

(3 Hours)

Total Marks: 80

- N.B. : (1) Questions No.1 is **compulsory**.  
 (2) Solve any **three** questions out of remaining **five** questions  
 (3) Draw neat labeled diagram whenever necessary  
 (4) Assume suitable data if necessary

- Q.1** Solve any **four** out of five **(5x4)**
- i) Determine the output power spectral density of the system whose impulse response is  $h(n) = 0.5^n U(n)$ . Input to the system is white noise with PSD =  $\sigma^2$
  - ii) Explain an Adaptive System with suitable example.
  - iii) Describe filter bank theory related to wavelet transform.
  - iv) Explain with block diagram the data acquisition system for ECG.
  - v) With mathematical concept explain the generation of reverberation effect synthetically using signal processing.
- Q.2**
- a) Compare Short Time Fourier Transform and Spectrogram with the mathematical concept and plots. **6**
  - b) Describe Welch method for determination of Power Spectrum estimate **6**
  - c) Explain with suitable mathematical approach Steepest-Descent Algorithm (SDA) **8**
- Q.3**
- a) Derive Least Mean Square (LMS) adaptive algorithm. Discuss convergence and stability properties of the LMS algorithm? **12**
  - b) Given that input sequence  $f = [8, 6, 5, 5, 4, 6, 10, 12]$ , find level-1 Haar wavelet transform and verify the result by using its inverse Haar transform. **8**
- Q.4**
- a) Explain with suitable diagram the application of adaptive system for echo cancellation in data transmission over telephone channel. **10**
  - b) Describe how Wavelet transform can be used for signal denoising. Also, discuss hard thresholding and soft thresholding for wavelet based denoising. **10**
- Q.5**
- a) Describe the Multi-Resolution Analysis (MRA)? How Discrete Wavelet Transform (DWT) is used for MRA. **10**
  - b) Explain various pre-processing operations required to perform before analysis of ECG signal with suitable mathematical concepts. **10**
- Q.6**
- a) Describe audio processing for generating chorus effect and flanging effect with block diagram and mathematical concept. **10**
  - b) Explain with the block diagram and algorithm for adaptive removal of Ocular Artefacts from human EEGs. **10**
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