy the following characteristics:

(i) Monotonic stopband and passband.
(ii) -3 dB cutoff frequency of 0.5π rad.
(iii) Magnitude down atleast 15 dB at 0.75π rad. **(08 Marks)**

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