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## MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

## I SEM M.Tech (MI) DEGREE END-SEMESTER EXAMINATIONS, JAN 2023.

SUBJECT: Medical Information Analysis (BME 5171) (REVISED CREDIT SYSTEM) Tuesday, 10<sup>th</sup> January, 2022, 2 to 5 PM

## **TIME: 3 HOURS**

MAX. MARKS: 50

Marks

## **Instructions to Candidates:**

Answer ALL questions.
Draw labeled diagram wherever necessary

No. Question

- 1. a) A biomedical signal is bandpass filtered to the range 0 150 Hz. Assume the filter to be ideal and assume any distribution of spectral energy over the bandwidth of the signal. (i) what is the minimum frequency at which the signal should be sampled to avoid aliasing error? (ii) A researcher samples the signal at 500 Hz. Draw a schematic representation of the spectrum of the sampled signal. (iii) Another researcher samples the signal at 200 Hz. Draw a schematic representation of the spectrum of the spectrum of the sampled signal. (iii) and (iii).
  - b) Explain how one may apply ensemble averaging and temporal (time) averaging procedures to process ECG signals. Identify applications of both types in ECG. (5)
- a) Draw a block diagram representing various steps in the Pan-Tompkins method to detect QRS complexes in ECG signals. Explain the purpose and nature of each step in the procedure, including detection of the peaks in the output corresponding (5) to the QRS complexes. (*No equations are required in your answer*)
  - b) You have been hired to develop a software package for the analysis of 10-channel EEG signals to detect the spike-and-wave complexes of a prespecified shape in any channel. Design signal processing package to address this problem by providing the following details: (i) A schematic block diagram representing the various signal processing steps that you recommend. (ii) Explain each block with a reason or logic behind your recommendation. (5)
- 3. a) Explain step-by-step to obtain an averaged periodogram when you are given only (5) a single record of duration.

b) Filter the following image using a 3x3 neighborhood averaging filter by assuming zero padding



c) A 2x2 image has the pixel values  $\begin{bmatrix} 7 & 2 \\ 4 & 0 \end{bmatrix}$ . Compute parallel-ray projections of the image at 0° and 90° (2)

4.

a) For the image shown in figure, evaluate and plot the histograms before and after the histogram equalization where L = 8

4	1	3	2
3	1	1	1
0	1	5	2
1	1	2	2

(4)

b) Compute the inverse 2D DFT of the transform coefficients given by

- c) Justify how does a set of projections at different viewing angles relate to the Fourier transform of an object (2)
- a) Determine the length of the shortest path from (i) (1, 1) to (5, 3) (ii) (1, 6) to (3, 1) using (a) 4-connectivity and (b) 8-connectivity (4)
  - b) Explain a step by step description of the Fourier method for reconstructing an (4) image from its projections
  - c) Given a discrete sequence  $f(m,n) = (m+n)^2$ , Solve  $f(m,n)\delta(m-1,n-1)$  (2)