Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.Tech. (BME) DEGREE MAKEUP EXAMINATIONS DEC/J AN 2016-17
SUBJECT: ADVANCED BIOMEDICAL SIGNAL PROCESSING (BME 401)
(REVISED CREDIT SYSTEM)
Friday, 6th January 2017, 2 to 5 PM

TIME: 3 HOURS **MAX. MARKS: 100**

Instructions to Candidates:

1. **Answer any FIVE full questions.**
2. **Draw labeled diagram wherever necessary**

1) (a) For the systems described by the following input output relation, determine whether the system is stable, causal, linear and time invariant. **8**

i) $T\{x(n)\} = \sum_{k=n_o}^{n} x(k)$ ii) $T\{x(n)\} = x(n-n_o)$

iii) $T\{x(n)\} = ax(n)+b$ iv) $T\{x(n)\} = x(-n)$

(b) Starting from the fundamentals, derive an expression for the periodogram spectral estimator. **6**

(c) Which method is used to differentiate between normal and diseased Doppler files? By sketching a neat characteristics, explain the method. **6**

2) (a) Perform convolution of two sequences: $x(n) = \begin{cases} \alpha^n, -2 \le n \le 2 \\ 0, elsewhere \end{cases}$ and $h(n) = \begin{cases} 1, 0 \le n \le 3 \\ 0, elsewhere \end{cases}$ **8**

(b) Compare multiplicative homomorphic filtering with homomorphic deconvolution. What do you understand by phase unwrapping technique? Explain. **6**

(c) How do you separate the components present in a visually evoked signal? Discuss the same with a flow diagram. **6**

3) **(a)** Let $X(e^{j\omega})$ denote fourier transform of the give signal $x(n)$ shown in Fig 3A. Without explicitly finding $X(e^{j\omega})$, find the following: **8**

i) $X(1)$, ii) $\int_{-\pi}^{\pi} X(e^{j\omega})d\omega$, iii) $X(-1)$, iv) $\int_{-\pi}^{\pi} \left|X(e^{j\omega})\right|^2 d\omega$

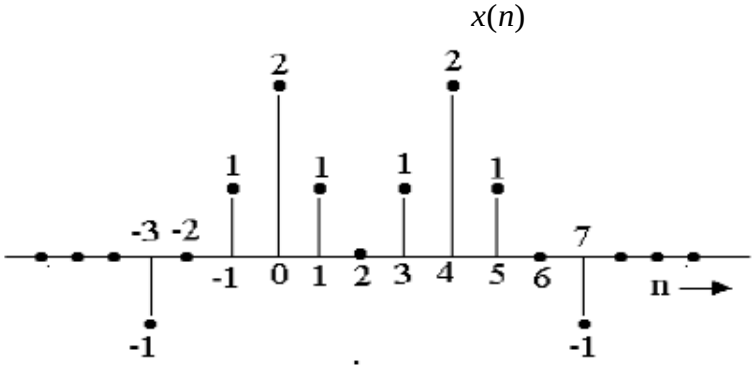

Fig 3A

(b) Explain with an adaptive linear combiner scheme, the least mean square algorithm to minimize the error so that best possible estimate of the desired signal is achieved. **6**

(c) Explain how the adaptive noise canceller is used to enhance the speech intelligibility in hearing impaired children in a school environment, where the required speech signal is buried under the influence of non-stationary interference due to sound pollution. **6**

4) **(a)** Consider the sequence $x(n) = \begin{cases} e^{j\omega_o n} : 0 \le n \le N-1 \\ 0 : otherwise \end{cases}$ and $x(n) = 0 : otherwise$. **8**

i) Find the $N-$point DFT of the sequence.

ii) Evaluate the DFT at $\omega_o = \frac{2\pi k_o}{N}$.

(b) How does adaptive noise canceler help in reducing the noise embedded in the ECG signal? Justify your answer with mathematical description. **6**

(c) What is the need of multi-channel adaptive enhancement scheme, to enhance the visually evoked potentials, acquired from the scalp of the patient? Illustrate with reasons. **6**

5) **(a)** i) Compute the magnitude and phase of the frequency response of the first order discrete time linear shift invariant system given by equation $y(n) - Ay(n-1) = Bx(n)$ where **4+4**

$|A| < 1$

ii) Find the correlation sequence between $p(n) = 4 : -10 < n < 10$ and

$u(n) = 2 : -2 < n < 2$

(b) How can we obtain the linear prediction model coefficients, when the input to the system that caused the EEG signal as its output, is unknown? Interpret the model by formulation in the frequency domain. **6**

(c) How do you analyze the activation wave from His-purkinje system to detect heart defects originating from the "bundle of His"? What is it that the system tracks leading to the better health condition? Explain. **6**

6) **(a)** Consider an ECG signal $x(n)$ with the total no. of samples N = 2000 + 10 (R x R), where R = your Roll Number. Write a program in MATLAB to obtain the cepstrum of $x(n)$ and recover $h(n) \& u(n)$.. **8**

(b) What is the significance of using an adaptive autoregressive moving average method based on least mean square algorithm to track changes in biomedical signals, whose frequency spectra are characterized by sharp peaks and deep valleys? Justify your answer with suitable structure. **6**

(c) The Autoregressive modeling is used to evaluate the condition of human lung and to estimate the source and transmission characteristics that would lead to early diagnosis of pleural effusion and emphysema. Justify this with a suitable scheme. **6**