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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: ECE / ETE / EIE / EEE / ML **Duration: 3 hrs.**
Course Code: 19ES5CCDSP **Max Marks: 100**
Course: DIGITAL SIGNAL PROCESSING

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Find the N-point DFT of the sequence **05**

$$x(n) = \begin{cases} 1 \quad for\ 0 \le n \le N-1 \\ 0\ otherwise\ for\ N = 10 \end{cases}$$

Also sketch the DFT of the sequence

b) Find the Circular Convolution for the following sequences for N=8 **05**
$x_1(n)=\{1, 0, 1, 0, 1, 0, 1, 1\}$
$x_2(n)=\cos(2\pi/3)n$ for $0 \le n \le 7$

c) $Given\ x(n) = \begin{cases} 2\ for\ n = even \\ 0\ for\ n = odd \end{cases} for\ 0 \le n \le N-1$ **10**

Find DFT of the sequence x(n) for N=even positive integer

OR

2 a) Find the N point DFT of the sequence **05**
i) $x(n) = 4 + \cos^2(2\pi n/N)$ for n=0, 1, ------- N-1

ii) Find N-point DFT of $x_1(n) = x(n).\cos\left(\frac{2\pi k_o n}{N}\right)$ **05**

b) Let x(n)={1, 2,0,3}. Find the circularly folded signal $x_1(n)=x((-n))_4$ and hence determine the circularly even and odd part of x(n). **05**

c) Given x(n)= { 1, 2, 3, 4} . Find the energy and hence verify Pasreval's Theorem **05**

UNIT - II

3 a) Determine the Output y(n) of a filter whose impulse response is h(n)={1, 1, 1} and input signal x(n)={3,-1,0,1,3,2,0,1,2,1} using **08**

i) Overlap Save Method

ii) Overlap add method

b) Find the DFT of the following sequence using DIT FFT algorithm and draw the flow graph indicating the intermediate values of the graph **07**

x(n)={1, 1, 1, 1, 1, 1, 0, 0 }

c) Find the IDFT of the sequence X(K)={3, 5-j8, -1, 5+j8) using decimation in frequency fast Fourier transform **05**

UNIT - III

4 a) Design a lowpass 1.4531 rad/sec bandwidth chebyshev filter with the following specifications **10**

i) Acceptable passband ripple of +1 dB

ii) Cutoff random frequency of 1.4531 rad/sec

iii) stop band attenuation of 20 dB or greater beyond 6.1536 rad/sec

b) For the analog transfer function $H(s)=\frac{2}{(s+1)(s+2)}$. Design an IIR filter using impulse invariance method. Assume T=1 sec. **05**

c) Realize the system with difference equation **05**

$$y(n)=\frac{3}{4}y(n-1)-\frac{1}{8}y(n-2)+x(n)+\frac{1}{3}x(n-1)$$ in cascade form

OR

5 a) Design an analog Butterworth Bandpass filter for the following specifications **10**

-3dB for frequencies above 500 Hz and below 5 KHz

-20 dB for frequencies less than 100 Hz and > 50 KHz

b) Design and realize a digital LPF using BLT to meet the following specifications **10**

i) Monotonic passband and stopband

ii) -3dB cutoff at 0.5π rad

iii) -15dB attenuation at 0.75π rad

UNIT - IV

6 a) A low pass filter is to be designed with the following desired frequency response **08**

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

Determine the filter coefficients $h_d(n)$ if the window function is defined as

$$\omega(n) = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & otherwise \end{cases}$$

Also determine the frequency response $H(e^{j\omega})$ of the desired filter.

b) Draw the linear phase structure for an FIR Filter characterized by **04**

$$h(n) = \delta(n) + \frac{1}{2}\delta(n-1) - \frac{1}{4}\delta(n-2) + \frac{1}{2}\delta(n-3) + \delta(n-4)$$

c) Design a lowpass FIR Filter using frequency sampling technique using cutoff frequency of $\pi/2$ rad/sec. The filter should have linear phase and length of 17. **08**

UNIT - V

7 a) Given a DSP upsampling system with the following specifications: **08**
Sampling rate =6000 Hz, Input audio frequency range=0-800 Hz, passband ripple=0.02 dB, Stopband attenuation =50 dB, up sample factor L=3. Determine the FIR filter length, cut off frequency and window type if window design method is used.

b) With the block diagram and relevant example, explain the concept of changing sampling rate by a non Integer factor L/M **06**

c) With the relevant figures and equation illustrate how adaptive filter is used as echo canceller in modem of digital communication system**.** **06**

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