

Paper / Subject Code: 37002 / DISTRICT TIME SIGNAL PROCESSING

Q. P. Code: 27083

[Time: Three Hours]

[Marks:80]

- 3.: (1) Question No.1 is compulsory.
 (2) Attempt any three out of remaining questions.
 (3) Assume suitable data wherever required.

- 1 a. State Parseval's relation in z-transform. (05)
 b. Assume two finite duration sequences $x_1(n)$ and $x_2(n)$ are linearly combined. Let $x_3(n) = ax_1(n) + bx_2(n)$. What is the DFT of $x_3(n)$? (05)
 c. What is the need for employing window technique for FIR filter design? (05)
 d. What is the need for anti-aliasing filter prior to downsampling? (05)

- 2.a. Design an FIR filter approximating the ideal frequency response (10)

$$H_d(e^{j\omega}) = e^{-j3\omega} \quad \text{for } \frac{-\pi}{4} \leq |\omega| \leq \frac{\pi}{4}$$

$$= 0 \quad \text{for } \frac{\pi}{4} \leq |\omega| \leq \pi$$

Using Hamming window with $N=7$.

- b. Derive the DFT of the sample data sequence $x(n) = \{1, 1, 2, 2, 3, 3\}$ and compute the corresponding amplitude and phase spectrum. (10)

- 3.a. Determine 8 point DFT for a continuous time signal, $x(t) = \sin(2\pi Ft)$ with $F = 50\text{Hz}$ using DIF FFT algorithm. (10)

- b. Design a Butterworth filter using the impulse variance method for the following specifications (10)

$$0.9 \leq |H(e^{j\omega})| \leq 1 \quad 0 \leq \omega \leq 0.3\pi$$

$$|H(e^{j\omega})| \leq 0.1 \quad 0.7\pi \leq \omega \leq \pi$$

- 4.a. Determine the Direct form-I and Direct form-II realization for the system (10)
- $$y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2).$$

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b. A multirate system is shown below in Fig.1. Find the relation between $x(n)$ and $y(n)$.

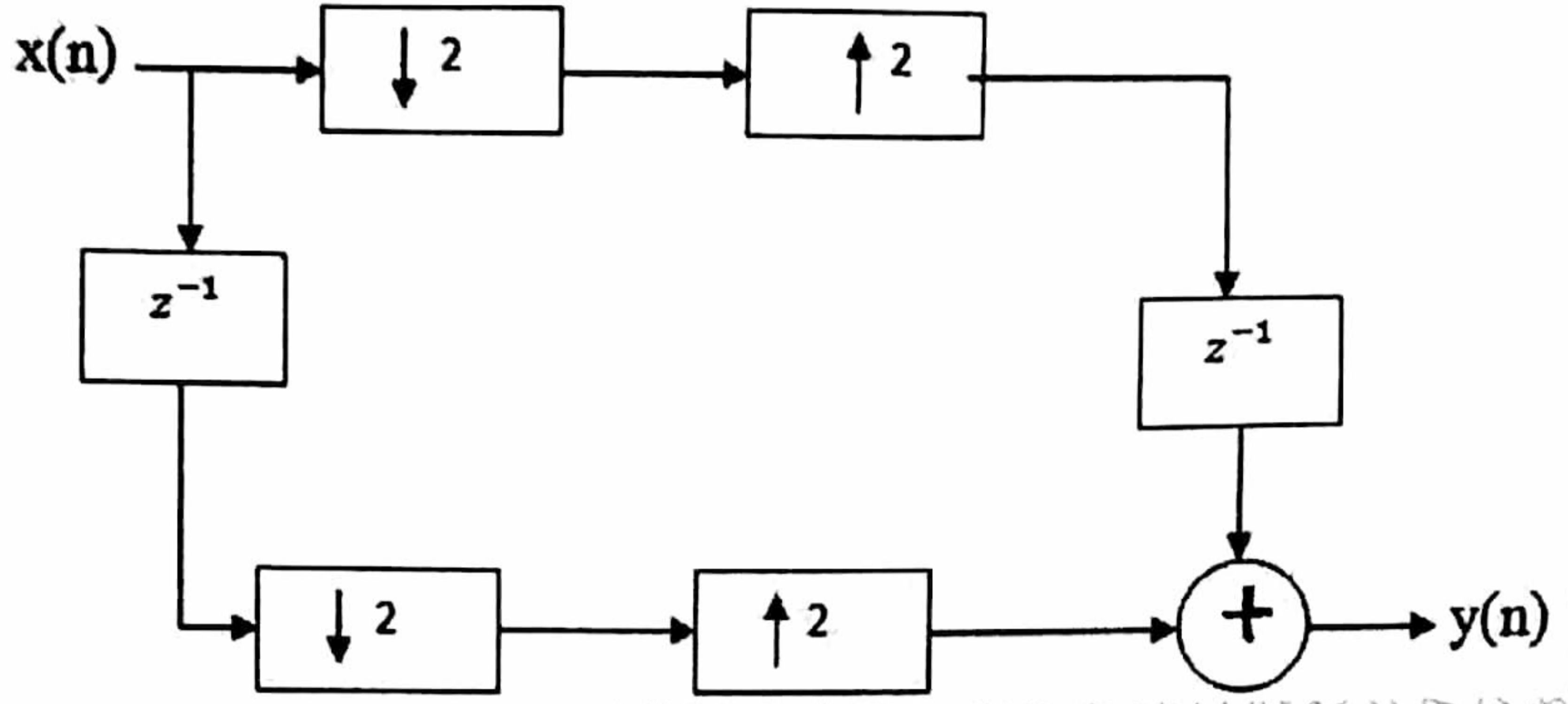


Fig.1

Q.5 a. Determine the periodogram of the random signal by taking 8 samples of the signal

$$x(n) \cos 2\pi f_1 n + \cos 2\pi (f_1 + \Delta f)n, \quad f_1 = 0.2, \quad \Delta f = 0.05.$$

b. The transfer function $H(z) = H_1(z)H_2(z)$ where

$$H_1(z) = \frac{1}{1 - a_1 z^{-1}} \quad \text{and} \quad H_2(z) = \frac{1}{1 - a_2 z^{-1}}$$

Assume $a_1 = 0.5$ and $a_2 = 0.6$, find the output roundoff noise power.

Q.6 Write short notes on following,

- a. Musical Sound Processing.
- b. Dual tone multi frequency signal detection.
- c. Subband Coding of Speech signals.
