**Duration: 3hrs** **[Max Marks:80]**

N.B.: (1) Question No 1 is Compulsory.

(2) Attempt any three questions out of the remaining five.

(3) All questions carry equal marks.

(4) Assume suitable data, if required and state it clearly.

**1** Attempt any **FOUR** **[20]**

a Obtain the linear phase realization of the system function

$$H(z) = \frac{1}{2} + \frac{1}{3}z^{-1} + z^{-2} + \frac{1}{4}z^{-3} + z^{-4} + \frac{1}{3}z^{-5} + \frac{1}{2}z^{-6}$$

b Discuss the properties of Butterworth and type-I Chebyshev filter

c Given H(Z), compute the truncated H'(z) with coefficients represented by 4-bit word length. $H(z) = \frac{1}{z-0.752352}$

d Find the IDIF-FFT for a given sequence X(k)= {26, -2+2j, -2, -2-2j}.

e State the condition for stability and causality of analog and digital filter.

**2** a Design a lowpass filter for the following specification **[10]**
Cutoff frequency=500 Hz ; sampling frequency = 2000 Hz; order of the filter N=10.Use Hamming window to get the impulse response.

b Determine the output response y(n) if h(n)= (1,1,1), x(n)= (1,2,3,1) by using linear convolution, circular convolution & circular convolution with zero padding. **[10]**

**3** a Find the DFT of the sequence x[n] = {1, 2, 3, 4, 4, 3, 2, 1} using radix-2 decimation in time FFT algorithm. **[10]**

b For the analog transfer function $(s) = \frac{2}{s^2+3s+2}$. Determine H(z) using impulse invariant transformation if (a) T=1 second and (b) T=0.1 second. **[10]**

**4** a Determine the impulse response h(n) of a filter having desired response=7, use frequency sampling approach **[10]**

$$Hd(w) = \begin{cases} e^{-j3\omega} & 0 \le |\omega| \le \frac{\pi}{2} \\ 0 & \frac{\pi}{2} \le |\omega| \le \pi \end{cases}$$

b Derive the equation for steady state noise power due to input quantization. **[10]**

**5** a Design a digital Butterworth low pass filter that satisfies the following constraint using BLT. Assume $T = 1\ sec$ **[10]**

$$0.707 \le |H(w)| \le 1 \quad ; \qquad for \quad 0 \le \omega \le 0.5\pi$$

$$|H(w)| \le 0.2 \quad ; \qquad for \quad 0.75\pi \le \omega \le \pi$$

b Determine the zeros of the following FIR systems and identify whether the following system is minimum phase, maximum phase, mixed phase. Also comment on stability. **[10]**

(i) $H_1(z) = 6 + z^{-1} + 6z^{-2}$

(ii) $H_2(z) = 1 - z^{-1} - 6z^{-2}$

(iii) $H_3(z) = 1 - \frac{5}{2}z^{-1} - \frac{3}{2}z^{-2}$

(iv) $H_4(z) = 1 - \frac{5}{2}z^{-1} - \frac{2}{3}z^{-2}$

**6** a Describe echo cancellation and sub-band coding of speech signal. **[10]**

b Obtain the cascade and parallel form realization of the system **[10]**

Y(n)= -0.1y(n-1) +0.2y(n-2) +3x(n)+3.6x(n-1) +0.6x(n-2)

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