

**N.B.: (1) Question No.1 is compulsory.**

**(2) Attempt any three out of remaining questions.**

**(3) Assume suitable data wherever required.**

- Q.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)

- Q.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)

- Q.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)

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

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

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

**[TURN OVER]**

- b. A multirate system is shown below in Fig.1. Find the relation between  $x(n)$  and  $y(n)$ . (10)

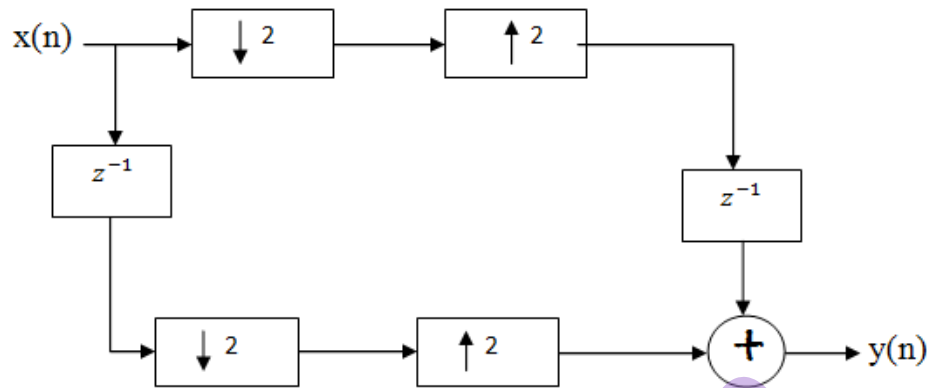


Fig.1

- Q.5 a. Determine the periodogram of the random signal by taking 8 samples of the signal (10)

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

- b. The transfer function  $H(z) = H_1(z)H_2(z)$  where (10)

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

Assume  $a_1 = 0.5$  and  $a_2 = 0.6$ , find the output roundoff noise power. (10)

- Q.6. Write short notes on following,

- Musical Sound Processing. (07)
- Dual tone multi frequency signal detection. (06)
- Subband Coding of Speech signals. (07)

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