

ANNEXURE I

Course Name: Certificate Course in Brain Behavioural Cognitive Neuroscience

Course Objective: By the end of this course, students will be able to:

1. Define and explain key concepts in brain behavioral cognitive neuroscience with on fundamentals of brain structure and function
2. Understanding on functional specifications for human behaviour and simultaneously the human brain processing.
3. Exploring multidisciplinary aspects of neuroscience, psychological, physiology, Philosophy, cognitive science, healthcare, education, forensic and computer science
4. Develop and apply machine learning algorithms to classify cognitive states and assess cognitive performance using multimodal physiological data.

Course Prerequisite:

- **Education:** Any Engineering, Science, Statistics, (10+2+3/ 10+2+4) OR higher qualification
- **Experience:** Basic familiarity with neuroscience. Elementary knowledge of python, statistics and machine learning concepts is desirable.
- **Course Outcome:** We will delve into the underlying principles of these physiological signals, examine their relationship to various cognitive functions, and explore advanced methods for analysing and interpreting these signals for cognitive assessment applications in Exploring multidisciplinary aspects of neuroscience, psychological, physiology, cognitive science, healthcare, education, forensic and computer science

Course Duration: 80 Hrs (8 hours/ day for 2 Weeks)

Course Outline:

S. No.	Course Modules	Duration (Hrs)
1	Introduction and History of Brain Behavioural Neuroscience Structure and Function of the Nervous System	08
2	Applications and Methods in Behavioural Cognitive Neuroscience	08
3	Cognitive basis of functions i.e. Sensation, Perception, Attention and Consciousness, Control, logic, learning & Language;	08
4	Multidisciplinary aspects of behaviour related to anthropology, psychological, physiological, Philosophical and computational science	08
5	Basic of Python programming for Data Analysis	08
6	Data Preparation and Pre-processing EEG Data for Cognitive Assessment	08
7	Machine Learning for Multimodal Cognitive Assessment	08
8	Modelling and Evaluation of Cognitive Assessment Systems	08
9	Project: Developing a Comprehensive Cognitive Assessment System	16
	Total	80

Detailed Course Content:

- 1. Introduction and History of Brain Behavioural Neuroscience Structure and Function of the Nervous System**
 - Foundations of Brain and Behavior: An Overview of Neuroscience
 - Unravelling the Mysteries: Structure and Organization of the Nervous System
 - The Symphony of Signals: Functionality of the Nervous System in Behavior
- 2. Applications and Methods in Behavioural Cognitive Neuroscience**
 - Introduction to Behavioral Cognitive Neuroscience:
 - Applications of Behavioral Cognitive Neuroscience:
 - Methods in Behavioral Cognitive Neuroscience:

- 3. Cognitive basis of functions i.e Sensation, Perception, Attention and Consciousness, Control, logic, learning & Language;**
 - Foundations of Cognitive Functions; Exploring the Cognitive Basis; Unraveling Sensation and Perception; Understanding the Role of Attention and Consciousness
 - Control, Logic, and Learning in Cognition; Navigating Cognitive Control Processes; Logic as a Fundamental Cognitive Element; Insights into the Mechanisms of Learning
 - Language as a Cognitive Marvel; Delving into the Cognitive Roots of Language; Language as a Window to Cognitive Processes; Examining the Interplay of Cognition and Linguistics
- 4. Multidisciplinary aspects of behaviour related to anthropology, psychological, physiological, Philosophical and computational science**
 - Interconnected Perspectives on Behavior: A Multidisciplinary Exploration
 - Philosophical Dimensions of Behavior: Bridging Thought and Action
 - Behavioral Insights through Computational Science: Merging Data and Human Dynamics
- 5. Basic of Python programming for Data Analysis**
 - Introduction to Python for Data Analysis:
 - i. Understanding the importance of Python in the field of data analysis.
 - ii. Basic syntax and structure of Python code.
 - Data Structures and Libraries in Python:
 - i. Introduction to key data structures like lists, dictionaries, and tuples.
 - ii. Overview of essential libraries for data analysis, including NumPy and Pandas.
 - iii. Hands-on exercises to analyze data using Python data structures.
 - Data Visualization with Matplotlib and Seaborn:
 - i. Introduction to data visualization and its significance in data analysis.
 - ii. Matplotlib and Seaborn libraries for creating compelling visualizations.
 - iii. Practical examples and exercises to create basic plots and charts
- 6. Data Preparation and Pre-processing EEG Data for Cognitive Assessment**
 - Introduction to EEG Data for Cognitive Assessment:
 - i. Overview of EEG data and its significance in cognitive assessment.
 - ii. Understanding the types of information EEG data in brain activity.
 - iii. Importance of proper data preparation for accurate cognitive analysis.
 - Data Cleaning Techniques for EEG Data:
 - i. Identifying and handling common artifacts in EEG signals.
 - ii. Pre-processing steps to remove noise and artifacts for cleaner data.
 - iii. Filtering methods to enhance signal quality and extract cognitive information.
 - Feature Extraction and Transformation for Cognitive Insights:
 - i. Selecting relevant features from EEG signals for cognitive assessment.
 - ii. Transformation techniques to enhance the discriminatory power of features.
 - iii. Feature scaling and normalization for meaningful cognitive analysis.
- 7. Machine Learning for Multimodal Cognitive Assessment**
 - Introduction to Multimodal Cognitive Assessment:
 - i. Understanding and its significance in evaluating cognitive functions.
 - ii. Overview of different modalities involved, such as speech, images, and sensor data, and their role in capturing diverse aspects of cognitive performance.
 - Machine Learning Fundamentals:
 - i. Basics of machine learning algorithms and application in multimodal data.
 - ii. Model training for effective integration of modalities in cognitive assessment.
 - Practical Implementation and Case Studies:
 - i. Implementing machine learning techniques for multimodal assessment.
 - ii. Real-world applications in analyzing diverse datasets to gain insights.
- 8. Modelling and Evaluation of Cognitive Assessment Systems**
 - Modelling Techniques in Cognitive Assessment:
 - i. Different modeling approaches used in designing cognitive assessment systems.
 - ii. statistical models, ML algorithms & other methodologies employed for accurate cognitive evaluation.
 - Evaluation Strategies for Cognitive Assessment Systems:
 - i. Methods and metrics to evaluate the performance of cognitive assessment.
 - ii. Importance of reliability, validity, and sensitivity in assessing cognitive measures.
- 9. Project: Developing a Comprehensive Cognitive Assessment System**
 - A live project to get in depth knowledge of the domain.