B.Tech. DEGREE EXAMINATION, JULY 2023
Seventh Semester

18BME469T – NEURO REHABILITATION AND HUMAN MACHINE INTERFACE
(For the candidates admitted from the academic year 2018-2019 to 2021-2022)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours

Max. Marks: 100

PART – A (20 × 1 = 20 Marks)
Answer ALL Questions

		Marks	BL	CO	PO

1. Non-declarative memory includes.   1   1   1   1
   (A) Memory for skills and habits
   (B) Memory of facts and events
   (C) Memory that require conscious recall
   (D) Memory that result from exposure to stimuli prior

2. Trauma induced death of oligodendrocytes leads to   1   2   3   4
   (A) Retrograde atrophy and degeneration
   (B) Cascading degeneration of connected neurons
   (C) Synapse stripping and loss of synaptic connections
   (D) Demyelination and disruption of neural conduction

3. Cascading degeneration refers to   1   1   3   4
   (A) Progressive degeneration of neurons connected to an initially affected neuron
   (B) Loss/ interruption of nerve supply to a tissue / organ
   (C) Degenerative changes in neurons located upstream of an injury site
   (D) Shrinkage/ reduction in size of neurons no longer receiving input

4. What is the order of information processing in serial processing?   1   1   2   3
   (A) Simultaneous processing
   (B) Sequential processing
   (C) Parallel processing
   (D) Serial-distributed processing

5. How is the somatosensory cortex organized?   1   2   2   4
   (A) Randomly distributed
   (B) Based on the size of body parts
   (C) According to the intensity of sensations
   (D) In a haphazard manner

6. What is proprioception refer to?   1   2   2   3
   (A) Perception of temperature
   (B) Perception of pain
   (C) Perception of body position and movement
   (D) Perception of visual stimuli

7. What is the role of spinal cord plasticity in individuals with spinal cord injuries?   1   3   2   3
   (A) Complete recovery of motor function
   (B) Compensation for lost function
   (C) Prevention of further injury
   (D) Reduction of pain perception

8. The functional organization and interaction of motor cortex regions enable: 1   3   2   3
   (A) Voluntary muscle contractions
   (B) Sensory perception
   (C) Cognitive processing
   (D) Emotional regulation

9. The regeneration of the brain in planarians consist of how many distinct stages?   1   2   1   3
   (A) Five
   (B) Three
   (C) Two
   (D) Four

10. Which vertebrate species demonstrates limited axon regeneration and plasticity following spinal cord injury?   1   1   3   3
    (A) Lamprey
    (B) Zebrafish
    (C) Goldfish
    (D) Mammals

11. What is the term used to describe the growth of new branches or extensions from intact axons adjacent to the site of injury?   1   2   1   1
    (A) Regeneration
    (B) Sprouting
    (C) Myelination
    (D) Demyelination

12. Which myelin inhibitor has been implicated in regulating dendritic spine morphology and suppressing activity-dependent synaptic plasticity in the hippocampus?   1   2   3   4
    (A) MAG
    (B) MGP
    (C) NOGO
    (D) PIRB

13. For which of the following subject BCI cannot be used?   1   3   4   4
    (A) Amyotrophic lateral sclerosis
    (B) Cerebral palsy
    (C) Cognitive impairment
    (D) Spinal-cord injuries

14. Which of the following neuroimaging modality is a portable BCI system?   1   2   4   12
    (A) PET
    (B) MEG
    (C) FMRI
    (D) FNIRS

15. Which of the following control signals does not require training the subject for using in BCI?   1   4   4   4
    (A) SSVEP
    (B) Sensory motor rhythms
    (C) Slow cortical potentials
    (D) Motor imagery EEG signals

16. FNIRS-EEG based BCI system is an example of   1   1   4   4
    (A) Invasive BCI
    (B) Dependent BCI
    (C) Multi-modal BCI
    (D) Synchronous BCI

17. Sensors present in rehabilitation robots does not measure   1   2   5   12
    (A) Positions
    (B) Velocities and accelerations
    (C) Torques and forces
    (D) Emotional stress

18. Robot-assisted treadmill training cannot be used with subjects suffering from

1	2	5	4

    (A) Severe contractures   (B) Spinal cord injury
    (C) Children with cerebral palsy   (D) Multiple sclerosis

19. "You Grabber" rehabilitation system in an example of

1	1	5	12

    (A) Upper extremely robotic system   (B) Lower extremely robotic system
    (C) Passive system   (D) Total support system

20. What is not an advantage of intracranial BCI?

1	2	5	4

    (A) Higher spatial resolution   (B) Less subject to attenuation and distortion by intervening biological tissues
    (C) Less contaminated by artifacts from scalp and ocular muscle activity   (D) Non-invasive BCI

PART – B (5 × 4 = 20 Marks)
Answer ANY FIVE Questions

	Marks	BL	CO	PO

		Marks	BL	CO	PO
21. What is axonal sprouting and how it is different from axonal regeneration?		4	1	2	4
22. Explain non-associative memory with suitable example.		4	3	1	1
23. Explain the functioning of human somatosensory system with example.		4	4	2	3
24. State the various steps involved in human inflammatory signaling mechanisms.		4	3	3	4
25. Explain the structure of a typical BCI system with a block diagram.		4	1	4	4
26. What are the requirements for next-generation advanced HMI? What are the approaches followed in its development?		4	1	4	4
27. What are the two types of electrodes used in intracortical HMI system?		4	1	5	4

PART – C (5 × 12 = 60 Marks)
Answer ALL Questions

		Marks	BL	CO	PO
28. a. Discuss the principles of movement neuroscience that guide the field of neurorehabilitation. Provide examples of how these principles are applied to enhance motor recovery and functional rehabilitation.		12	5	2	4

(OR)

		Marks	BL	CO	PO
b. How do neural mechanisms of habituation operate in Aplysia for non-associative learning? Provide an explanation of the underlying processes and their significance in the context of habituation.		12	5	1	1

29. a. In the context of functional plasticity of central nervous system, discuss the functional organization of the motor cortex and its significance. 12 5 1 4

(OR)

b. Explain the mechanisms underlying the functioning of the human visual system, and how does the development of visual connections occur in human brain. 12 3 3 4

30. a. What is myelin-associated axon growth inhibitors? Explain the major differences between extrinsic inhibitors and neuron-intrinsic regulators. 12 2 1 1

(OR)

b. What is regenerative capacity of the non-mammalian vertebrate nervous system, specifically in the context of axon regeneration in the injured fish option nerve? Discuss the challenges associated with restoring the retinotectal map. 12 3 3 4

31. a. What are the direct and indirect ways of measuring brain activity in BCI? Explain each with their advantages and disadvantages.

(OR)

b. How is the combined FNIRS-EEG signal used in the development of next-gen BCI? Describe the blocks of the system and explain with an example. 12 2 6 3

32. a. What are the issues and principles involved in the clinical application of therapeutic robots? 12 1 5 12

(OR)

b. Explain neurodegeneration at the electrode-brain interface. What are the strategies used to address it? 12 1 5 12

* * * * *