3104   *Your Roll No.* ....

MEE   J

Paper – EE.558

DIGITAL SIGNAL PROCESSING

Time : 3 hours   *Maximum Marks : 100*

(Write your Roll No. on the top immediately
on receipt of this question paper.)

Attempt any **five** *questions.*
All *questions carry equal marks.*

1. Design a FIR digital filter that will reject a very strong
    (60-Hz). Sinusoid, interference Contaminating a
    200 Hz, useful Sinusoidal signal. Determine the gain
    of the filter so that the useful signal does not change
    amplitude. The filter works at a Sampling frequency
    (F_s = 500 Samples/sec). Compute output of the filter
    if the input is a 60 Hz. Sinusoid or a 200 Hz sinusoid
    with unit amplitude.   (20)

2. (a) Write, if the following FIR systems are minimum,
        maximum or mixed phase.

        (i) h(n) = {10, 9, –7, –8, 0, 5, 3}
                    ↑

                                        P.T.O.

   (ii) $h(n) = \{5, 4, -3, -4, 0, 2, 1\}$ (10)
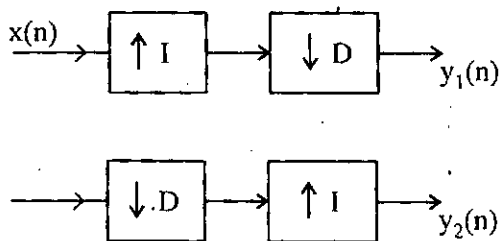 $\uparrow$

(b) Write, why the Comb filter

$$H(Z) = \frac{1}{1 - aZ^{-D}}$$

   can be used as a reverberator ?   (10)

3. Determine the impulse response of a FIR Lattice filter with parameters $K_1 = 0.6$, $K_2 = 0.3$, $K_3 = 0.5$, $K_4 = 0.9$.   (20)

4. consider the two different ways of cascading a decimator with an interpolator shown below :

(a) If $D = I$, show that the outputs of the two configurations are different. Hence, in general the two systems are not identical.   (12)

(b) Show that the two systems are identical if and only if D and I are relatively prime.   (8)

5. · In an Auto-regressive process, $x(n)$ is characterized by the auto-correlation

   Sequence $\gamma_{xx}(0) = 1$, $\gamma_{xx}(1) = \dfrac{1}{2}$, $\gamma_{xx}(2) = \dfrac{1}{8}$ and

   $\gamma_{xx}(3) = \dfrac{1}{64}$.

   Use the Schür algorithm to determine the three reflection co-efficients K_1, K_2 and K_3.   (20)

6. (a) Design the FIR Wiener filter using Levinson-Durbin algorithm.   (10)

   (b) Write the major design differences between the Wiener filter & Deconvolution filters.   (10)

7. Write short note on the following :

   (i) ESPRIT

   (ii) Applications of Adaptive filters

   (iii) LPC

   (iv) Kalman filters   (5×4=20)