1. Compare the characteristics of different windows (any three).

2. Let \( H(z) = \frac{3z^2 + 5z + 1}{z^2 + 5z + 3} \). It is a
   (a) LPF  (b) HPF  (c) All pass  (d) None

3. Is multi rate system a LTI system or not. Justify.

4. What are ghosts in up sampling? How do you remove them?

5. Explain why re-sampling filters are used.

6. Draw the characteristics of a Nyquist filter.

7. Draw the characteristics of a half band filter.

8. Draw the realization diagram of a recursive all pass filter.

9. Why timing recovery is important in demodulators.

10. What are advantages of multiple stage filter structures?

PART - B (50 Marks)

11.(a) Compare Impulse invariant and Bilinear transformation methods.
    (b) Convert the analog filter \( H(s) \) to digital domain using Impulse invariance method.
        \[ H(s) = \frac{S + 3}{S^2 + 4S + 4} \]

12. Design a FIR equiripple filter of length 3 to have pass band cut off frequency at 500 Hz and a stop band cut off frequency at 200 Hz. The tolerances in pass band and stop band are in the ratio 1:2.

13.(a) Draw the two channel QMF filter bank and explain.
    (b) Design a linear phase FIR low pass filter to meet the following specifications.
        Pass band : 0 to 200 Hz
        Stop band : 220 to 5000 Hz
        Pass band ripple : 0.02
        Stop band ripple : 0.04
        Choose suitable sampling frequency.

14.(a) State and prove noble identities.
    (b) Discuss the applications of square root Nyquist filter.

15.(a) With a mat diagram explain recursive polyphase filters.
    (b) Draw the polyphase diagram for a decimation of 10.

16.(a) What are Comb filters.
    (b) Discuss the applications of Comb filters.

17. Write short notes on any two.
    (a) Hilbert transform