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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch: Electronics and Communication Engineering

Stream(s): **1: Applied Electronics And Instrumentation**

2: Telecommunication Engineering

01EC6105 Advanced Digital Signal Processing

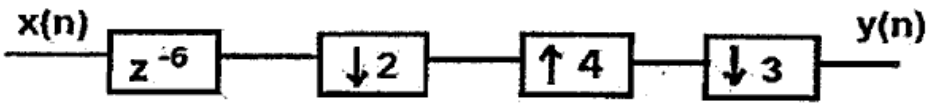
Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. Simplify the given system using identities and find an expression for y(n) in terms of x(n). 5



Also verify the result for the input
$x(n)= \{x_0\ x_1\ x_2\ x_3\ x_4\ x_5\ x_6\ x_7\ x_8\ x_9\ x_{10}\ x_{11}\ x_{12}\}$

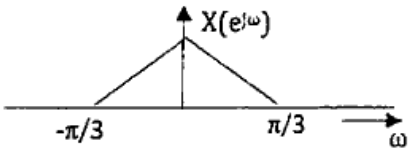
b. Derive the implementation of Uniform DFT filter bank using polyphase decomposition. 4

2. a. Describe polyphase decomposition of a filter function H(z). 7

How polyphase decomposition be used for efficient realization of decimators and interpolators?

b. State the noble identities that help in reduction of multirate systems 2

3. a. Consider the sequence x(n) with $X(e^{j\omega})$ as shown in figure. Let y(n)=x(3n). Plot $Y(e^{j\omega})$. 5



Also show how can we recover x(n) from y(n) using filters and multirate blocks

b. Give the conditions for perfect reconstruction QMF. 4

Draw the computationally efficient realisation of perfect reconstruction QMF using polyphase decomposition.

PART B

4. a. Show the time-frequency tiling of Short Time Fourier Transform (STFT) and Discrete Wavelet Transform (WT). Explain how wavelet transform try to overcome the limitations imposed by Heisenberg's uncertainty principle in time frequency analysis. 5

   b. Write a note on multiresolution analysis. Check whether Haar wavelet can be used for multiresolution analysis. 4

5. a. Prove that the spaces spanned by scaling function bases are nested and the spaces spanned by wavelet function bases are orthogonal among themselves in Haar decomposition 5

   b. A signal in $\mathbf{V_2}$ space is given as x(n)= [4,8,2,-6,2,4,2,6] 4
   Perform Haar decomposition into $\mathbf{V_1, W_1, V_0}$ and $\mathbf{W_0}$ spaces.

6. Find the wavelet coefficients W(a,b) for the signal f(t) for 0<a<1,b>0 . Use Haar wavelet 5

$$f(t) = \begin{cases} 1, & 0 \le t \le 1 \\ 0, & \text{otherwise} \end{cases}$$

   b. How wavelet transform can be used in the compression of image data? Show the filter bank structure for image decomposition. 4

PART C

7. a. Explain LMS algorithm for optimum design of an adaptive filter. Give proper equations and derivations. 6

   b. Explain Periodogram analysis for power spectrum estimation. 6

8. a. Explain Yule-Walker method for Power spectrum estimation. 6

   b. Give the steps involved in Blackman and Tukey method of Power spectrum estimation. 6

9. a. Obtain 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