QPC: RN23PHD402 AY 23 Reg. No

# GIET UNIVERSITY, GUNUPUR – 765022

Ph.D. (First Semester) Examinations, January – 2024

## 23SPPEEC1012 - Biomedical Signal Processing

(ECE)

Time: 3 hrs Maximum: 70 Marks

**The figures in the right hand margin indicate marks.**

**Answer ANY FIVE Questions** **(14 x 5 = 70 Marks)**

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| 1.a. | Discuss the role of biomaterials in electrode design for bio-physiological sensing. How does the choice of biomaterial affect signal quality and biocompatibility? | 7 |
| b. | What are some practical challenges in using body surface electrodes for electrocardiography (ECG) and electromyography (EMG) applications? How can these challenges be addressed? | 7 |
| 2.a. | Explain the role of Fourier analysis in biomedical signal processing. How does it help in understanding the frequency components of bio-signals? | 6 |
| b. | Explain the principles of signal conditioning in the context of bio-signal acquisition. How do analog-to-digital converters (ADCs) and digital-to-analog converters (DACs) play a role in the process? | 8 |
| 3.a. | Describe the significance of time-frequency analysis in the context of diagnosing and monitoring medical conditions. Provide practical examples of its applications in healthcare. | 7 |
| b. | How does the coherent treatment of various biomedical signal processing methods contribute to signal classification and noise reduction? Provide real-world applications to illustrate the concept. | 7 |
| 4.a. | Discuss the challenges in analysing non-stationary signals in the biomedical context. How can spectral analysis techniques be adapted to handle such signals effectively? | 6 |
| b. | Discuss the concepts of correlation and regression in the context of analysing bio-signals. How do these statistical techniques help in medical research and diagnosis? | 8 |
| 5.a. | Explain the analysis of chaotic signals and their relevance in biomedical signal processing. Provide examples of bio-signals that exhibit chaotic behaviour. | 7 |
| b. | What are the various types of bio-signals, and how do their origins differ? Discuss the parameters that are diagnostically significant for each type. | 7 |
| 6.a. | Define Principal Component Analysis (PCA) and explain its application in biomedical signal processing. Provide examples of how PCA can be used to extract meaningful information from bio-signals. | 7 |

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| b. | Discuss the advantages of wavelet analysis, specifically time-frequency analysis, in processing bio-signals. Provide examples of bio-signals where wavelet analysis is particularly useful. | 7 |
| 7.a. | Describe the significance of Independent Component Analysis (ICA) in separating and identifying independent sources within bio-signals. Provide practical examples of its applications in healthcare and research. | 7 |
| b. | Compare and contrast the acquisition of bio-signals using body surface electrodes, internal electrodes, and microelectrodes. Highlight the practical considerations and challenges for each type of electrode. | 7 |
| 8.a. | Provide a detailed overview of the computational methods for extracting diagnostically significant parameters from bio-signals using Fourier and wavelet analysis. | 8 |
| b. | Define signal classification and discuss its importance in biomedical signal processing. How is it used to distinguish between signals and noise? | 6 |

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