



Name :
Roll No. :
Invigilator's Signature :

CS / B. TECH (BME) / SEM-7 / BME-701 / 2010-11

2010-11

BIOSIGNAL PROCESSING

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$
 - i) The AZTEC algorithm converts raw ECG samples into
 - a) lines and dots
 - b) dots and plateaus
 - c) points and curves
 - d) slopes and plateaus.
 - ii) For $h(n)$ in adaptive filter to converge to its optimal value h_{opt} is
 - a) $1 < \mu < R$
 - b) $0 < \mu < 1$
 - c) $0 < \mu < 1/R$
 - d) $1 < \mu < 1/R$.



iii) Gain of an ECG amplifier is

- a) 100
- b) 10×10^4
- c) 1000
- d) 10^6 .

iv) SNR of an EMG DAQ after averaging is

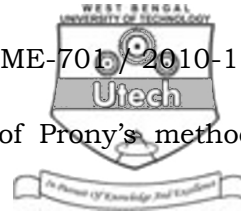
- a) \sqrt{m}
- b) $\sqrt{m}SNR_0$
- c) $\frac{\sqrt{m}}{SNR_0}$
- d) $\frac{SNR_0}{\sqrt{m}}$.

v) How many stages can be classified for human sleep ?

- a) 2
- b) 3
- c) 6
- d) 7.

vi) EEG signal is a typical example of

- a) Biphasic signal
- b) Monophasic signal
- c) Random signal
- d) Deterministic signal.



vii) p -term complex exponential model of Prony's method comprises α_K , which represents

- a) Sampling factor b) Damping factor
c) Phase factor d) None of these.
- viii) BPF used in analysis of evoked potential using Prony's method is having a bandwidth of
- a) 0.01-100 Hz b) 1-50 Hz
c) 0.1-30 Hz d) 10-200 Hz.
- ix) PRD is a numerical measure of
- a) Percentage root mean-square difference
b) Predicted root detection
c) Predicted root mean-square difference
d) percentage root error detection.
- x) CORTES algorithm is a combination of
- a) TP + TP b) TP + AZTEC
c) AZTEC + AZTEC d) None of these.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is homomorphic system ? Draw a block diagram of Mel Bank filtering. 2 + 3
3. What are the differences between Simple high speed and High speed method of QRS detection ? What is the heart-beat rate if R peaks are detected at 45th & 165th samples when an ECG signal is sampled at 200 samples per second ? 2 + 3
4. Draw Markov chain from the following matrix T_1 :

$$\begin{matrix}
 0 & \frac{1}{2} & \frac{1}{4} \\
 \frac{1}{2} & \frac{1}{2} & 0 \\
 \frac{1}{3} & \frac{1}{3} & \frac{1}{3}
 \end{matrix}$$

5. Construct a flow graph from the AZTEC data set
 $\{ 1, 3, 2, -4, -3, 5, -2, -2, 1, 0 \}$
6. After applying CORTES algorithm to a signal, the saved array is $\{ 4, 10, 8, 5, **8, 12, 5, -10, -20, -5, ***10, 50 \}$, where ** is the mark separating AZTEC data from TP and *** is the mark separating TP from AZTEC. Assume distance between TP values as 2 time units.



- a) Reconstruct the signal waveform
- b) What is the peak-to-peak amplitude of the signal reconstructed from the data ?
- c) What is the amount of data compression achieved ?

$$2 + 1\frac{1}{2} + 1\frac{1}{2}$$

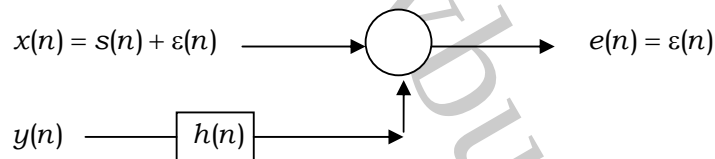
7. What is AR process ? Obtain the Yule Walker equation in AR process.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

- 8. a) Design an adaptive filter noise canceller model for filtering foetal ECG from mother's ECG. 6
- b) Consider the adaptive filter with weight as given below :



Write an expression for $E\{e^2(n)\}$.

Determine the theoretical optimal value of h that minimizes the mean square error. Assume that $\epsilon(n)$ is not correlated to $s(n)$ and $y(n)$. 4 + 5



9. a) Give a schematic representation of ECG signal acquisition with specifications. How can we detect QRS complex using template cross correlation method ? 5 + 5
- b) How can you separate EMG from baseband noise ? 5
10. What is the shortcoming of Prony's method for analysis of large sampled signal ? How this shortcoming has been overcome ? 3 + 12
11. a) Describe the Markov model and Markov chain. What is the simple Markov chain ? 9
- b) Describe the properties of Linear Prediction Theory. 6
12. Describe AZTEC data compression technique with a flow-chart. What are the advantages of this technique ? 12 + 3



13. Write short notes on any *three* :

3 × 5

- a) CORTES algorithm
- b) Data compression by DPCM
- c) LMS adaptive filtering
- d) Homomorphic Deconvolution
- e) Automata based template matching.

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