

Time:- 3 hrs.

Maximum Marks:- 80

N. B.

1. Q.1 is compulsory.
2. Answer any **three** out of the remaining five questions.
3. Figures to the right indicate marks.
4. Answer to the questions should be grouped and written together.

Q1. Solve **any four** out of five

- a. Show that energy spectral density of signal is equal to Fourier transform of autocorrelation of the signal 5
- b. Explain the need of Wavelet transform. 5
- c. Derive an expression for spectrum of down sampled signal. 5
- d. Explain an adaptive system with a block diagram 5
- e. Describe the adaptive echo cancellation concept with a suitable block diagram 5

- Q2 a. Derive the Perfect reconstruction and alias cancellation condition for the Haar filter bank 10
- b. Explain the Yule-Walker method for AR model parameters 10

- Q3 a. Derive the LMS algorithm and mention its limitations 10
- b. Describe Welch method of determination of power spectrum estimate. State the expressions for Variability, Frequency resolution and Figure of merit. 10

- Q4 a. The transfer function of an FIR filter is given by 10

$$H(z) = 0.2 + 0.7z^{-1} + 0.8z^{-2} + 0.15z^{-3} + 0.6z^{-4} + 0.32z^{-5} + 0.5z^{-6} + 0.4z^{-7} + 0.9z^{-8}$$

Obtain the polyphase decomposition of  $H(z)$  to decompose into (a) 2 sections, and (b) 4 sections

- b. The third-order AR process  $u(n)$  is described by the difference equation 10
- $$u(n) = -0.75u(n-1) - 0.8u(n-2) + v(n)$$

where  $v(n)$  is a zero mean unit variance white process.

Compute the Correlation matrix

- Q5 a. Describe the signal processing algorithms for audio processing. 10
- b. How are ocular artefacts removed from the human EEG signal? Explain with a neat block diagram. 10

Q6 Write short notes on

- a. Bartlett method of Spectrum estimation 5
- b. Short Time Fourier transform 5
- c. Adaptive linear combiner 5
- d. Applications of DSP in the field of Radar 5