

Educational Objectives:

This course will provide basic concepts and understanding of basic biology of the neuron and synapses. Collectively neurons are responsible to control the cognitive function which makes us different from other animals. This course will provide understanding of the neural processes and molecular level organization of the synapse, mechanism of the neurotransmitter release and the advance concepts in molecular biology of the nervous system.

Course Outcomes:

Provide the student with an in-depth understanding of the neural foundation for behavior and cognition. The course provides students with insight into ongoing research in neuroscience and provides a platform for continued studies in neuroscience.

Course contents:

- Introductory topics in Neuroscience
 - The anatomical organization of the central nervous system
 - The brain and behavior
 - Nerve cells and behavior
 - The cytology of neurons
 - Membrane potential
 - The action potential
- Molecular Neuroscience
 - Genes and their contribution towards behavior
 - Axonal transport: Synthesis and trafficking of neuronal protein:
 - Ion channels and molecular mechanism of gating of channels
 - Local signaling: passive electrical properties of the neuron
 - Overview of synaptic transmission
 - Molecular mechanism of the signaling at the nerve-muscle synapse: synaptic integration
 - Molecular mechanism of neurotransmitter release
 - Neurotransmitters
 - Glutamate receptors and their role in cognitive functions
 - Synaptic plasticity

- The formation and regeneration of synapses
- Membrane receptors (GPCRs and Ionotropic receptors)
- Experimental techniques in neuroscience (data analysis and software training)

Recommended Books:

- **Principles of Neural Sciences** by Eric Kandel, James Schwartz, Thomas Jessell: Third Edition 2000
- **Neuroscience** by Dale Purves: Third Edition 2004

MEMBRANE TOPOLOGY & SIGNAL TRANSDUCTION (HCB-816) Credit Hrs 3(3-0)

Educational Objectives:

This course is designed to help students understand workings of the cell structure and function at cellular and molecular level that various viruses utilize in their life cycles. In this course molecular basis of cell structure and function is discussed which will provide students a detailed account of functional signaling cascade physiology of the cells. Furthermore, this course will discuss the key components of the immune system at cellular and molecular level.

Course Outcomes:

Students will be able to understand the basic principles and the structural relationships of the membrane and its relation to the signaling at the cellular level. Describe basic biological concepts and principles, and the applications of the topology into various fields.

Course contents:

- Cell Adhesion and ECM
- Cell adhesion molecules and protein targeting
- Collagen Matrix and Non-collagen Matrix
- Metastasis
- Protein sorting
- An overview of protein targeting
- Peroxisomal protein targeting
- Secretary protein targeting
- Membrane proteins
- Functions of cell surface receptors
- Post-translation modifications

- Golgi protein sorting
- Vesicular Transport
- Cytoskeleton and force generation
- Actin dynamics and Actin myosin interaction and regulation
- Microtubule dynamics (dynamic instability model)
- MAPS and microtubule motors
- Cilia and flagella structure and movement
- Pathways of intracellular signal transduction
- P38 MAPK, JNK, ERK pathways
- RAS and RAF pathways
- Oxidative stress and anti-stress signaling (GST, MnSOD)
- GTPase and their role in cancer
- Ion channels expression, regulation and its relations to diseases
- Purinergic signaling (p2X and p2Y)
- PKA, PKB (AKT) PKC pathways
- JAK/STAT and TGF- β /smad pathways
- NF- κ B signaling
- Hedgehog Wnt and Notch pathways
- G-Protein coupled membrane receptors signaling
- Steroid hormones and nuclear receptors signaling
- Neurotransmitters, Opioids receptors and Eicosanoids signaling
- Peptide hormones and growth factors signaling
- Feedback and crosstalk signaling network
- Cell Signaling and its Applications in Disease and Therapeutics

Recommended Books:

1. **Gene VIII** By Lewin Benjamin Eds 2004. Oxford University press, Inc, New york.
2. **Molecular Biology of the Gene** by Watson, J. D., T. A. Baker, S. P. Bell, A. Gann, M. Levine, and R. Losick, 5th Ed. 2003. New York, Benjamin Cummings ISBN 0-8053-4635-X
3. **The Cell** by Bruce Albert and Dennis Bray, 3rd Ed. Garland Publishing Inc, New York and London.
4. **Biochemistry** by [Victor L. Davidson](#), [Donald B. Sittman](#). 3rd Ed. 1993, Harwal Pub Co.
5. **Cell and Molecular Biology** by Gerald Karp. 1996, John Willey and Sons, Inc. London.