DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
PROGRAMME: B. TECH (Minor in Cognitive Science)
COURSE TITLE: Introduction to Brain Computer Interface and Application

Course Category: Minor Degree	**Internal: 50 Marks**
Course Code: HSMCS 401	**Theory 50 Marks**
Credits 3 (L-03, T-00)	**Total: 100 Marks**
Semester: 7th	**Time: 3 Hrs.**

Course Objectives

This course introduces Brain-Computer Interface (BCI) technology. Subsequent modules cover BCI components, types, applications in animals and humans, both medical and non-medical, various BCI technologies, and prospects.

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: Introduction to BCI

Basic Neuroscience, Neurons, Action Potentials. Recording Signals from the Brain, Stimulating the Brain. Invasive Techniques, Noninvasive Techniques, Simultaneous Recording and Stimulation, Multielectrode Arrays, Neurochip, BCI Technology.

Unit II: Understanding Brain Function and Signal Processing

Brain's functions, Signal Acquisition, Frequency Domain Analysis, Time Domain Analysis, Wavelet Analysis. Feature Extraction, Classification, Types of Classifiers. Applications of BCI, Challenges Faced During Implementation of BCI.

Unit III: Types of BCI

Invasive BCIs in Animals, BCIs for Prosthetic Arm and Hand Control. Invasive BCIs in Humans, Cursor and Robotic Control Using a Multielectrode Array Implant, Cognitive BCIs. Noninvasive BCIs, EEG BCIs, Oscillatory Potentials and ERD, Stimulus-Evoked Potentials, BCIs Based on Cognitive Tasks. Other Noninvasive BCIs: fMRI, MEG, and fNIR.

Unit IV: Application of BCI technology

Medical Applications, Sensory Restoration, Motor Restoration, Cognitive Restoration, Rehabilitation, Restoring, Brain-Controlled Wheelchairs. Nonmedical Applications, Web Browsing and Navigating Virtual Worlds, Robotic Avatars, Lie Detection.

Course Outcomes

By the end of this course, students will have a comprehensive understanding of BCI technology, its applications, challenges, and prospects, enabling them to contribute effectively to this exciting field.

Suggested Readings

1. Wolpaw, J. R. (2013). Brain–computer interfaces. In *Handbook of clinical neurology* (Vol. 110, pp. 67-74). Elsevier.

2. Nam, C. S., Nijholt, A., & Lotte, F. (Eds.). (2018). *Brain–computer interfaces handbook: technological and theoretical advances*. CRC Press.

3. Wolpaw, J. R., Millan, J. D. R., & Ramsey, N. F. (2020). Brain-computer interfaces: Definitions and principles. *Handbook of clinical neurology*, *168*, 15-23.

4. Clerc, M., Bougrain, L., & Lotte, F. (Eds.). (2016). *Brain-computer interfaces 2: technology and applications*. John Wiley & Sons.