CBCS SCHEME

USN

15EC52

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive the DFT expression from the DTFT. **(04 Marks)**

b. Compute the 'N' point DFT of the sequence $x(n) = a.n \; 0 \le n \le N-1$. **(06 Marks)**

c. Find the circular convolution between the sequences using DFT and IDFT method $x_1(n) = (1, 2, 3, 1)$ and $x_2(n) = (4, 3, 2, 1)$ **(06 Marks)**

OR

2 a. State and prove that circular (i) Folding ii) Frequency shift properties of an 'N' point sequence. **(06 Marks)**

b. Consider the finite length sequence $x(n) = \delta(n) + 2\delta(n-j)$ Find :

(i) 10 point DFT of x(n)

(ii) $y(k) = e^{-j\left(\frac{4\pi k}{10}\right)} X(k)$ where X(k) is 10 point DFT of x(n) find y(n)

(iii) Find z(n) that has DFT $z(k) = X(k).w(k)$ where w(k) is the 10 point DFT of $w(n) = u(n) - u(n-7)$ **(07 Marks)**

c. Let x(n) be a finite length sequence with $x(k) = \{1, 4j, 0, -4j\}$, find the DFT's of

(i) $x_1(n) = e^{j\frac{\pi}{2}n} x(n)$ (ii) $x_2(n) = \cos\left(\frac{\pi}{2}n\right) x(n)$ (iii) $x_3(n) = x((n-1)_4)$ **(03 Marks)**

Module-2

3 a. Explain the disadvantages of direct computation of DFT and advantage of FFT. **(04 Marks)**

b. Find the output y(n) of a filter whose impulse response h(n) = {3, 2, 1} and input x(n) = {2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1}. Using overlap and save method. Use 8 point circular convolution in your approach. **(10 Marks)**

c. State and prove symmetric property of twiddle factor w_N. **(02 Marks)**

OR

4 a. Find the number of complex multiplications and additions required to computer 128 point DFT using (i) Direct method (ii) FFT (iii) what is the speed improvement factor (iv) Number of real registers needed (v) Number of trigonometric functions needed. **(06 Marks)**

b. A long sequence x(n) is filtered with a filter with impulse response h(n) to produce output y(n). If x(n) = {1, 4, 3, 0, 7, 4, -7, -7, -1, 3, 4, 3} and h(n) = {1, 2}. Compute y(n) using overlap and add method. Use only 5 point circular convolution in your approach. **(10 Marks)**

Module-3

5 a. Develop 8 point DIT-FFT radix – 2 algorithm and draw the signal flow graph. **(08 Marks)**

b. Find the 8 point DFT of the sequence x(n) = {1, 1, 1, 1, 0, 0, 0, 0} using radix – 2 DIF FFT algorithm. **(08 Marks)**

OR

6 a. Find the 4 point circular convolution of x(n) and h(n) given below using radix – 2 DIT FFT algorithm. x(n) = {1, 1, 1, 1} h(n) = {1, 0, 1, 0}. **(06 Marks)**

b. First five points of 8-point DFT's of a real valued sequence is given by x(0) = 0 x(1) = 2 + 2j, x(2) = -4j, x(3) = 2 – 2j, x(4) = 0. Determine the remaining points. Hence find the sequence x(n) using radix – 2 DIT FFT algorithm. **(10 Marks)**

Module-4

7 a. Compare Butterworth and Chebyshev filters. **(04 Marks)**

b. Design an analog lowpass Butterworth filter for the following specifications

$0.8 \le |H_a(s)| \le 1, 0 \le \Omega \le 0.2\pi, \ |H_a(s)| \le 0.2, 0.6\pi \le \Omega \le \pi$. **(08 Marks)**

c. Explain Analog to Analog transformation. **(04 Marks)**

OR

8 a. Design a digital lowpass filter using BLT to satisfy the following chart.

i) Monotonic pass and stop band
ii) -3dB cut –off of 0.5π rad
iii) Magnitude down atleast 15dB at 0.75π rad **(08 Marks)**

b. Find H(z) for the given T.F $H(s) = \frac{s+a}{(s+a)^2 + b^2}$ using Impulse Invariant Transformation (IIT) technique. **(08 Marks)**

Module-5

9 a. Obtain direct form – I, Form – II, Cascade and parallel form of realization for the following system. y(n) = 0.75 y(n – 1) – 0.125 y(n – 2) + 6x(n) + 7x (n – 1) + x(n – 2). **(12 Marks)**

b. Realize an FIR filter given by $h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-4)]$ using direct form – I. **(04 Marks)**

OR

10 a. Write equations of any four different windows used in design of FIR filters. **(10 Marks)**

b. Design the symmetric FIR, lowpass filter whose desired frequency response is given as

$$H_d(w) = \begin{cases} e^{-jw\tau} & \text{for } |w| \le w_c \\ 0 & \text{otherwise} \end{cases}$$

The length of the filter should be 7 and w_c = 1 radian/sample use rectangular window. **(06 Marks)**

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