

## VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.C.E.) VII-Semester Main &amp; Backlog Examinations, Dec.-23/Jan.-24

## Biomedical Signal Processing (PE-IV)

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

| Q. No.                           | Stem of the question  | M | L | CO | PO | PSO |
|----------------------------------|---|---|---|----|----|-----|
| 1.                               | A random variable X is uniformly distributed between 3 and 15. Find the variance of X   | 2 | 1 | 1  | 1  | 3   |
| 2.                               | The power spectral density of a random process x(t) is given by<br>$S_{xx}(w) = \begin{cases} \Pi & \text{if }  w  < 1 \\ 0 & \text{elsewhere} \end{cases}$ Find its auto correlation function. | 2 | 3 | 1  | 2  | 3   |
| 3.                               | Classify data compression techniques and list the features of each technique  | 2 | 2 | 2  | 1  | 3   |
| 4.                               | Explain the property of DCT that is suitable for data reduction   | 2 | 2 | 2  | 1  | 3   |
| 5.                               | What are the artifacts present in ECG signal? How are they removed?   | 2 | 2 | 3  | 1  | 3   |
| 6.                               | What are the advantages of Adaptive noise canceller over fixed noise canceller?   | 2 | 4 | 3  | 2  | 3   |
| 7.                               | What do you mean by Spike and Wave rhythm in EEG signals?   | 2 | 1 | 4  | 1  | 3   |
| 8.                               | Explain the limitations of signal averaging.  | 2 | 2 | 4  | 2  | 3   |
| 9.                               | Write the different types of signal modeling techniques.  | 2 | 2 | 5  | 2  | 3   |
| 10.                              | What are the 4 stages of sleep pattern?   | 2 | 2 | 5  | 1  | 3   |
| <b>Part-B (5 × 8 = 40 Marks)</b> |   |   |   |    |    |     |
| 11. a)                           | Illustrate the relation among the probability, probability cumulative distribution function and probability density function of a continuous random variable.                                   | 4 | 3 | 1  | 2  | 3   |
| b)                               | Discuss briefly the correlation in time domain. Explain the significance of cross-correlation of biomedical signals recorded simultaneously   | 4 | 2 | 1  | 2  | 3   |
| 12. a)                           | Describe Different QRS Detection Techniques and compare them?   | 4 | 2 | 2  | 1  | 3   |

|        |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|
| b)     | Explain why the data reduction techniques based on Huffman coding are 'Lossless'. For the given dataset { a,a,a,a,b,b,b,b,c,c,c,d,d,e}, derive the code words for the data using Huffman coding. What is the average code word length and reduction ration? | 4 | 3 | 2 | 2 | 3 |
| 13. a) | Enlist different types of cardiac arrhythmia's. How are the arrhythmia's detected from ECG signal   | 4 | 2 | 3 | 2 | 3 |
| b)     | Analyze the multiple reference noise canceller used in Fetal ECG enhancement with neat waveforms and block diagram.   | 4 | 3 | 3 | 1 | 3 |
| 14. a) | Derive the Yule walker equation for spectral estimation.  | 4 | 4 | 4 | 2 | 3 |
| b)     | Explain how signal averaging increases the SNR as a function of number of sweeps?   | 4 | 1 | 4 | 1 | 3 |
| 15. a) | For the AR process of the order two $x(n) = a_1 x(n-1) + a_2 x(n-2) + w(n)$ . Where $a_1$ and $a_2$ are constants $w(n)$ is a white noise process of zero mean and variance . Calculate the mean and autocorrelation of $x(n)$ .                            | 5 | 4 | 5 | 2 | 3 |
| b)     | Describe the characteristics of different stages of sleep in terms of frequency, voltage levels   | 3 | 2 | 5 | 2 | 3 |
| 16. a) | Discuss power spectral density analysis? How do you find the noise bandwidth and noise figure of a system?  | 4 | 1 | 1 | 2 | 3 |
| b)     | Draw and analyze the flowchart for AZTEC Algorithm  | 4 | 3 | 2 | 2 | 3 |
| 17.    | Answer any <b>two</b> of the following:   |   |   |   |   |   |
| a)     | Obtain the equation for the LMS adaptive filter? Explain any one application of this filter.  | 4 | 4 | 3 | 2 | 3 |
| b)     | Explain the analysis of evoked potentials.  | 4 | 1 | 4 | 2 | 3 |
| c)     | Discuss the method for modeling the signals with exponential components.  | 4 | 2 | 5 | 2 | 3 |

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

|      |                               |     |
|------|-------------------------------|-----|
| i)   | Blooms Taxonomy Level – 1     | 20% |
| ii)  | Blooms Taxonomy Level – 2     | 40% |
| iii) | Blooms Taxonomy Level – 3 & 4 | 40% |

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