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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2017

Electronics and Communication Engineering

1. Applied Electronics And Instrumentation
2. Telecommunication Engineering

01EC6105 Advanced Digital Signal Processing

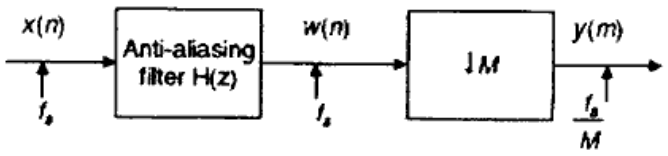
Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. For the given system

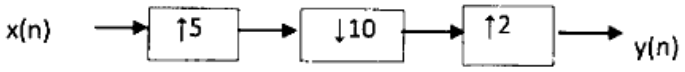


6

Derive an expression for $Y(e^{j\omega})$ in terms of $X(e^{j\omega})$ and explain the need for H(z) Given $x(n) = 5\sin\left(2\pi \times \frac{n}{8}\right) + \cos\left(2\pi \times 2.5\frac{n}{8}\right)$. If the sampling frequency f_s is 8 kHz and M=2, show the spectral components at the output with and without using H(z).

b. Implement a 2 band polyphase decomposition on $H(z)=\frac{1-3z^{-1}}{1+4z^{-1}}$ 3

2. a. For the following multirate system develop an expression for x(n) as a function of y(n)



4

b. Develop computationally efficient realization of factor-of- 3 interpolator employing length-12 linear phase filter using polyphase decomposition 5

3. a. Develop the analysis-synthesis section of a maximally decimated perfect reconstruction two channel QMF filter bank using polyphase implementation with proper derivations. Sketch the implementation. 5

b. If one of the analysis filters $H_0(z)=2+6z^{-1}+z^{-2}+5z^{-3}+z^{-5}$. Find a set of stable synthesis filters that result in perfect reconstruction 4

PART B

4.	a.	Compare the time-frequency tiling of Short Time Fourier Transform (STFT) and Discrete Wavelet Transform (WT).	4
	b.	Prove that the space spanned by scaling function bases is nested and the space spanned by wavelet function bases is orthogonal among themselves	5
5.	a.	If W(a,b) =W_Ψ[f(t)] denotes the continuous wavelet transform of f(t) with respect to Ψ(t) then find the continuous wavelet transforms of $f(t-\tau)$and $f(\frac{t}{\alpha})$ where τ and α are any two real numbers.	4
	b.	Explain the 2 dimensional DWT decomposition of a 512x512 image. Give the filter bank structure	5
6.		From the Haar dilation and wavelet equation derive the filter bank implementation for signal analysis. Show the filter bank structure and the spectrum involved.	9

PART C

7.	a.	Give the steps involved in parametric spectral estimation method.	6
	b.	Explain AR and ARMA models and give expression for power spectrum estimates.	6
8.	a.	Explain the concept of steepest descend algorithm. Give applications	6
	b.	Give the relation between the autocorrelation and power spectral density of the random sequence. Determine the autocorrelation and power spectral density of the random sequence $$x(n) = \sum_{k=1}^{K} A_k \cos(\omega_k n + \phi_k) + w(n)$$ where $\{A_k\}$are constant amplitudes, $\{\omega_k\}$are constant frequencies and $\{\phi_k\}$are mutually statistically independent and uniformly distributed random phases. The noise sequence w(n) is white with variance σ_w^2	6
9.	a.	Give the normal equations for the m-step linear predictor?	6
	b.	Explain how Levinson-Durbin algorithm can be used to solve the normal equations recursively	6