Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

VII SEM B.Tech (BME) DEGREE END SEMESTER EXAMINATIONS, NOV/DEC 2018.

SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 4101)
(REVISED CREDIT SYSTEM)
Saturday, 24th November, 2018, 2 to 5 PM

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

Instructions to Candidates:

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

1. a) Design a time-domain filter to remove random noise with zero mean and variance σ_n^2 in a biomedical signal if there is a possibility of acquiring multiple realizations of the signal or event of interest. 4

   b) Design an optimal filter to remove noise $\eta(n)$ from a signal $x(n) = d(n) + \eta(n)$, given that the desired signal $d(n)$ and noise processes $\eta(n)$are independent, stationary random processes. You may assume that the "desired" characteristics of the uncorrupted signal are known. The noise characteristics may also be assumed to be known. 6

2. a) Consider a biomedical signal with power-line interference at $f_0 = 60Hz$ and with a sampling frequency of $f_s = 1\,kHz$. Design a frequency domain filter to remove this periodic artifact. 5

   b) Design a derivative based time domain filter to remove baseline drift in the ECG signal. 5

3. a) Draw a block diagram representing various steps in the Pan-Tompkins method to detect QRS complex in ECG signals. Explain the purpose and nature of each step in the procedure. 4

   b) Explain the adaptive thresholding used in Pan-Tompkins algorithm to detect R-peaks. 3

   c) Explain the search back technique in Pan-Tompkins algorithm to detect missed RR-intervals. 3

4. a) Design a homomorphic filter to separate two that have been combined through the convolution operation. 5

   b) Describe a frequency-domain approach (Coherence analysis) to study the presence of rhythms in multiple channels of EEG signals. 5

5. a) Investigate the effect of the distribution of energy over the time axis on a signal's characteristics. Propose measures to parameterize the effects using the minimum phase correspondent and signal length. 5

   b) Investigate the Bias properties of the Periodogram Spectral Estimate. 5