Examples of Quiz 4 question

* Three noble identities are related to the down-sampling operation. Sketch them with block diagrams as in lectures and explain what impact their use has on implementation complexity of a multirate system.

* The filter $H(z) = 8 + 33z^{-1} + 67z^{-2} + 83z^{-3} + 83z^{-4} + 67z^{-5} + 33z^{-6} + 8z^{-7}$ is used as an **anti-alias** filter in a decimator, whose down-sampling factor is 3. Make a polyphase decomposition of the filter and based on that, describe a computationally efficient implementation of the decimator.

* The filter $H(z) = 8 + 33z^{-1} + 67z^{-2} + 83z^{-3} + 67z^{-4} + 33z^{-5} + 8z^{-6}$ is used as an **anti-image** filter in an interpolator, whose up-sampling factor is 3. Make a polyphase decomposition of the filter and based on that, sketch a computationally efficient implementation of the interpolator.

* Provide signal flow graphs of the integrator and comb blocks, which are used to compose Cascaded Integrator-Comb (CIC) filters.

* Describe how efficient interpolation for factor R is implemented when CIC is used for anti-imaging by drawing a block diagram. Assume that a second-order CIC filter (= one with two integrators and two combs) is used with delay D = 2R is used.

* Provide reasons why multirate implementation of a narrowband FIR filter reduces the rate of MAC operations.

* Multirate implementation of a FIR filter. Compared to the single-rate implementation, why multiply-accumulate (MAC) rate of the kernel filter is lower?

* What are the main computational steps in multirate narrowband FIR filter? Explain how does MAC operation rate of these steps change when downsampling factor M is increased (M = 2,3,4,...)?

* Explain the main ideas for using oversampling A/D conversion.

* Oversampling A/D conversion (ADC).

(a)What are the two main operation steps in it?

(b) What advantage does oversampling provide for ADC?