

**Optional Course**

**CELLULAR AND MOLECULAR NEUROBIOLOGY (LS642A)**

Amal C. Mondal\*

| <b>S<br/>No</b> | <b>Course Content</b>   | <b>Contact<br/>Hrs</b> |
|-----------------|---|------------------------|
| 1               | <b>Neurons &amp; glia:</b> Components and classification of neurons and glia. Different types of neurons, glia, astrocytes, oligodendrocytes, and Schwann cells, types of astrocytes--type-I, II astrocytes, functions of otherglial cells: Oligodendrocytes and microglial cells. Cell-specific molecular markers for neurons & glial cells.   | 3                      |
| 2               | <b>Molecular structure of synapse and neuromuscular junction:</b> Overview of central nervous system (CNS) synapse and NMJ, Kinds of CNS synapses, Molecular components of synaptic junction, Pre-synaptic and post-synaptic specialization, Molecular structure of neuromuscular junctions: Composition and properties of AChR, Development of NMJ, Signaling mechanism of AChR clustering. Diseases related to problems in synaptic transmission in the NMJ.  | 5                      |
| 3               | <b>The Cellular and molecular basis of neural development:</b> Neural induction, Polarity and segmentation, generation of neurons and glia, Migration of neurons in the CNS. Determination of neural and glial cell identity, Axon outgrowth, Axon guidance, Target selection, Naturally-occurring neuron death, Synapse formation and function. Refinement of synaptic connections. Growth factors and survival of neurons: Transcription factors gradients –regional differentiation, Cell death & neurotrophic hypothesis, Neurotrophins family and its receptors, Cytokines and growth factors in nervous system, competitive interactions during development. Functions in neuronal PCD. | 6                      |
| 4               | <b>Molecular biology of Channels and Sensory transduction:</b> Basic properties of ion channels, Resting and gated ion channels, Ligand and voltage gated ion channels, Gap junction, different states of ionchannels: closed, open, and refractory. Models of open and closed channels, Growth factor (BDNF) signaling, Second messengers mediated signaling(cAMP, cGMP, IP3, DAG, receptor tyrosine kinases), Activation of metabotropic and ionotropic receptors, Activation mechanism of common protein kinases (PKA, PKC, CAMKII, cGMP-dependent kinase). Alteration of signal transduction through genetic manipulation: optogenetics, Conditional knockout etc.                        | 6                      |

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| 5 | <b>Neuro-immunological and neurodevelopmental disorders:</b> Brain inflammation: the role of astrocytes and microglia, Multiple sclerosis, Neuro AIDS. Cerebral palsy, autism.   | 3 |
| 6 | <b>Disorders of the central nervous system:</b> Models for understanding brain disorders. Molecular neurobiology of anxiety, depression, Alzheimer's disease, and their possible interplay in between. Parkinson's disease, Multiple sclerosis, and current therapeutic approaches.  | 4 |
| 7 | <ul style="list-style-type: none"> <li>• Principle of Immunohistochemical localization and analysis in the nervous system</li> <li>• Gene transfer into neural cells using adenoviral vectors.</li> <li>• An overview of primary neuronal cell culture</li> <li>• Purpose of whole cell voltage clamp recording and its overview</li> <li>• Tests for anxiety and depression like behavior in animals</li> </ul> | 5 |

### **Suggested readings:**

1. Principles of Neural Science by Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell
2. Fundamental Neuroscience by Larry R. Squire, Floyd E. Bloom, Susan K. McConnell
3. From Neuron to Brain by John G. Nicholls, A. Robert Martin, Bruce G. Wallace, Paul A. Fuchs.
4. Development of the Nervous system by Dan H. Sans, Thomas A. Reh, William A. Harris