CBCS SCHEME

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18EC52

# Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
## Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

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



### Module-1

1 a. State and prove circular time shift property. **(06 Marks)**

b. Find the 4-point DFT of the sequence $x(n) = \text{Cos}\left(\frac{\pi}{4}n\right) + \text{Sin}\left(\frac{\pi}{4}n\right)$ use linearity property. **(08 Marks)**

c. Consider 4-point sequences $x(n) = \text{Cos}\left(\frac{\pi n}{2}\right); 0 \le n \le 3$

$h(n) = 2^n ; \ 0 \le n \le 3$

Compute circular convolution. Using concentric circle method. **(06 Marks)**

**OR**

2 a. State and prove Parseval's theorem. **(06 Marks)**

b. Find 6- point DFT of the sequence

$x(n) = n ; \quad 0 \le n \le 5$

$= 0 ; \quad$ otherwise **(08 Marks)**

c. Find the IDFT of the DFT $X(K) = \{6, -2+j2, -2, -2-j2\}$. **(06 Marks)**

### Module-2

3 a. Consider a FIR with filter whose impulse response $h(n) = \{3, 2, 1, 1\}$ if the input is $x(n) = \{1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$, find the output using over lap add method assuming the length of block as 7. **(10 Marks)**

b. Develop Radix- 2 DIT-FFT algorithm and draw complete signal flow graph for N = 8. **(10 Marks)**

**OR**

4 a. Find the output y(n) of a filter whose impulse response in $h(n) = \{1, 1, 1\}$ and the input signal to the filter is $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$. Using overlap save method. **(10 Marks)**

b. First five point of the Eight point DFT of a real valued sequence is given by

$x(0) = 0, \qquad x(3) = 2-2j$

$x(1) = 2 + 2j \quad x(4) = 0$

$x(2) = -j4$

Determine the remaining points. Hence find the original sequence x(n) using Decimation in frequency FFT algorithm. **(10 Marks)**

### Module-3

5 a. List the different types of windowing techniques used in the design of FIR filters. Write the analytical equations, draw the magnitude response and show the largest side lobe value below the dc magnitude. **(08 Marks)**

b. The frequency response of an FIR filter is given by

$H(\omega) = e^{-j3\omega}(1 + 1.8\cos 3\omega + 1.2\cos 2\omega + 0.5\cos\omega)$

Determine the coefficient of the impulse response h(n) of the FIR filter. **(06 Marks)**

c. Determine the coefficient $K_m$ of the lattice filter corresponding to FIR filter described by the system function $H(z) = 1 + 2z^{-1} + \frac{1}{3}z^{-2}$. And also draw the Lattice structure. **(06 Marks)**

**OR**

6 a. Determine the filter coefficient $h_d(n)$ for the desired frequency response of a Lowpass filter is given by

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

Find h(n) and also frequency response H(w) using Hamming window. **(10 Marks)**

b. Obtain the cascade form realization of system function :

$H(z) = 1 + 5z^{-1} + 2z^{-2} + 2z^{-3}$ **(05 Marks)**

c. Realize the following function in Direct form.

$$H(z) = \left(1 + \frac{1}{2}z^{-1} + z^{-2}\right)\left(1 + \frac{1}{4}z^{-1} + z^{-2}\right)$$ **(05 Marks)**

## Module-4

7 a. Discuss the general procedure for IIR filter design using Bilinear transformation. **(06 Marks)**

b. An analog filter is given by $H_a(s) = \frac{s + 0.1}{(s + 0.1)^2 + 16}$. Obtain digital IIR filter using bilinear transformation method. Digital filter is to have resonant frequency $\omega_r = \frac{\pi}{2}$ radians. **(08 Marks)**

c. Compare FIR and IIR filter. **(06 Marks)**

**OR**

8 a. Design a Butterworth digital low pass filter with the following specifications.

i) 3dB attenuation at the passband frequency of 1.5KHz
ii) 10dB stopband attenuation at the frequency of 3KHz
iii) Sampling frequency of 8000Hz. **(10 Marks)**

b. A system is represented by a transfer function H(z) is given by $H(z) = 1 + \frac{4z}{z - \frac{1}{2}} - \frac{2}{z - \frac{1}{4}}$

i) Does this H(z) represent a FIR or IIR filter? Why?
ii) Draw direct form – I and Direct form – II realization by showing all differences equations? **(10 Marks)**

## Module-5

9 a. Explain IEEE floating point formats using :

i) Single precision format ii) Double precision format. **(08 Marks)**

b. Discuss briefly multiplier and Accumulator unit in Digital signal processor hardware units. **(04 Marks)**

c. Draw the block diagram to TMS320C3X floating point digital signal processor. **(08 Marks)**

**OR**

10 a. With block diagram explain Digital signal processor based on Harvard architecture. **(06 Marks)**

b. Convert the Q-15 signed number to decimal numbers.

i) 1.110101110000010 ii) 0.100011110110010 **(04 Marks)**

c. Explain the basic architecture of TMS320CS54X used in fixed point Digital signal processor. **(10 Marks)**

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