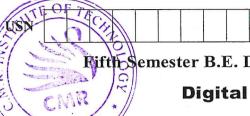
Max. Marks: 100



emester B.E. Degree Examination, Aug./Sept.2020

Digital Signal Processing

Note: 1. Answer any FIVE full questions, selecting at least TWO questions from each part. 2. Use of normalized filter tables not permitted.

PART - A

Define DFT. Derive the relationship of DFT to the Z-transform.

(05 Marks)

Compute the 8-point DFT of the sequence x(n) given by $x(n) = \{1, 1, 1, 1, 0, 0, 0, 0, 0\}$.

Let $x_p(n)$ be a periodic sequence with fundamental period N. Consider the following DFT's, $X_p(n) \stackrel{DFT}{\longleftrightarrow} X_1(K)$

$$x_p(n) \stackrel{\text{DFT}}{\longleftrightarrow} X_3(K)$$

What is the relationship between $X_1(K)$ and $X_3(K)$?

(07 Marks)

State and prove the following properties:

(i) Time Shift Property

(ii) Parseval's theorem

(06 Marks)

= 2ⁿ. Compute the 4-point circular and h(n) b. Given the sequences $x(n) = \cos x$ convolution.

(06 Marks)

Let $x(n) = \{1, 2, 0, 3, -2, 4, 7, 5\}$. Evaluate the following:

(i) X(0)

(08 Marks)

Compute linear convolution of 2 sequences given: 3

 $x(n) = \{1, 2, 0, -3, 4, 2, -1, 1, -2, 3, 2, 1, -3\}$ and $h(n) = \{1, 1, 1\}$

Use overlap-add convolution technique. (10 Marks) (04 Marks)

b. Prove the (i) Periodicity and (ii) Symmetry property of the twiddle factor W_N.

c. In the direct computation of 256-point DFT of x(n), how many

Complex multiplications (i)

Complex additions (ii)

(iii) Real multiplications

(iv) Trigonometric function evaluations, are required.

(06 Marks)

Find the 8-point DFT of the sequence, $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using DIT-FFT radix-2 (10 Marks) algorithm.

b. Find X(2) using Goertzel algorithm for the sequence $x(n) = \{1, 0, 1, 0\}$.

(04 Marks)

Write a short note on Chirp-z transform.

(06 Marks)

PART - B

Compare Butterworth and Chebyshev filter. 5

(04 Marks)

Derive the expression of order and cutoff frequency of a Butterworth low pass filter.

(06 Marks)

- c. Design a Chebyshev-I filter to meet the following specifications:
 - (i) Passband ripple : $\leq 2 \text{ dB}$
 - (ii) Passband edge: 1 rad/sec
 - (iii) Stopband attenuation: ≥20 dB
 - (iv) Stopband edge: 1.3 rad/sec

(10 Marks)

6 a. Draw the block diagrams of Direct form – I, Direct form – II and parallel realizations for a digital IIR filter described by the system function:

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$$
 (12 Marks)

b. Realize the linear-phase FIR filter having the following impulse response,

$$h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$$
 (04 Marks)

- c. Determine the coefficients k_m of the lattice filter corresponding to FIR filter described by the system function, $H(z) = 1 + 2z^{-1} + \frac{1}{3}z^{-2}$. Also draw the corresponding second-order lattice structure. (04 Marks)
- 7 a. Compare FIR and IIR filters.

(06 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 FIR filter if Hamming window is used with N = 7.

(10 Marks)

- c. Mention few advantages and disadvantages of windowing technique.
- (04 Marks)
- 8 a. A digital lowpass filter is required to meet the following specifications.
 - (i) Monotonic passband and stopband
 - (ii) -3.01 dB cutoff frequency of 0.5π rad
 - (iii) Stopband attenuation of atleast 15 dB at 0.75π rad

Find the system function H(z) using Bilinear transformation. Also obtain the difference equation. (14 Marks)

b. Transform the analog filter, $H_a(s) = \frac{s+1}{s^2 + 5s + 6}$ into H(z) using impulse invariant transformation. Take T = 0.1 sec. (06 Marks)
