

Assignment: ECG Signal Processing and Analysis

Objective:

Analyze real-world ECG signal data and apply biomedical signal processing concepts to understand heart activity, signal noise, and system interactions.

Instructions:

- Answer all questions with detailed explanations and justifications.
- Use graphs, tables, and statistical analyses where applicable.
- Submit a report along with MATLAB/Python code for signal analysis and visualization.

1. Data Exploration

- Load the ECG dataset and display the first five rows. Identify the key signal parameters available.

2. ECG Signal Behavior Analysis

- Plot the raw ECG signal over time. Identify and annotate the P, Q, R, S, and T wave points in the ECG signal.
- What trends do you observe using FFT(Fast Fourier Transform)/ Spectrum Analysis.
- Calculate the average heart rate (BPM) based on detected R-peaks.

3. Feature Extraction and Correlations

- Extract RR intervals and plot their distribution.
- Analyze the effect of noise (e.g., PLI (POWER LINE INTERFERENCE 50 HZ/ 60HZ) on the ECG signal.
- What trends do you observe using FFT(Fast Fourier Transform)/ Spectrum Analysis?

4. Noise Reduction and Signal Processing

- Apply a notch filter (50/60Hz) to remove PLI and high-frequency noise. Compare the filtered and unfiltered signals.
- Suggest additional methods to enhance ECG signal quality in real-time applications.
- What trends do you observe using FFT(Fast Fourier Transform)/ Spectrum Analysis.
- Calculate the mean and standard deviation of ECG amplitudes Before and after added noise.

5. Practical Implementation (Answer in Brief)

- If you were designing a real-time ECG monitoring system, what logic would you use to detect arrhythmias?
- How can ECG signal features be used to predict cardiovascular diseases?
- Discuss the potential of wearable ECG devices for continuous health monitoring.

Submission Requirements

- A detailed report with answers, All graphs including FFT, and explanations.
- MATLAB/Python code (if applicable) for ECG analysis and visualization.
- Recommendations on improving real-time ECG signal monitoring systems.