DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
PROGRAMME: B. TECH (Minor in Cognitive Science)
COURSE TITLE: An Introduction to Neuroimaging Techniques and EEG

Course Category: Minor Degree **Internal: 50 Marks**
Course Code: HSMCS 304 **Theory 50 Marks**
Credits 3 (L-03, T-00) **Total: 100 Marks**
Semester: 6th **Time: 3 Hrs.**

Course Objectives

This course delves into the theory and practice of analyzing neural time series data, focusing on cognitive electrophysiology. The course covers topics such as time-domain analyses, frequency-domain analyses, connectivity analyses, statistical procedures, and recommendations for reporting results.

Instructions for Examiner

The number of questions to be set will be five, at least one from each unit. The examinees will be required to attempt all five questions. All questions shall carry equal marks.

Unit I: Foundations and Introductions

Introduction to Cognitive Electrophysiology. Advantages and limitations of Electroencephalography (EEG) and Event-related potentials (ERPs). Temporal resolution, Spatial resolution, precision, and accuracy of EEG.

Unit II: Pre-Processing and Time-domain Analysis

EEG preprocessing, Filtration, Epoch, Baseline subtraction, Referencing. Trial rejection, Independent components analysis (ICA) for removing artifacts, Surface Laplacian for cleaning, Topological localization.

Unit III: Time-Frequency Domain Analysis

Convolution, Morlet wavelets, Inter-trial phase clustering. Total, phase-locked and non-phase-locked power. Wavelet convolution, Hilbert transform, Band-pass filtering and the filter-Hilbert method, Short-time Fourier transform.

Unit IV: Connectivity and Statistical Analysis

Introduction to EEG connectivity, Volume conduction, Time and Trial-based connectivity, Phase-based connectivity analyses, Power-based connectivity analyses. Introduction to Statistics, Permutation-based statistics, Multiple comparisons and their corrections, Group-level analyses, Avoiding circular inference.

Course Outcomes

This course provides students with the knowledge and skills necessary to analyze EEG neural time series data effectively, advancing their understanding of cognitive electrophysiology and its applications in research.

Suggested Readings

1. Cohen, M. X. (early 2014). *Analyzing Neural Time Series Data: Theory and Practice*. MIT Press.
2. Cooper, R., Osselton, J. W., & Shaw, J. C. (2014). *EEG technology*. Butterworth-Heinemann.
3. Nidal, K., & Malik, A. S. (Eds.). (2014). *EEG/ERP analysis: methods and applications*. Crc Press.
4. Sanei, S., & Chambers, J. A. (2013). *EEG signal processing.* John Wiley & Sons.