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**GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR  
(GIET UNIVERSITY)**

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

**23SPPEEC1013– 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)    Marks**

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| 1.a. | Explain the process of acquisition and generation of bio-signals. Provide examples of different bio-signals and discuss their diagnostic significance.   | 8  |
| b.   | Provide an in-depth explanation of motion artifacts in bio-signal acquisition. How can these artifacts be minimized or corrected in signal processing?   | 6  |
| 2.   | 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.      | 14 |
| 3.a. | Describe the electrode-electrolyte interface and its importance in bio-signal acquisition. Discuss the factors that can lead to electrode polarization.  | 7  |
| b.   | Explore the array of electrodes and microelectrodes. How are they used in specialized applications such as neural signal recording and mapping?  | 7  |
| 4.   | 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?             | 14 |
| 5.a. | Explain the role of Fourier analysis in biomedical signal processing. How does it help in understanding the frequency components of bio-signals?   | 7  |
| b.   | Provide a detailed overview of the computational methods for extracting diagnostically significant parameters from bio-signals using Fourier and wavelet analysis.   | 7  |
| 6.a. | Explain the concept of spectral analysis for deterministic and stationary random signals. Provide examples of each type of signal and describe their spectral characteristics.                                     | 7  |
| b.   | Discuss the challenges in analyzing non-stationary signals in the biomedical context. How can spectral analysis techniques be adapted to handle such signals effectively?  | 7  |
| 7.   | 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. | 14 |
| 8.a. | Explain the analysis of chaotic signals and their relevance in biomedical signal processing. Provide examples of bio-signals that exhibit chaotic behavior.  | 7  |
| b.   | 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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