



Reg. No. : .....

Name : .....

**First Semester M.Tech. Degree Examination, March 2014**  
**(2013 Scheme)**  
**Electronics and Communication**  
**Stream : Signal Processing**  
**TSC 1004 : MULTIRATE SYSTEM AND WAVELETS**

Time : 3 Hours

Max. Marks : 60

**Instruction:** Answer *any two* questions from *each* Module.

MODULE - I

1. Find  $H(z)$  if the configuration in Fig. 1(a) and Fig. 1(b) are equivalent.

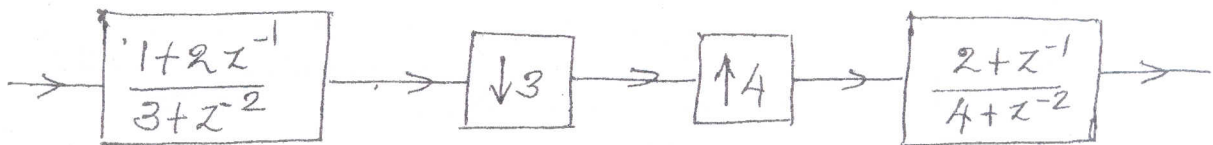


Fig 1(a)

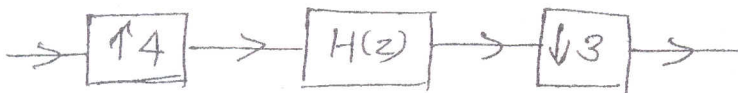


Fig 1(b)

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2. a) Let  $H(z) = (a + z^{-1})/(1 + az^{-1})$ . Write down the expression for the Type 1 polyphase components (with  $\mu = 2$ ).

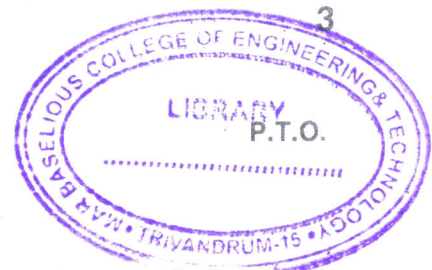
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b) Show the schematics of implementation of the uniform DFT filter bank using polyphase decomposition. What is the advantage of such an implementation ?

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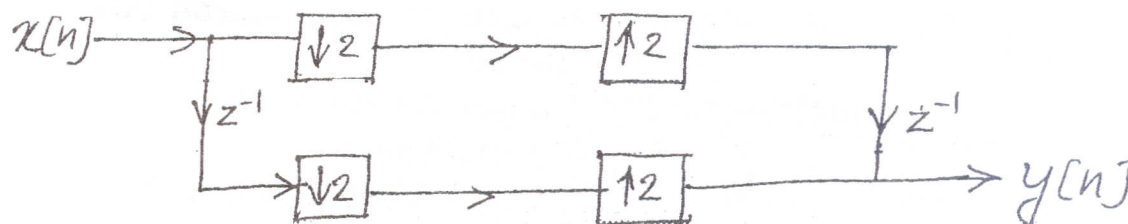
3. a) If a QMF bank is free from aliasing, amplitude distortion and phase distortion, it is said to have the perfect reconstruction. Can you translate this statement as a condition imposed on distortion function  $T(z)$ .

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- b) Show that the two channel filter bank in Fig. 2 is a perfect reconstruction QMF bank. Write the expression for analysis and synthesis filters.



(Hint : Analyse in time domain)

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### MODULE – II

4. a) Sinusoids are useful in analyzing periodic and time-invariant phenomena, while wavelets are well suited for the analysis of transient, time varying signals. State your observations about this statement. 5
- b) A signal  $x(t)$  consists of sinusoids of 500 Hz in the first 20 ms, 2500 in the next 10 ms and sum of two sinusoids of frequencies 1000 Hz and 5000 Hz in the following 10 ms. The value is zero afterwards. If we want to analyze the signal using Windowed Fourier Transform, suggest a suitable window size. Can you graphically depict the frequency domain information obtained. 5
5. Derive the relationship between discrete wavelet transform and filter banks for signal decomposition. 10
6. a) Derive the conditions imposed on filter coefficients due to normality constraint of scaling function (unit area under scaling function). 5
- b) What is double shift orthogonality? 5

### MODULE – III

7. a) What are B splines? 2
- b) Draw the waveform of spline of order 2. 2
- c) Explain it as a combination of scaled version of itself and its translates. 3
- d) Does this belong to an orthogonal wavelet system? Justify your answer. 3
8. a) Assume that the data set  $d = \{5, 2, 1, 0, 1, 2, 3, 5\}$  represent the coefficient, when the signal is expressed in terms of normalized Haar bases in  $V_3$ . Perform wavelet packet analysis using Haar wavelet packets. 7
- b) Suggest an application of wavelet packet analysis. 3
9. a) What do you mean by lifting scheme? 5
- b) How is wavelet transform applied for denoising? 5