האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

BRAIN NEURONS AND EVERYTHING IN BETWEEN - 76961

Last update 15-10-2018

HU Credits: 4

Degree/Cycle: 2nd degree (Master)

Responsible Department: Brain Science: Computation & Information Proc.

Academic year: 0

Semester: 1st Semester

Teaching Languages: English

Campus: E. Safra

Course/Module Coordinator: Inbal Goshen

Coordinator Email: inbal.goshen@elsc.huji.ac.il

Coordinator Office Hours: monday, 9:30

Teaching Staff:

Ms. Adi Kol

Dr. Inbal Goshen

Course/Module description:

Syllabus

Brain, neurons and everything in between (course # 76961)

1) Intro to cell biology: Cell structure, major organelles, from genes to proteins, channels, pumps, intracellular signaling.

2) Cell types in the nervous system and their roles: Neurons (in more detail later), astrocytes (including BBB), microglia, oligodendrocytes & Schwan cells.

3) Neuronal membrane potential (Ion channels and the electrochemical force, resting potential maintenance and Nernst potential, the Goldman equation, isopotential neuron as electric circuit - RC circuit, the parallel conductance model, neurons as low pass filters, the passive cable theory).

4) The action potential – action potential initiation, steps (depolarization, repolarization and after hyperpolarization), voltage gated ion channels, the Hodgkin – Huxley model (voltage clamp circuit, the gated theory – differential equations for voltage gated channels), the voltage gated potassium channel, the voltage gated sodium channel, molecular dynamic simulation, the refractory period and information flow, action potential transduction (saltatory conduction), threshold manipulation and ion channels effect on firing rate (adaptation and anodic break response, types of ion channels).

5) Single-cell computations – linear and non-linear signal summation (integrate and fire model, time and length constants effects on signals, Connor-Stevens model, multi compartment model, non-linear passive mechanisms (shunting inhibition, back propagation), non-linear active mechanisms (directional selectivity), axonal computations.

6) Synapses: signal transduction between neurons. Quantal release, Vesicle release machinery, receptors (ionotropic and metabotropic; autoreceptors)

7) Neurotransmitters: Natural activity and neuropharmacology, including related normal and abnormal behaviors. Focus on: glutamate, GABA, neuromodulators – dopamine, acetylcholine, serotonin, peptides and lipids.

8) Plasticity: Short and long-term plasticity. Synaptic potentiation, synaptic depression, structural changes, STDP. How can one synapse change while a neighboring synapse stays the same – from the whole cell's perspective? Relation to memory processes.

9) Intro to Neuroanatomy: Basic lingo, blood supply, meninges, development of the nervous system.

10) Functional neuroanatomy: Who does what in the brain? Including Hands-On dissections of bovine brains. Cortex, thalamus, hypothalamus, limbic system, striatum, cerebellum.

Course/Module aims:

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Learning outcomes - On successful completion of this module, students should be able to:

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Attendance requirements(%):
100

Teaching arrangement and method of instruction: frontal lectures
electrical lab,
brain dissection lab

Course/Module Content:

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Required Reading:

Reading Material

Principles of Neural Science. 5th edition, By Kandel, Schwartz, Jessell, Siegelbaum

and Hudspeth. Published by McGraw-Hill Medical
** This book is THE neuroscience textbook, and will be used in other ELSC courses (physiology 1 & 2 as well).*
Chapters: 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 52, 53, 54, 56, 65, 67. Appendix C, D, F,

From Neuron to Brain. 5th edition, By Nicholls, Martin, Fuchs, Brown, Diamond and Weisblat. Published by Sinauer Associates Inc.,U.S.
Chapters (from the 4th edition, in the ELSC library): 1-14, 23, 24. Appendix A, B, C

Additional Reading Material:

Course/Module evaluation:
End of year written/oral examination 0 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 15 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 85 %
Other 0 %

Additional information: