Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY/ JUNE 2025

Date: 03-06-2025 **Time:** 09:30 am – 12:30 pm

School: SOE	**Program:** B. Tech ECE	
Course Code: ECE3035	**Course Name:** Biomedical Signal Processing DEV	
Semester: VI	**Max Marks**: 100	**Weightage:** 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	24	26	26	24	-

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	How is signal envelope extraction helpful in diagnosing neurological disorders from EEG signal?	**2 Marks**	**L2**	**CO3**
2.	How does autoregressive modeling help in signal prediction?	**2 Marks**	**L2**	**CO4**
3.	What causes the P-wave in an ECG signal?	**2 Marks**	**L2**	**CO1**
4.	List any two distinguishing features between EEG and EMG signals.	**2 Marks**	**L1**	**CO1**
5.	Compare the frequency ranges of ECG, EEG, and EMG signals.	**2 Marks**	**L2**	**CO2**
6.	What are the applications of the Envelogram in biomedical research?	**2 Marks**	**L2**	**CO3**
7.	Explain the need for amplification in the acquisition of bio-signals.	**2 Marks**	**L2**	**CO2**
8.	Explain the use of autocorrelation in analyzing EEG rhythms.	**2 Marks**	**L2**	**CO4**
9.	Why is adaptive filtering preferred in removing motion artifacts?	**2 Marks**	**L2**	**CO2**
10.	Why FFT is very popular in biomedical signal processing applications?	**2 Marks**	**L2**	**CO3**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	During a clinical study, a biomedical engineer faces several obstacles while acquiring blood pressure signals. What are the primary challenges associated with accurate BP signal recording, and in what ways can these issues affect the reliability and precision of the data collected?	**10 Marks**	**L3**	**CO1**
		Or			
12.	**a.**	Photoplethysmography (PPG) is commonly used in wearable devices to monitor cardiovascular health. Explain the principle of PPG and explain the challenges faced during PPG signal acquisition, particularly with motion artifacts, and suggest potential solutions to mitigate these issues.	**10 Marks**	**L3**	**CO1**

13.	**a.**	EMG signals are used to monitor muscle activity and diagnose neuromuscular conditions. Describe the origin of EMG signals and explain how they are used to measure muscle activity. Explain the characteristic features of EMG signals and their relevance in diagnosing various muscle and nerve-related disorders.	**10 Marks**	**L3**	**CO1**
		Or			
14.	**a.**	Respiration rate is an important physiological parameter used to monitor respiratory health. Explain the origin of respiration signals and explain how respiratory rate is measured from bio-signals. Describe the characteristic patterns in respiration signals and explain their significance in diagnosing respiratory conditions.	**10 Marks**	**L3**	**CO1**

15.	**a.**	A signal x[n] = [1, 2, 2, 3, 4, 2, 1, 0, 1, 3, 3, 2, 3, 2, 3] is given in discrete-time form. Use a 4-point moving filtering technique to smooth the signal. Compute the filtered sequence and visualize both the original and the processed signal using a discrete-time plot to demonstrate the noise-smoothing effect.	**10 Marks**	**L3**	**CO2**
		Or			
16.	**a.**	You are tasked with designing an appropriate filter to enhance Photoplethysmogram (PPG) signals for biomedical applications. As a biomedical engineer, what key considerations must be addressed during filter design (e.g., noise sources, frequency range, and real-time performance)? Explain a concise methodology for developing and implementing this filter in PPG signal processing.	**10 Marks**	**L3**	**CO2**

17.	**a.**	Mr. Smith is developing a system to improve the quality of bio-signals affected by noise. He is evaluating the use of a Wiener	**10 Marks**	**L3**	**CO2**

		filter for this purpose. Describe the working principle of the Wiener filter and explain why it is effective for signal denoising. Also, highlight its practical benefits and potential drawbacks.			
		Or			
18.	**a.**	Mr. David is developing a signal processing solution aimed at analyzing signals with minor but continuous changes. To ensure optimal filtering, he must select the most appropriate time-domain filtering technique. Which filtering method would best suit this application? Provide justification for your choice and explain how well it maintains the essential features of the original signal.	**10 Marks**	**L3**	**CO2**
19.	**a.**	In the process of collecting bio-signals from patients of different genders, what challenges arise due to biological and physiological differences? Explain in brief the process followed for data collection of human subjects.	**20 Marks**	**L4**	**CO3**
		Or			
20.	**a.**	The Pan-Tompkins algorithm is a popular method for detecting QRS complexes in ECG signals, especially in real-time applications. Describe the step-by-step process of the Pan-Tompkins algorithm with the help of a suitable diagram. How does the algorithm ensure reliable detection of QRS complexes even in the presence of noise? Explain potential limitations when dealing with poor-quality signals and suggest possible strategies to overcome them.	**20 Marks**	**L4**	**CO3**
21.	**a.**	Parametric modeling of biomedical systems is crucial for understanding signal behavior. How do models like Autoregressive (AR), Autocorrelation, and ARMA contribute to accurate prediction and analysis of biomedical signals, and what are their limitations in real-world applications?	**20 Marks**	**L4**	**CO4**
		Or			
22.	**a.**	In biomedical signal processing, different models like Autoregressive (AR), Autoregressive Moving Average (ARMA), and Autocorrelation are used to understand and predict signals such as EEG or ECG. Compare these three models by explaining how they work, how well they predict signals, and where they are used. Explain how each model handles noisy data, changing signals, and complex signal patterns. Give examples and explain the advantages and disadvantages of each model in practical healthcare situations	**20 Marks**	**L4**	**CO4**