Ex/MECE 516/2018

M.TECH. VLSI DESIGN & MICROELECTRONICS TECHNOLOGY EXAMINATION 2018

(2nd Year 2nd Semester)

ADVANCED DIGITAL SIGNAL PROCESSING **Time: Three Hours** **Full Marks: 100**

Answer any ***Five*** questions
All questions carry equal marks

1. a) Show that in Direct Form II structure for general LTI recursive system, the no. of Multiplications and the no. of delay elements are M + N + 1 and max {M,N} respectively where the symbols have their usual significance. 8

   b) Explain with reasons the difference between IIR and FIR filters. 4

   c) Determine the first six samples of the Impulse response of the system shown in Figure -1 and also classify the system. 7 + 1

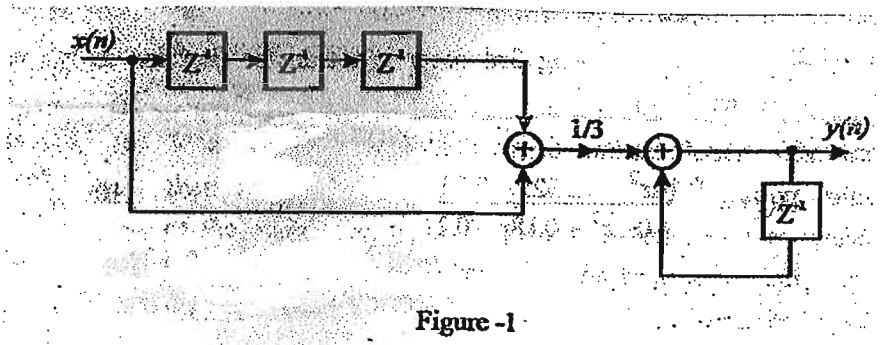

Figure -1

2. a) Realize the system in cascade form having the difference equation

   $y(n) = \frac{3}{4}\, y(n-1) - 1/8\, y(n-2) + x(n) + 1/3\, x(n-1)$ 8

   b) Realize the system in parallel form having the difference equation

   $y(n) = -0.1\, y(n-1) + 0.72\, y(n-2) + 0.7\, x(n) - 0.252\, x(n-2)$ 12

3. a) Derive the Tapped Delay Line implementation of a 5^{th} order FIR filter. 7

   b) Derive also the Transposed version of the structure of Part 'a' and hence show that the two structures are equivalent. 8 + 5

4. a) For an FIR filter of length M = 7 having anti-symmetric impulse response, derive the expression for the frequency response. 5

   b) Repeat Part 'a' for M = 11. 5

   c) Based on the derivations in Part 'a' and Part 'b', derive the general expressions for the magnitude and phase characteristics of the frequency response of the FIR filter. Comment on the phase characteristics. 4 + 3 + 3

5. a) Derive the general equation for determining the zeros of Linear Phase FIR filter. 4

   b) Based on the equation in Part 'a', determine the end-point zeros for all possible cases, with respect to symmetry of the impulse response and filter order. Justify also the potential applications of the filter. 12 + 4

6. a) Derive the expression for the frequency response of N-point Bartlett window. 10

   b) Show that in Bartlett window the first zero occurs at $\omega = 4\pi/(N-1)$. 10

7. A low pass FIR filter is to be designed using Fourier method whose desired frequency response is specified as

$$H_d(e^{j\omega}) = \begin{cases} 1 & -\pi/3 \le \omega \le \pi/3 \\ 0 & \text{elsewhere} \end{cases}$$

   a) Determine the impulse response of the realizable 9^{th} order filter. 10

   b) Derive also the expression for the magnitude response of the filter in part 'a' and sketch it. 8 + 2

8. A band pass FIR filter is to be designed using Rectangular window whose desired frequency response is specified as

$$H_d(e^{j\omega}) = \begin{cases} 1 & 2\pi/3 \geq |\omega| \geq \pi/3 \\ 0 & \text{elsewhere} \end{cases}$$

a) Determine the impulse response of the realizable 11^{th} order filter. 10

b) Derive also the expression for the magnitude response of the filter in part 'a' and sketch it. 8 + 2