CBCS SCHEME

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18EC52

Fifth Semester B.E. Degree Examination, July/August 2021
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Describe the process of frequency domain sampling and reconstruction of discrete time signal. **(08 Marks)**

b. Find the 4-point DFT of the sequence $x(n) = \{1, 2, 0, 1\}$ using matrix method. **(04 Marks)**

c. Using graphical method (concentric method) obtain 5 point circular convolution of two DFT signal defined as,

$x(n) = (1.5)^n ; \ 0 \le n \le 2$

$y(n) = (2n-3) ; \ 0 \le n \le 3$ **(08 Marks)**

2 a. Compute the 4-point DFT of the given sequence $x(n) = \{0, 1, 2, 3\}$ and verify the result with IDFT method using formula method. **(08 Marks)**

b. Compute the N-point DF of the sequence $x(n) = a^n ; \ 0 \le n \le N-1$. **(04 Marks)**

c. State and prove the following properties :

(i) Circular time shift of a sequence.

(ii) Parseval's theorem. **(08 Marks)**

3 a. Consider a FIR filter with impulse response $h(n) = \{3, 2, 1, 1\}$, if the I/P $x(n) = \{1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$ find the output. Use overlap save method assuming the length of the block is 9. **(10 Marks)**

b. Find the 8 point DFT of the sequence $x(n) = \{1, 1, 1, 1, 0, 0, 0, 0\}$ using DIT – FFT radix – 2 algorithm and draw the signal flow graph. **(10 Marks)**

4 a. Consider a FIR filter with impulse response $h(n) = \{1, 2\}$ and input sequence $x(n) = \{1, 4, 3, 0, 7, 4, -7, -7, -1, 3, 4, 3\}$. Compute y(n) using overlap add technique assuming the length of the block is 5. **(10 Marks)**

b. Derive the computational arrangement of 8-point DFT using Radix-2 DIF-FFT algorithm and draw the signal flow diagram. **(10 Marks)**

5 a. Design a symmetric FIR low pass filter whose designed frequency is given by,

$$H_d(\omega) = \begin{cases} e^{-j\omega\tau} & ; |\omega| \le \omega_C \\ 0 & ; \text{otherwise} \end{cases}.$$

The length of the filter should be 7 and cut off frequency is 1 rad/sec use rectangular window. **(08 Marks)**

b. Determine the direct form realization of the following system function:

$H(z) = 1 + 2z^{-1} - 3z^{-2} + 5z^{-4} - 4z^{-3}$. **(06 Marks)**

c. List the advantages and disadvantages of FIR filters. **(06 Marks)**

6 a. Draw the magnitude response and show the biggest side lobe values for the following windows:
(i) Rectangular window. (ii) Hanning window.
(iii) Hamming window. (iv) Bartlett window **(04 Marks)**

b. The desired frequency response of a low pass filter is given by,

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j3\omega} ; & |\omega| < \frac{3\pi}{4} \\ 0 ; & \frac{3\pi}{4} < |\omega| < \pi \end{cases}$$

. Determine the frequency response of the FIR filter if Hamming window is used with N = 7. **(08 Marks)**

c. Consider an FIR lattice filter with coefficients $K_1 = 0.65$, $K_2 = -0.34$, $K_3 = 0.8$, find its impulse response. Draw the equivalent direct form structure. **(08 Marks)**

7 a. Draw the frequency response curve and write the transformation to convert the analog lowpass prototype into practical analog low pass, high pass, band pass and band stop filters with specified frequency. **(08 Marks)**

b. Realize the following digital filter using a direct form II structure

$$H(z) = \frac{1+0.4z^{-1}}{1-0.5z^{-1}+0.06z^{-2}}.$$ **(04 Marks)**

c. Assuming that T = 2 sec in BLT and given the following points:
(i) $S = -1 + j$, on the left half of the S-plane.
(ii) $S = 1 - j$, on the right half of the S-plane.
(iii) $S = j$, on the positive jw on the S-plane.
(iv) $S = -j$ on the negative jw on the S-plane.

Convert each of these points in the S-plane to the Z-plane and verify the mapping properties. **(08 Marks)**

8 a. Draw and discuss flow chart for IIR filter design using Bilinear transformation. **(04 Marks)**

b. An analog filter is given by,

$$H_a(s) = \frac{3}{(s+3)(s+1)},$$

with T = 1 sec. Obtain H(z) using Bilinear transformation. **(08 Marks)**

c. Draw the Direct form – I and Direct form – II structure for the system given by,

$$H(z) = \frac{z^{-1} - 3z^{-2}}{(10 - z^{-1})(1 + 0.5z^{-1} + 0.5z^{-2})}$$ **(08 Marks)**

9 a. Explain Digital Signal processors using Harvard architecture. **(08 Marks)**

b. Convert the following number in the IEE single precision format to the decimal format:
(i) 110000000.010……0000
(ii) 010000000000…….0000 **(04 Marks)**

c. Explain Fixed-point digital signal processes using basic architecture of TMS320C54X family. **(08 Marks)**

10 a. Explain the following Digital Signal processor hardware units:
(i) Multiplier and Accumulator
(ii) Shifters
(iii) Address Generators. **(09 Marks)**

b. Discuss IEEE Double Precision format. **(07 Marks)**

c. Convert the following Q-15 signed numbers into the Decimal number :
(i) 1110101110000010
(ii) 0100011110110010 **(04 Marks)**

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