MB209 Aug. 3:1

Molecular and Cellular Neurophysiology

Instructor

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Department: Molecular Biophysics Unit

Course Time: 11:00 AM - 12:00 PM

Lecture venue: Molecular Biophysics Unit Annex Seminar Hall

Detailed Course Page: http://mbu.iisc.ac.in/~mb209/

Announcements

The first meeting of the course MB209, Molecular and Cellular Neurophysiology (3:1), will be on the 7th of August 2017, 11:00 AM at the first floor seminar hall in the MBU Annex building.

Instructors: Prof. S. K. Sikdar and Prof. Rishikesh Narayanan, Molecular Biophysics Unit, IISc.

Course website: http://mbu.iisc.ac.in/~mb209/

Send to: BC, Bioengg, CEDT, CeNSE, CES, CNS, CSA, ECE, EE, MBU, MCBL, Mecheng, MRD, UG

Brief description of the course

This is a basic course on molecular and cellular neurophysiology. The course can be taken by UG, Masters and PhD students, and does not assume any background in neuroscience.

Prerequisites

None.

Syllabus

Membrane components and structures; membrane transport; passive and active electrical properties of the

membrane-ionic mechanisms of membrane and action potential; quantifying ionic hypothesis by voltage-clamp technique; Hodgkin Huxley formalism; structure-function aspects of voltage and chemically gated ionic channels; excitatory and inhibitory postsynaptic potentials; patch-clamp technique; recording and analysis of electrophysiological data; measurement of Ca concentrations in single cells; cell membrane capacitance and exocytosis, confocal microscopy. Synaptic plasticity: short-term and long-term potentiation and depression; mechanisms underlying synaptic plasticity; dendritic structure; dendritic ion channels; active properties of dendrites; dendritic spikes and backpropagating action potentials; intrinsic plasticity; mechanisms underlying intrinsic plasticity.

Course outcomes

The students would get a broad introduction to cellular and molecular neurophysiology. Whereas the first part of the course deals with the quantitative details of neuronal passive properties, action potential generation, synaptic transmission using simple experimental systems, the second part of the course delves into details of mammalian neuronal physiology with a specific focus on neuronal and synaptic plasticity during learning.

Grading policy

Assignments: 25%

Mid-term test: 25%

Grant proposal defended through a presentation: 25%

Final exam: 25%

Assignments

There are several take-home assignments that test the understanding of the students, apart from allowing them to work out details of quantitative aspects of cellular neurophysiology. In addition, there is also assignments that are provided from the perspective of research training:

1. Present an approximately two-three-page critical summary of a recently-published research article (assigned by the instructor). The summary should reflect the student's understanding of the motivations, previous

literature, significance, technical correctness, implications and internal and external consistencies/conflicts of the paper. After submission, on the day of a class presentation, figures in the paper will be projected as slides in the class, and one of the students will be randomly picked to explain each figure to the class. The emphasis would be on critically analyzing the research article and its contents.

2. Present an approximately two-three page comparative analyses of two review articles that propound two opposing viewpoints (assigned by the instructor). The summary should reflect the student's understanding of the motivations, previous

literature, significance, technical correctness, implications, and internal and cross-consistencies/conflicts of the articles. After submission, in the class, a group discussion will be initiated with the figures (or talking points) from each of the papers projected as slides. All students are expected to participate with discussions spanning the merits and demerits of the two reviews.

Resources

Teaching is from books and/or research articles, with a strong emphasis placed on the students reading from the original research articles.

Books:

â€¢ Foundations of Cellular Neurophysiology by D. Johnston and S. Wu

â€¢ Ion Channels of Excitable Membranes by B. Hille

â€¢ Ion Channels. Molecules in Action by Aidley & Stanfield

â€¢ Principles of Neural Science by Kandel, Schwartz and Jessel.

â€¢ From Neuron to Brain by Nicholls, Martin, Wallace and Fuchs.

â€¢ Synapses by Cowan, W.M., SÃ¼dhof, T.C., Stevens, C.F.

â€¢ Dendrites by Stuart, G., Spruston, N., Hausser, M.

Websites:

Electrophysiology of the Neuron - an interactive tutorial by John Huguenard and David A McCormick. The book and the tutorial can be downloaded for free from: http://tonto.stanford.edu/eotn/

Several other links are provided in the course website, which include classic papers, journals related to the course, electrophysiology links and links to Grant writing and making presentations:

http://mbu.iisc.ac.in/~mb209/links.htm