CBCS SCHEME

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15EC52

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

Note:* 1. *Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Normalized filter tables not permitted.

Module-1

1 a. Describe the process of frequency domain sampling and reconstruction of discrete time signals. **(06 Marks)**

b. Compute 8-point DFT of x(n) = {1, 1, 1}, also sketch magnitude and phase plot. **(10 Marks)**

OR

2 a. Derive the Relationship of DFT with Z-transform. **(04 Marks)**

b. State and prove circular time shift property of DFT. **(04 Marks)**

c. Compute circular convolution of x(n) = {1, 2, 3, 4} and h(n) = {1, 2, 2} using transform domain approach. **(08 Marks)**

Module-2

3 a. Find the output y(n) of a filter whose impulse response h(n) = {1, −2} and input x(n) = {3, −2, 4, 1, 5, 7, 2, −9} using overlap add method. Use 5-point circular convolution in your approach. **(08 Marks)**

b. Determine N-point circular correlation of $x(n) = \cos\left(\frac{2\pi n}{N}\right)$ and $y(n) = \sin\left(\frac{2\pi n}{N}\right)$ **(08 Marks)**

OR

4 a. State and prove Parseval's theorem of DFT. **(04 Marks)**

b. Explain the linear filtering of long data sequence using overlap-save method. **(08 Marks)**

c. State and prove properties of twiddle factor. **(04 Marks)**

Module-3

5 a. Develop DIT-FFT algorithm to compute DFT of a sequence and obtain the signal flow diagram for N = 8. **(12 Marks)**

b. Compute 4-point IDFT of $X(K) = \{6, (-1-j),\ 0,\ (-1+j)\}$ using DIT-FFT algorithm. **(04 Marks)**

OR

6 a. Compute 8-point DFT of x(n)={1, 2, 3, 4, 5, 6, 7, 8} using DIF-FFT algorithm. **(08 Marks)**

b. Explain Geortzal algorithm for computation of DFT. **(08 Marks)**

Module-4

7 a. Obtain DF-II and parallel realization of $H(z) = \dfrac{1+z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}$. **(08 Marks)**

b. Derive the expression for order and cutoff frequency for a lowpass Butterworth filter. **(08 Marks)**

OR

8 a. Design a digital filter H(z) that when used in A/D – H(z) – D/A structure gives an equivalent analog filter with the following specifications: passband attenuation of 3 dB at 500 Hz, stopband attenuation of 15 dB at 750 Hz with sampling rate 2 kHz. The filter is to be designed by performing a BLT on an analog system function. Use Butterworth prototype. Also obtain the difference equation. **(10 Marks)**

b. Explain how an analog filter is mapped on to a digital filter using impulse invariance method. What are the limitations of the method? **(06 Marks)**

Module-5

9 a. Derive the frequency response of a symmetric FIR low pass filter for N = odd. **(08 Marks)**

b. A FIR filter is described by $y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$. Draw its Lattice structure. **(08 Marks)**

OR

10 a. Design a LPF with the frequency response

$$H_d(jw) = \begin{cases} e^{-j2w} & |w| < \frac{\pi}{4} \\ 0 & \frac{\pi}{4} < |w| < \pi \end{cases}$$

using rectangular window, also find its impulse response, frequency response and difference equation. **(12 Marks)**

b. Realize the linear phase FIR filter having the impulse response $h(n) = \left\{1, \frac{1}{4}, -\frac{1}{8}, \frac{1}{4}, 1\right\}$. **(04 Marks)**

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