

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

I SEM M. Tech (BME) DEGREE MAKE UP EXAMINATIONS DEC/JAN 2018-19 SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 5103) (REVISED CREDIT SYSTEM) Thursday, 27th December 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. Obtain the expected value of the PSD estimator with respect to rectangular data 3 window.
 - 1B. How does the homomorphic filter separate the components present in a composite 3 signal? Explain
 - 1C. A linear shift invariant system has an impulse response h(n) = u(n). Determine the 4 response of this system to the input:
 - i) x(n) = 0: n < 0
 - ii) $x(n) = a^n : 0 \le n \le N_1$
 - iii) $x(n) = 0: N_1 < n < N_2$
 - 2A. How Weiner filter helps to remove noise from a given biomedical signal? 3 Mathematically provide the proof.
 - 2B. Find the correlation between the two sequences: x(n) = u(n) - u(n-6) & h(n) = u(n-2) - u(n-5)
 - 2C. The system function of a causal linear shift invariant system is $H(z) = \frac{1 z^{-1}}{1 + \frac{3}{4}z^{-1}}$.

The input to this system is $x(n) = \left(\frac{1}{3}\right)^n u(n) + u(-n-1)$

- i) Find the impulse response of the system.
- ii) Determine the output of the system.

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- 3A. What are the advantages of parametric methods over the Fourier based methods in 3 analyzing the diastolic heart sounds? Justify.
- 3B. In what way the multi-channel adaptive filter structure helps in enhancing the EEG 3 signals? Explain with a proper structure.
- 3C. How does the least mean square algorithm minimize the error so that best possible 4 estimate of the desired signal is obtained? Briefly explain the gradient descent method.
- 4A. What role does adaptive filter play in enhancing the ECG in an operation theatre 3 environment? Explain with a proper structure.
- 4B. How do you separate the components present in an auditory evoked potential 3 signal? Discuss the same with a flow diagram.
- 4C. Obtain the linear prediction model coefficients, when the input to the system that 4 caused the EEG signal as its output, is unknown?
- 5A. What is that suitable technique used to interpret an ECG signal, to determine the 5 status of the subject under observation? Explain.
- 5B. What are the typical characteristics of the knee vibration signal, observed over a long duration? What approach would you adopt, to analyze such a signal? Describe the approach in detail.