Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

I SEM M. Tech (BME) DEGREE END SEMESTER EXAMINATIONS NOV-DEC 2018

SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 5103)

(REVISED CREDIT SYSTEM)

Saturday, 24th November 2018: 2:00 PM to 5:00 PM

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to Candidates:

1. **Answer all questions.**
2. **Draw labeled diagram wherever necessary.**

1A. How Bartlett method is different from Welch method in estimating the power spectral density? Mathematically arrive at the power spectral density estimate using the Bartlett method. 3

1B. Compare multiplicative homomorphic filtering with homomorphic deconvolution. What do you understand by phase unwrapping technique? Explain. 3

1C. Consider the periodic sequences $x_p(n)$ & $h_p(n)$ with period $N = 4$. 4

$x_p(n) = 1, n = 1, n = 2$ & $x_p(n) = 0$, *elsewhere*

$h_p(n) = n + 1,\ 0 \le n \le 3$ & $h_p(n) = 0$, *elsewhere*

Determine the output $y_p(n) = x_p(n) \otimes h_p(n)$ using both i) graphical discrete time circular convolution and ii) DFT method

2A. 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. 3

2B. A model for a signal is described by the relationship $y(n) = x(n) + 0.5x(n-1) + 0.25x(n-2)$, where $x(n)$ is the input and $y(n)$ is the output. 3

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.

Comment on the stability of the system.

2C. A causal LSI system has the impulse response $h(n)$, for which the z-transform is $H(z) = \frac{1+z^{-1}}{(1-\frac{1}{2}z^{-1})(1+\frac{1}{4}z^{-1})}$ Determine the impulse response of the system. Is the system stable? 4

3A. Derive time series models based on the transfer function of a predictive system. Draw the respective signal flow diagrams with respective difference equations 3

3B. In what way the time sequenced adaptive filter structure helps in enhancing the fetal ECG in an ECG monitoring system? Explain with a proper structure. 3

3C. How does the least mean square algorithm minimize the error so that best possible estimate of the desired signal is obtained? With an adaptive linear combiner scheme, provide mathematical explanation. 4

4A. What role does adaptive filter play in enhancing the speech intelligibility of a hearing impaired child? Explain with a proper structure. 3

4B. How do you separate the components present in a speech signal? Discuss the same with a flow diagram. 3

4C. 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 time domain. 4

5A. Which algorithm is best suited to detect the QRS complex from an ECG signal? Describe the same with suitable sketches and neat diagrams. 5

5B. What is the role played by autoregressive moving average modeling method in analyzing diastolic heart sounds to help in detecting the coronary artery disease? With necessary spectrum plots and pole models, explain the method. 5