Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
(A Constituent Institute of Manipal University)
Manipal – 576 104

FIRST SEMESTER M.Tech (BME) DEGREE END-SEM EXAMINATIONS, NOV/DEC 2015
SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 505)
Saturday, December 5, 2015 (2.00 p.m. - 5.00 p.m.)

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

Instruction to Candidates:

Answer any FIVE full questions.
Assume relevant data if missing.
Give diagrams 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) How do you estimate the power spectrum density (PSD) of a given signal based on Welch's method? Discuss the advantages of Welch's method over the Bartlett method in estimating the PSD of a given signal. 6

   (C) i) Prove that the Fourier transform of autocorrelation sequence associated with periodic signals gives the power spectral density. 6

   ii) Explain the technique for extracting QRS complex, based on successive differentiation.

2. (A) Let $X(e^{j\omega})$ denote fourier transform of the give signal $x(n)$ shown in Fig 2A. 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) $\int_{-\pi}^{\pi} \left|X(e^{j\omega})\right|^2 d\omega$

   (B) Visually evoked responses are recorded from a patient having seizure. How do you identify the segment corresponding to seizure - activity from the normal EEG? Describe the method. 6

   (C) Consider speech samples from a female uttering the vowels. Use spectral analysis followed by a suitable linear filter to separate at least three constituents of the samples. 6

3. (A) Consider the sequence $x(n)=\begin{Bmatrix} e^{j\omega_o n} : 0 \le n \le N-1 \\ 0 : otherwise \end{Bmatrix}$ 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) What role does adaptive line enhancer play in the enhancement of visually evoked potentials? Justify with a modified adaptive scheme. 6

(C) How effective is adaptive line enhancer in eliminating the respiratory artifact from an electro-gastric signal? Explain with a specific adaptive scheme. 6

4. (A) An input to a linear shift invariant system is $x(n)=\left(\frac{1}{3}\right)^n u(n)+2^n u(-n-1)$, and the corresponding output is $y(n)=5\left(\frac{1}{3}\right)^n u(n)-5\left(\frac{2}{3}\right)^n u(n)$. Find the transfer function, and the impulse response of the system. Find the difference equation that satisfies the given output and the input relation. 4+4

(B) How different is adaptive noise canceler in comparison with adaptive line enhancer? Justify your answer by describing both, with respect to the least mean square algorithm. 6

(C) Take the case of an operation theatre in a hospital. The ECG signal is buried under the influence of non-stationary interferences. Illustrate with a schematic diagram, a procedure for enhancing of the ECG signal. 6

5. (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) How do you estimate the autoregressive parameters, when there are slow changes in the spectra of a physiological signal? Explain with mathematical terms. 6

(C) Which is the method employed in the analysis of diastolic heart sounds to detect coronary artery disease non-invasively? Give suitable explanation. Draw the spectrum for patients and normal subjects. Interpret the results. 6

6. (A) a) Find even and odd parts associated with each of the following signals: 8

i) $x(n) = u(n)$ and ii) $x(n) = \delta(n)$

b) Determine whether the following signals are "energy signals" or "power signals": i) $x(n) = u(n)$, ii) $x(n) = 2e^{jn}$

(B) How do you interpret the ECG signal based on methods involving decision logic, and the typical feature extraction method? Explain. 6

(C) Discuss the various features of the following bio-electric signals: 6

i) Electromyogram, ii) Electroencephalogram and iii) Vibroarthrogram

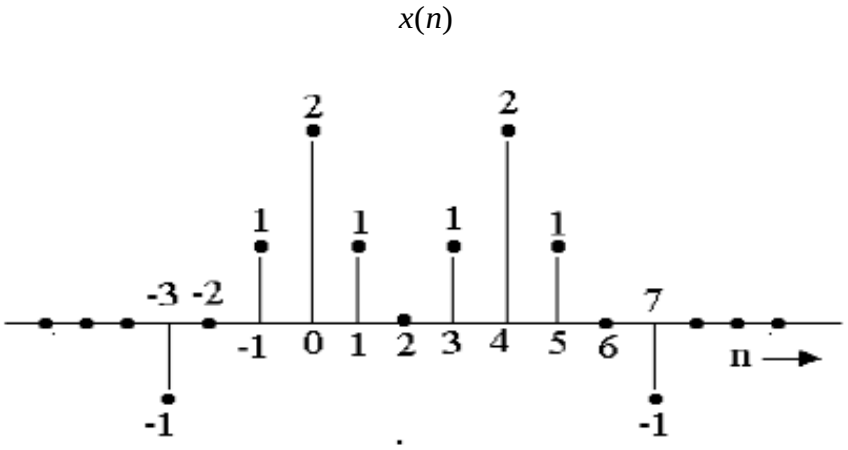

Fig 2A