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MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

VII SEMESTER B. Tech. (BME) DEGREE MAKE-UP EXAMINATIONS DEC/JAN 2019-20

SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 4101)

(REVISED CREDIT SYSTEM)

Thursday, 26th December 2019: 2 PM to 5 PM

TIME: 3 HOURS

MAX. MARKS: 50

Instructions to Candidates:

Answer ALL questions.
Draw labeled diagram wherever necessary

- 1A. A typical ECG signal is expected to be band-limited to 120 Hz, with significant 4 components of interest up to 60 Hz. But, the signal is contaminated with a periodic artifact having fundamental frequency of 60 Hz and significant third and fifth harmonics. This signal is sampled at 240 Hz without pre-filtering. What kind of filter will be of help to remove the artifact?
- 1B. How does the adaptive noise canceller works with the least mean square algorithm, to 6 remove a non-stationary interference from a non-stationary signal.
- 2A. Considering the evoked response signals, how does the homomorphic filter separate 5 the components present in those signals? Explain with mathematical terms.
- 2B. What is the purpose of Pan-Tompkins algorithm pertaining to ECG signal? Represent 5 the various steps of the algorithm in the form of block diagram and explain the each step with mathematical terms.
- 3A. In what way the ECG waveform is analyzed and how does the fourier domain 5 algorithm help to obtain the envelopes of PCG?
- 3B. Describe the coherence analysis method to study the presence of rhythms in multiple 5 channels of EEG signals.

- 4A. Starting from the fundamentals arrive at the periodogram. Obtain the expected value 4 of the periodogram using the Bartlett window.
- 4B. Why averaging of periodogram is necessary? Provide the necessary solution in the 3 form of mathematical proofs.
- 4C. What is the linear prediction approach to detect fetal breathing movements from the 3 recordings of maternal and abdominal movements? Describe the method with necessary block diagram and waveforms.
- 5A. How can we obtain the linear prediction model coefficients, when the input to the 5 system that caused the EEG signal as its output, is unknown? Provide a suitable mathematical solution.
- 5B. A model is described by the relation: y(n) = x(n) + 0.5x(n-1) + 0.25x(n-2) 5
 - 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.