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B. Tech.
(SEM V) THEORY EXAMINATION 2021-22
DIGITAL SIGNAL PROCESSING

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. Define the Recursive and Non-Recursive systems.
b. Enlist the Condition for Linear Phase FIR digital filter with 5 Number of samples.
c. Differentiate Butterworth Low Pass Filter with Chebyshev LPF in terms of Filter Order.
d. Evaluate the value of $C_3(x)$, Chebyshev Polynomial.
e. Demonstrate the term Gibb's Phenomenon with schematic diagram.
f. Explain the terms Truncation Error & Round off Error with suitable examples.
g. Evaluate the DFT for the sequence [1, 2, 7, 3].
h. Find out the total no of Complex additions and Complex multiplications required for calculating 8-point Conventional DFT & by using butterfly structure DIT-FFT.
i. Explain the term Decimation with suitable example.
j. Find the output of the sequence [1 2 3] after up sampling by a factor N=3.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Realize the given H(z) for using ladder structure.

$$H(z)=\frac{2+8z^{-1}+6z^{-2}}{1+8z^{-1}+12z^{-2}}$$

b. Design Digital Butterworth filter to satisfy the following constraints using bilinear transformation method, the sampling Interval is 2 second: assume missing data if required:

$$0.52 \le |H(e^{jw})| \le 1 \quad ,0 \le w \le \pi/2$$
$$|H(e^{jw})| \le 0.1 \quad ,3\pi/4 \le w \le \pi$$

c. Explain the concept of the Limit Cycle Oscillations & dead band effect with suitable example.
d. Calculate the circular convolution using graphical method for x(n) = [1,2,3,4] and h(n) = [4,3,2,1].
e. Summarize QMF & Explain analytical and synthesis filter bank with aliasing free filter bank.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Describe the linear phase FIR systems, &For h (n) = [1/2, 1/3, 1/5, 1/3, 1/2] Realize H(z) of the Linear Phase FIR system for the given impulse response.
(b) Find out the direct form-I & direct form-II realization of a discrete-time system represented by the transfer function

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$$y(n) = -\frac{13}{12}y(n-1) - \frac{9}{24}y(n-2) - \frac{1}{24}y(n-3) + x(n) + 4\,x(n-1) + 3\,x(n-2)$$

4. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) Design Chebyshev Digital LPF filter to satisfy the following constraints using Impulse Invariant method.

$$0.9 \le |H(e^{jw})| \le 1 \quad ,0 \le w \le 0.25\pi$$
$$|H(e^{jw})| \le 0.24 \quad ,0.5\pi \le w \le \pi$$

(b) Design Chebyshev Digital LPF filter to satisfy the following constraints using Bilinear Transformation method, assume that the sampling time is one second.

$$0.707 \le |H(e^{jw})| \le 1 \quad ,0 \le w \le 0.2\pi$$
$$|H(e^{jw})| \le 0.1, 0.5\pi \le w \le \pi$$

5. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) A low Pass filter is to be designed with the following specifications:

$$H_d(e^{jw}) = \begin{cases} e^{-2jw} & , -\pi/4 \le w \le \pi/4 \\ 0 & , \text{otherwise} \end{cases}$$

Using Rectangular window function, Find the Filter coefficients & Frequency spectrum of the designed filter.

(b) Design a Filter with

$$H_d(e^{jw}) = \begin{cases} e^{-3jw} & , -\pi/4 \le w \le \pi/4 \\ 0 & , \pi/4 \le w \le \pi \end{cases}$$

Using Hamming window with M= 7.

6. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) Using DIF FFT find X (k), for $x(n) = 2^{n+1}$, **for N=8.**

(b) Derive &solve the DIT FFT algorithm for 8 numbers of samples.

7. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) Explain the block diagrammatic presentation of DSP processor, with its architecture, addressing formats and its commercial usages.

(b) Write a short note on LMS Algorithm.