

## Optional Course

### Cellular and Molecular Neurobiology (LS-648) [2 credits]

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S No	Topic	Contact Hours/ Teachers
1	Neurons & glia: Components and classification of neurons and glia, Nissl and Golgi stains, Cell specific markers for neurons and glia. Different types of neurons. Different types of glial cells, astrocytes, oligodendrocytes, and Schwann cells, types of astrocytes--type-I, II astrocytes, fibrous and protoplasmic astrocytes, functions of other glial cells: Oligodendrocytes and microglial cells.	3 / ACM
2	Molecular structure of synapse and neuromuscular Junction: 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.	3 / ACM
3	The Cellular and molecular basis of neural development: Neural induction, Polarity and segmentation, The 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 / ACM
4	Molecular biology of Channels and Sensory transduction: Basic properties of ion channels, Resting and gated ion channels, Ligand and voltage gated ion channels, Gap junction, different states of ion channels: 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.	8/ BNM
5	Molecular basis of memory: Overview of learning and memory,	6/ SKJ

	Patient HM, Animal model systems to study memory, Commonly studied types of memories, Different phases of memory, Consolidation, reconsolidation, LTP, LTD, synaptic plasticity, memory extinction	
6	Neuroimmunological and neurodevelopmental disorders: Brain inflammation: the role of astrocytes and microglia, Multiple sclerosis, NeuroAIDS. Cerebral palsy, autism	2/ ACM
7	Students' Seminar, Group Discussion and Tutorials: Topics to be taught by the student to students: <ul style="list-style-type: none"> <li>• Immunohistochemical localization in the nervous system</li> <li>• Gene transfer into brain using adenoviral vectors <i>in vivo</i> &amp; <i>invitro</i>.</li> <li>• Primary neuronal cell culture</li> <li>• Whole cell voltage clamp recording</li> <li>• Test of anxiety in animals</li> <li>• Polysomnographic recording</li> </ul>	5/ ACM

**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