CBCS SCHEME

USN 15EC52

Fifth Semester B.E. Degree Examination, July/August 2022
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. Consider the signal $x(n) = a^n u(n)$, $0 < a < 1$. The spectra of this signal is sampled at frequencies $W_K = \frac{2\pi K}{N}$, K = 0, 1, …… N – 1. Determine the reconstructed spectra for $a = 0.8$ when $N = 5$. **(08 Marks)**

b. Compute the 8-point DFT of $x(n) = (-1)^{n+1}$, $0 \le n \le 7$. **(08 Marks)**

OR

2 a. Establish the relationship between (i) DFT and DFS (ii) DFT and DTFT **(05 Marks)**

b. Define DFT and IDFT. Compute IDFT of the sequence $X(K) = \{2, 1+j, 0, 1-j\}$. **(11 Marks)**

Module-2

3 a. State and prove the following DFT properties:
(i) Time reversal of a sequence (ii) Circular frequency shift **(08 Marks)**

b. The five samples of 8-point DFT X(K) are given as follows:
$X(0) = 0.25$, $X(1) = 0.125 - j0.3018$, $X(6) = X(4) = 0$, $X(5) = 0.125 - j0.0518$
Determine the remaining samples if sequence x(n) is real valued sequence. **(08 Marks)**

OR

4 a. Find the output y(n) of a filter whose impulse response is h(n) = {1, 1, 1} and the input signal to the filter is x(n) = {3, -1, 0, 1, 3, 2, 0, 1, 2, 1} using overlap save method. **(08 Marks)**

b. What are FFT algorithms? State their advantages over the direct computation of DFT. **(04 Marks)**

c. Compute the 8-point circular convolution of $x_1(n) = \left(\frac{1}{4}\right)^n$, $0 \le n \le 7$ and $x_2(n) = \cos\frac{3\pi}{8}n$, $0 \le n \le 7$. **(04 Marks)**

Module-3

5 a. Derive the signal flow graph for N = 8 point Radix – 2 DIF-FFT algorithm. **(08 Marks)**

b. Use the 8-point Radix-2 DIT-FFT algorithm to find the DFT of sequence:
x(n) = {0.707, 1, 0.707, 0, –0.707, –1, – 0.707, 0} **(08 Marks)**

OR

6 a. What is Goertzel algorithm? Obtain the Direct form-II realization of it. **(08 Marks)**

b. For X(K) = {0, 0, –j4, 2 – j2, 0 , 2 + j2, 0, 2 – j2}, find sequence x(n) using DIF-FFT algorithm. **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-4

7 a. Design a Chebyshev filter to meet the following specifications:
   (i) Passband ripple ≤ 2 dB
   (ii) Stopband attenuation ≥ 20 dB
   (iii) Passband edge : 1 rad/sec
   (iv) Stopband edge : 1.3 rad/sec (10 Marks)

b. The system function of low pass digital filter is given by $H(z) = 0.5\left(\frac{1+z^{-1}}{2-z^{-1}}\right)$. From the above equation find y(n). (06 Marks)

OR

8 a. Derive an expression for order and cutoff frequency of the Butterworth filter. (06 Marks)

b. The system function of the analog filter is given as $H_a(s) = \frac{s+0.1}{(s+0.1)^2+16}$. Obtain the system function of the digital filter using Bilinear transformation which is resonant at $\omega_r = \frac{\pi}{2}$. (10 Marks)

Module-5

9 a. Determine the filter coefficients $h_d(n)$ for the desired frequency response of the low pass filter given by

$$H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega} & \text{for } -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4} \\ 0 & \text{for } \frac{\pi}{4} \leq |\omega| \leq \pi \end{cases}$$

If we define new filter coefficient by $h(n) = h_d(n).\omega(n)$,

$$\text{where } \omega(n) = \begin{cases} 1 & \text{for } 0 \leq n \leq 4 \\ 0 & \text{elsewhere} \end{cases}$$

Determine h(n) and also the frequency response $H(e^{j\omega})$ and compare with $H_d(e^{j\omega})$. (08 Marks)

b. Explain the frequency sampling method of designing linear phase FIR filters. (08 Marks)

OR

10 a. The coefficients of three stages FIR lattice structure is $K_1 = 0.1$, $K_2 = 0.2$ and $K_3 = 0.3$. Find the coefficients of direct form – I FIR filter and draw its block diagram. (08 Marks)

b. Write short notes on:
   (i) Hamming window
   (ii) Hanning window
   (iii) Bartlett window (08 Marks)

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