

**Two Mark Question and Answers:**

1. List down the various advantages of multirate signal processing.

a) Computational requirements is less. b) Storage for filter coefficient is less. c) Finite arithmetic effect is less. d) Filter order required in multirate application is low.

2. Define sampling theorem.

According to the sampling theorem, a band limited signal  $x(t)$  having finite energy, which has no frequency components higher than  $f_h$  hertz, can be completely reconstructed from its samples taken at the rate of  $2f_h$  samples per sec. ( $f_s \geq 2f_h$ ).  $f_s$  --- sampling frequency ;  $f_h$  --- highest signal frequency.

3. State some applications of DSP?

Speech processing, Image processing, Radar signal processing.

4. What is multirate signal processing?

The theory of processing signals at different sampling rates is called multirate signal processing.

5. What is the need for anti aliasing filter prior to down sampling?

The spectra obtained after down sampling a signal by a factor  $M$  is the sum of all the uniformly shifted and stretched version of original spectrum scaled by a factor  $1/M$ , then down sampling will cause aliasing. In order to avoid aliasing the signal  $x(n)$  is to be band limited to plus or minus  $\pi/M$ . This can be done by filtering the signal  $x(n)$  with a low pass filter with a cutoff frequency of  $\pi/M$ . This filter is known as antialiasing filter.

6. Define down sampling ?

Down sampling a sequence  $x(n)$  by a factor  $M$  is the process of picking every  $M^{\text{th}}$  sample and discarding the rest.

7. What is meant by up sampling? Up sampling by factor  $L$  is the process of inserting  $L-1$  zeros between two consecutive samples. If the spectrum of a sequence  $x(n)$  is  $X(\exp(j\omega))$ , then what is the spectrum of a signal down sampled by factor 2.

$$Y(\exp(j\omega)) = 0.5[X(\exp(j\omega/2)) + X(\exp(j(\omega/2 - \pi)))]$$

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**PART-A**

1. What is twiddle factor?

2. How many stages of decimation are required in the case of a 64 point radix-2 DIT-FFT algorithm?

3. Why is the Butterworth response called a maximally flat response?

4. What is frequency prewarping?

5. What are the features of FIR filter design using the Kaiser approach?