Reg.	No.
LLCE.	1 1 0 0



MANIPAL INSTITUTE OF TECHNOLOGY

(A Constituent Institute of Manipal University) Manipal – 576 104



8

VII SEMESTER B.Tech (BME) DEGREE MAKE-UP EXAMINATIONS, DEC/JAN. 2015-16 SUBJECT: ADVANCED BIOMEDICAL SIGNAL PROCESSING (BME 401) Saturday, January 9, 2016 (2.00 p.m. - 5.00 p.m.)

Instruction to Candidates:

TIME: 3 HOURS

MAX. MARKS: 100

Answer any FIVE full questions. Assume relevant data if missing. Give diagrams wherever necessary.

1. (A) i) Determine whether or not the system $y(n) = \sum_{k=-\infty}^{\infty} x(k)x(n+k)$ is linear, shift invariant, stable and causal.

ii) Sketch the even and odd parts of the following signal: x(n) = u(n). Also express the result using the impulse function.

- (B) How different is the Welch's method in comparison with the Bartlett method in estimating the PSD of a given signal? Justify your answer with mathematical explanation.
- (C) Which method is used to differentiate between normal and diseased Doppler 6 files? By sketching a neat characteristics, explain the method.
- 2. (A) Determine the step response of a linear shift invariant system whose 8 impulse response is $h(n) = a^{-n}u(-n): 0 < a < 1$
 - (B) Compare multiplicative homomorphic filtering with homomorphic 6 deconvolution. What do you understand by phase unwrapping technique? Explain.
 - (C) Consider speech samples of female voice, uttering the vowels. Use complex 6 spectrum followed by homomorphic filter, to separate any three constituents of the samples.

- 3. (A) i) Find the correlation between the sequences: x(n) = u(n) - u(n-6) & h(n) = u(n-2) - u(n-5)ii) Determine N – point circular convolution of $x_1(n) \& x_2(n)$. $x_1(n) = x_2(n) = 1$; $0 \le n \le N - 1$
 - (B) How does adaptive noise canceler help in reducing the noise embedded in the 6
 ECG signal? Justify your answer with mathematical description.
 - (C) What is the role played by the adaptive line enhancer adopted in the modified 6 adaptive filter scheme to enhance visually evoked potentials? What are the advantages and disadvantages associated with the modified filter scheme? Provide the exact structure with description.
- 4. (A) A linear shift invariant system has an impulse response 4+4h(n) = u(n). Determine the response of this system to the input:

i)
$$x(n) = 0: n < 0$$

ii)
$$x(n) = a^n : 0 \le n \le N_1$$

iii)
$$x(n) = 0: N_1 < n < N_2$$

- iv) $x(n) = a^{n-N_2} : N_2 \le n \le N_2 + N_1$
- (B) What is the role played by autoregressive model to analyze lung sounds in order to estimate the source and transmission characteristics? Explain with a neat sketch.
- (C) What are the advantages of parametric methods over the fourier based 6 methods in analyzing the diastolic heart sounds? Justify.
- 5. (A) Find the four-point circular convolution of the sequences 8 $h(n) = \begin{cases} 1, n = 0, 1, 2, 3\\ 0, else \end{cases} \text{ and } x(n) = \begin{cases} 1, n = 0\\ 2, n = 1\\ 3, n = 2, 3\\ 0, else \end{cases}$

- (B) Why is adaptive autoregressive method based on recursive least square 6 algorithm used to track changes in biomedical signals? Provide mathematical explanation.
- (C) How do adaptive line enhancer and adaptive noise canceler help in enhancing 6
 electro-gastric signal? Explain with a neat adaptive scheme.
- 6. (A) Explain with an adaptive linear combiner scheme, the least mean square
 8 algorithm to minimize the error so that best possible estimate of the desired signal is achieved.
 - (B) Obtain autoregressive moving average model from the transfer function of a linear prediction model. Provide the difference equation with suitable scheme.
 - (C) 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.