Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

VII SEM B.Tech (BME) DEGREE MAKE-UP EXAMINATIONS, DEC/JAN 2018-19

SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 4101)

(REVISED CREDIT SYSTEM)

Thursday, 27th December, 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 in a biomedical signal given only one realization of the signal or event of interest. (4M)

   b) Design a 5th order IIR Low pass digital filter for a cut off frequency $f_c = 40Hz$ and with a sampling frequency of $f_s = 200Hz$ using Bilinear transformation to remove high frequency artifact with minimal loss of signal components. Consider analog Butterworth Low pass filter design for the given specifications. (6M)

2. a) Consider a biomedical signal with power-line interference at $f_0 = 60Hz$ and odd harmonics at 180 Hz, 300 Hz and 420 Hz. Let the sampling frequency $f_s = 1\ kHz$. Assume the absence of any aliasing error. Design a frequency domain filter to remove this periodic artifact. (5M)

   b) Design an optimal filter (the adaptive noise canceler) to remove noise or interference $\eta(n)$ from a signal $x(n) = d(n) + \eta(n)$, given that the desired signal $d(n)$ and noise processes $\eta(n)$are uncorrelated, non-stationary random processes. The filter should continuously adapt to the changing characteristics of the signal and interference. (5M)

3 Design a matched filter to detect spike-and-wave complex in an EEG signal. Assume a reference spike-and-wave complex is provided. (10M)

4. a) Design a homomorphic filter to separate the modulated signals. (5M)

   b) Design the correlation based method to detect the presence of the α – rhythm in an EEG channel. How it would be extended to detect the presence of the same rhythm simultaneously in two EEG channels. (5M)

5. a) Formulate the amplitude demodulation algorithm to extract the envelope of a biomedical signals such as EMG or PCG signals. (5M)

   b) Investigate the Variance properties of the Periodogram Spectral Estimate. (5M)