

**Eighth Semester B.E. Degree Examination, May/June 2010**  
**Biomedical Signal Processing**

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting  
at least TWO questions from each part.**

**PART – A**

- 1 a. Explain the following biomedical signals. Draw the waveforms and give the frequency ranges relevant to these signals:
  - i) ECG
  - ii) EEG

(08 Marks)
- b. With the help of a block diagram, explain the objectives of biomedical signal analysis.
 

(06 Marks)
- c. Explain three difficulties encountered in biomedical signal analysis and acquisition.
 

(06 Marks)
- 2 a. Starting from mesh equations of potential differences between the limbs RA, LA and LL, derive the expressions for  $aV_R$ ,  $aV_L$  and  $aV_F$ . Also represent relationships between these standard and augmented leads voltage.
 

(08 Marks)
- b. What are the two types of electrodes used in ECG? Which of them is popular? Why?
 

(06 Marks)
- c. Draw a diagram to illustrate the electrode placements for the frank VCG lead system. Also write the resistor network for combining the body surface potential to produce the three time varying scalar leads of the frank VCG lead system.
 

(06 Marks)
- 3 a. If the output sequence of a digital filter is  $\{1, 3, 2\}$  in response to a unit impulse, what is the transfer function of this filter? Draw the poles and zeroes of this transfer function mentioning the ROC.
 

(08 Marks)
- b. What are the advantages of digital filters over analog filters? Explain.
 

(06 Marks)
- c. The z-transform of a filter is  $H(z) = \frac{1}{4}(1 + 2z^{-1} + z^{-2})$ . What is its (i) amplitude response, (ii) phase response, (iii) difference equation?
 

(06 Marks)
- 4 a. With a block diagram and relevant expressions, explain LMS algorithm used in noise cancelor model.
 

(08 Marks)
- b. What are the advantages of adaptive filters? List the applications of biomedical clinical origin for using the adaptive filters.
 

(06 Marks)
- c. What are the difficulties encountered in capturing ECG of an unborn child? How to solve these difficulties?
 

(06 Marks)

**PART – B**

- 5 a. Show that signal averaging improves the SNR by a factor of  $\sqrt{m}$ , where m is the number of sweeps considered.
 

(08 Marks)
- b. Under what noise conditions will signal averaging fail to improve the SNR?
 

(06 Marks)
- c. In a signal averaging application, the amplitude of uncorrelated noise is initially 16 times as large as the signal amplitude. How many sweeps must be averaged to give a resulting signal-to-noise ratio of 4 : 1?
 

(06 Marks)

- 6 a. Using the TP algorithm, select the samples to be stored from the data:  
{15, 10, 6, 7, 5, 3, 7, 7, 10, 12}  
Explain the relevant mathematical and logical equation and also show the table for choosing the samples. (08 Marks)
- b. Explain the meaning of lossless and lossy data compression. List the algorithms under both these methods. (06 Marks)
- c. With an example, illustrate modified Huffman coding. (06 Marks)
- 7 a. With the help of a diagram of an ECG signal with tokens and of state transition diagram, explain automata based template matching of QRS detection. (08 Marks)
- b. With the help of a block diagram showing various filters involved, explain the analysis of the ECG signal. (06 Marks)
- c. In a moving window integrator of the QRS detection algorithm, how should the width of window be chosen? What are the effects of choosing a window width that is too large or too small? Explain with the help of a diagram. (06 Marks)
- 8 a. With a block diagram explain the portable arrhythmia monitor. (08 Marks)
- b. Describe the differences between a general purpose microprocessor and DSPs. (06 Marks)
- c. Define the following terms: (06 Marks)
- i) Parallel processing
  - ii) Bit serial processing.

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