NS202 Aug. 3:0

Fundamentals of Molecular and Cellular Neuroscience

Instructor

Balaji Jayaprakash, Vijayalakshmi Ravindranath, Deepak Nair, Swananda Marathe, Mini Jose and Naren Ramanan
Email: balajij@iisc.ac.in, viji@iisc.ac.in, deepak@iisc.ac.in, naren@iisc.ac.in, mini@iisc.ac.in, swanand@iisc.ac.in

Teaching Assistant

Email:

Department: Centre for Neuroscience (CNS)

Course Time: Mon., Wed., Fri., 10:00 - 11 AM

Lecture venue: CNS Lecture Hall (First Floor)

Detailed Course Page:

Announcements

The first meeting will be an introductory lecture on Friday, Aug 4, at 9.00 AM in the CNS Lecture Hall (First floor)

Brief description of the course

This course is suitable for all that are interested in having a fundamental understanding of nervous system development, organization, maintenance and function. Major topics covered include the molecular basis of neuronal development, neuronal transmission, synaptic organization and its relationship to synaptic physiology, small animal behavior, learning and memory and neurological disorders.

Prerequisites

None

Syllabus

Module 1: Developmental Neuroscience

Neuro-anatomy

Neural induction, polarity and segmentation

Neural Stem cells, cell cycle, neurogenesis, cell migration

Cellular determination and differentiation

Axon growth and guidance

Target selection

Cell death in the nervous system - Neurotrophins, Caspases,

Synapse formation and function

Dendritic development

Refinement of synaptic connections

Gliogenesis 1 - Astrocytes: Genesis, role in synapse formation, elimination

Gliogenesis 2 - Oligodendrocytes: Genesis, myelination

Module 2: Synaptic Transmission

Modes of Neuronal Communication

Chemical Neurotransmission

Classical neurotransmitters-1

Classical neurotransmitters-2

Non-classical Neurotransmitters

Molecular biology of Neurodegenerative Diseases 1

Molecular biology of Neurodegenerative Diseases 2

Module 3: Synaptic Physiology

Regulation of membrane potential

Neuronal excitability

Molecular basis of membrane potential generation

Spatial and temporal summation of EPSP and IPSP

Ultrastructure of synapse

Module 4: Techniques in Molecular and Cellular Neuroscience

Anatomical planes of study

Identification of gene expression - immunostaining and in situ hybridization

Methods for gene deletion and silencing for functional studies

Generation of transgenic and knockout mice

Quantitative microscopy

Module 5: Learning and Memory

Brief History of Memory

Associative and Non- Associative Learning

Rules of Association -I (Pavlovian Conditioning)

Rules of Association -II (Instrumental Conditioning)

Rescorla Wagner Equation and its Variants

S-S, S-R theories of Learning

Molecular basis of Associative Learning

Synaptic Plasticity: LTP, STDP

Transcription Factors and kinases involved in plasticity

Modern Studies in Learning and Memory

Course outcomes

Students will get a fundamental understanding of nervous system structure, development, neurotransmitter systems, synaptic plasticity, learning and memory.

Grading policy

Tests and/or assignments are given after each module. 20% for each module test.

Assignments

Resources

Lecture notes will be shared.

The suggested text books are:

1. Kandel ER, Schwartz JH and Jessell TM, Principles of Neural Science, Fifth Edition, Mc-Graw Hill, 2013
2. Dan H. Sanes, Thomas A. Reh, William A. Harris, Development of the Nervous System, Third edition, Academic Press, 2011
3. Larry R. Squire et al., Fundamental Neuroscience, Fourth Edition, Academic Press, 2013