

Second semester, 2023-2024

COURSE HANDOUT (PART II)

Course no. : BITS F315

Course Title : Introduction to Cognitive Neuroscience

Instructor-in-charge: Srinivasa Prasad K

Overview: The subject of cognitive neuroscience is, in a broad sense, the human mind. Cognitive neuroscience helps to understand how the human brain supports thought, perception, affection, action, social process, and other aspects of cognition and behavior. Questions about the mind are studied from different scientific perspectives in philosophy, linguistics, psychology, neuroscience, and computer science. Cognitive Neuroscience is an interdisciplinary approach to understanding the neural substrates of mental processes. It is a broad area where insights from psychology, neurobiology, bioengineering, physics, computer science, linguistics, mathematics, and philosophy find relevance. This course will introduce the students to the methods of Cognitive Neuroscience and will prepare students to address exciting problems in the field.

Outline & Learning Objective: This course aims to cover the methods and approaches used to investigate the workings of the mind. The objective is to introduce basic cognitive processes, including perception, attention, learning, memory, speech, hearing, and language. Experimental findings and theories regarding cognitive processes will be discussed in the course. Students will also learn, based on a demo, how to record and analyze EEG/ERP signals. This will teach the biology, pharmacy, and engineering students the applications of engineering aspects in revealing the biological principles in neuroscience. Students interested in biomedical engineering/medical devices/pharmaceutical applications can benefit from this course.

Textbook:

1. Gazzaniga, M.S., R.B. Ivry & G.R. Mangun. Cognitive neuroscience: the biology of the mind (4th ed., New York: Norton, 2008). ISBN: 978-0-393-11136-1.

References:

1. Ward, J. The student's guide to cognitive neuroscience (Hove: Psychology Press, 2006). ISBN: 1-84169-535-1.

2. BERNARD J. BAARS & NICOLE M. GAGE: COGNITION, BRAIN, AND CONSCIOUSNESS, Introduction to Cognitive Neuroscience Second Edition

3. MICHAEL W. EYSENCK and MARK T. KEANE: COGNITIVE PSYCHOLOGY A Student's Handbook, Sixth Edition

Use/ advantages of taking this course: This is an introductory level course with no prerequisites. Engineering students will be able to understand how AI and machine learning took inspiration from neuroscience and its theories. Also, biology/pharmacy/ humanities students will be able to appreciate the interdisciplinary nature of neuroscience and how engineering concepts and chemistry are being used in neuroscience research and the healthcare system. This will enable students to understand the importance of interdisciplinary sciences and make them aware of current advances and problems/opportunities requiring address. This will help students to look for careers in interdisciplinary themes/settings for them to fill the void in Indian markets/entrepreneurship.

No.	Topic	No. of Lecture
1	•Introduction:Introduction to Cognitive Neuroscience,The Brain Story, The Psychological Story, Philosophy of Mind and cognition	2L
2	• Methods of Cognitive Neuroscience: Neural Systems, Neurophysiology ,Cognitive Psychology and Behavioral Methods, The Marriage of Function and Structure: Neuroimaging, Brain Graphs,ComputerModeling, EEG,fMRI	3L
	• Neuroscience-Inspired Artificial Intelligence: How AI and Neuroscience drive each other	1L
3	• The Neuroscience of Happiness and Pleasure: Subjective well being, Satisfaction with Life Scale, Hedonic hotspots, HugThere's Neuroscience to prove it's good for you, Enhancing your Happiness level and leading a life of happiness and fulfillment Case Study: Mental Health Awareness and Psychodrama	3L
4	• Sensation and Perception: Senses, Sensation, and Perception, Sensation: Early Perceptual Processing, Audition, Olfaction, Gustation,Somatosensation, Vision, From Sensation to Perception, Deficits in Visual Perception, Multimodal Perception: I See What You're Sayin', Perceptual Reorganization, Object Recognition	3L
5.	• Brain IoT and Pervasive Healthcare: Eyetracking, Virtual reality, Augmented reality Brain Computer Interface, BCI as IoT and its application in remote health monitoring, Brain fingerprinting,Signal Processing, Data Processing, Feature Extraction, Feature Classification	4 L

6	<ul style="list-style-type: none"> • Attention & Action: The Anatomy of Attention ,The Neuropsychology of Attention, Models of Attention, Neural Mechanisms of Attention and Perceptual Selection, Attentional Control Network, , Physiological Analysis of Motor Pathways, Goal Selection and Action Planning , The Brain–Machine Interface 	4L
7	<ul style="list-style-type: none"> • Memory : The Anatomy of Memory, Memory Deficits: Amnesia Mechanisms of Memory, Imaging Human Memory, Memory Consolidation, Cellular Basis of Learning and Memory, Working memory: classical research on short-term memory, 	3L
8	<ul style="list-style-type: none"> • Emotions: What Is an Emotion? Neural Systems Involved in Emotion Processing, Categorizing Emotions, Theories of Emotion Generation, The Amygdala Interactions Between Emotion and Other Cognitive Processes, Get a Grip! Cognitive Control of Emotion, Emotional disorders 	3L
9	<ul style="list-style-type: none"> • Psycholinguistics: History, Language structure, Psycholinguistics and cognitive science, The Fundamentals of Language in the Human Brain, Language Comprehension ,Neural Models of Language Comprehension , eye tracking , EEG and fMRI evidences in language production, Connectionist models of speech perception, eye movements in visual word recognition → EEG Lab 	3L
10	<ul style="list-style-type: none"> • Network Neuroscience: Introduction to Network Neuroscience, Simple measures to characterize network structure, From EEG to graphs, Networks of the Brain: Quantitative Analysis and Modeling, Centrality measures and hubs, relation between Network structure and function and its application to Mental health and Neuroscientific data. 	5L
11	<ul style="list-style-type: none"> • Consumer Neuroscience: Secrets for selling to the subconscious mind, The neuromarketing toolbox, emotions and feelings, Wanting, Liking and Deciding, Neuroeconomics of individual and collective decision making from cellular to behavioural levels → EEG Lab 	4L
12	<ul style="list-style-type: none"> • Social Cognition: Anatomical Substrates of Social Cognition, Know Thyself Theory of Mind: Understanding the Mental States of Others, Social Knowledge 	2L

Evaluation scheme:

Components	Duration	Date	weightage (%)	Remarks
Midsem Examination	3 hour	15/03 - 4.00 - 5.30PM	30%	Closed Book

Surprise quizzes (1) + Assignment	TBA	TBA	10% + 20%	Closed book for quizzes + open book assignment
Comprehensive Examination	3 hour	17/05 AN	40%	20% - closed book 20% - open book

Grading policy: Grades would be awarded as per the institute guidelines. Decision for borderline cases would be based also on the student's sincerity and his/her participation in classroom activities.

Make-up policy: You may apply for make-up only if you miss any of the evaluation components due to serious medical emergency for which a valid proof from hospital would have to be produced and a request by parents. However, the final decision would rest with the instructor team. Make-up for quizzes, assignments and seminars will not be given. **Attendance to classes will be looked upon favourably during makeup allocation.**

Notices: Will be announced in google classroom.

Chamber visit hours: Mon – Saturday 12 pm -1 pm.

Instructor-in-charge BITS F315

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.