Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY
(A constituent unit of MAHE, Manipal 576104)

VII SEM B. Tech (BME) DEGREE END SEMESTER EXAMINATIONS, NOVEMBER 2019.

SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 4101)
Thursday 21st November 2019: 2 to 5 PM

TIME: 3 HOURS   MAX. MARKS: 50

Instructions to Candidates:

1. Answer ALL questions.
2. Draw labeled diagram wherever necessary

1A.	Consider an ECG signal with power line interference at 60 Hz and comprising of odd harmonics at 180 Hz, 300 Hz and 420 Hz. Let the sampling frequency be 1 KHz. Design a frequency domain filter to remove the periodic artifact. Assume the absence of any aliasing error.	4
1B.	What are the advantages of RLS algorithm over the LMS algorithm? Consider VAG signal with muscle contraction interference as reference. Design an adaptive RLS filter that provides the least squares estimate of the signal of interest.	6
2A.	Compare the two homomorphic processes that helps in separating the components present in a composite signal. Provide detailed block diagram of the processes with mathematical expressions.	5
2B.	How does the Pan-Tompkins algorithm detect the QRS complexes from the ECG signal? Representing the various steps in the form of block diagram, explain the purpose of each step with mathematical reasoning.	5
3A.	What are the measures of waveform complexity that may be used to analyze the event of variability in the case of samples of EMG or PCG signals? Express each one of them in mathematical terms with a brief explanation.	5
3B.	How does the search back technique in Pan-Tompkins algorithm help to detect the missed RR intervals? Also explain the role of adaptive thresholding in the detection of R peaks.	5

4A. 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.

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4B. What is the process of obtaining the averaged periodogram when we are given only one signal record of finite duration? Provide mathematical explanation.

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4C. What is the linear prediction approach to detect cartilage pathology, of patients with and without knee injuries during physical activity? Explain with a suitable block diagram.

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5A. 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.

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5B. A model is described by the difference equation:

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$$y(n) = -0.5y(n-1) - y(n-2) + x(n) + 0.5x(n-1) - x(n-2)$$

   i. What is the type of this system (among AR, MA and ARMA systems)?

   ii. What is the model order?

   iii. What is the transfer function?

   iv. Draw the pole-zero diagram of the system.

   v. Is the system stable? Give reason.