MCB 115: Cellular Basis of Neuronal Function – Fall 2012

Course Description: In this course, you will study how neurons, the cells that perform the computations in the brain, work at a cellular level. We will study how the ions found naturally in our body (such as sodium, potassium, and calcium) are used to send fast electrochemical signals, how these electrochemical signals are converted into more chemical and physical signals, how two neurons can communicate with each other, the changes that can occur in connections, and how scientists study them, amongst other topics. For details, please refer to the syllabus.

Course Times
Lectures: M, W, F: 2-3 PM in Biolabs 1080
Section: 1 hr/wk
- W 10-11 AM Biolabs 1075
- W 3:30-4:30 PM Biolabs 1079
- Th 11 AM-12 PM Biolabs 1075

Teaching Staff Info
Ryan Draft (Course Head)
Office Hours: W 3-5 PM Biolabs 1082D
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Farhan Ali (TF)
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Charmain McIntyre (TF)
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Website: http://isites.harvard.edu/k87053

Prerequisite: LPSA/ LS1a and MCB 80)

Recommended Background: Basic calculus (Math 1a or AP Calc) and Chemistry (PS1 or equivalent, AP Chem)

Textbooks
Required: Available at the COOP and Amazon.com
- Byrne JH and Roberts JL. From Molecules to Networks – 2nd Ed. Academic Press 2009

Additional Background and Supplementary: On reserve at Cabot Library
- Fain GL. Molecular & Cellular Physiology of Neurons. Harvard University Press 1999

Advanced Reading:
- Hille B. Ion Channels and Excitable Membranes – 3rd Ed. 2001
Grading:
Problem Sets (5).....30%
Midterm Exam (1)...25%
Final Exam.................35%
Term Paper..............10%

* Note: If the class average is below a B+, the score distribution will be curved to a B+ average

Letter Grade Cutoffs:
A \geq 90\%
A- \geq 85\%
B+ \geq 80\%
B \geq 75\%
B- \geq 70\%
C+ \geq 65\%
C \geq 60\%
C- \geq 55\%
D+ \geq 50\%
D \geq 45\%
D- \geq 40\%
E < 40\%

Course Policies
• No late assignments/exams will be accepted/given without a verified medical or advanced permission from the instructor
• All assignments must be completed independently. Any indication of collaboration, cheating, or plagiarism will be sent to the AdBoard
• Attendance at section is optional but strongly recommended

Important Dates (see schedule on the website for more details):
• First Class: Wednesday, Sept 5th
• First week of section: Sept 17th-21st
• P-sets (due BEFORE lecture)
  o Pset 1 – Mon, Sept 24th
  o Pset 2 – Mon, Oct 1st
  o Pset 3 – Mon, Oct 15th
  o Pset 4 – Mon, Nov 5th
  o Pset 5 – Fri, Nov 16th
• Term Paper
  o Draft – Wed/Th (in section), Nov 28/29th
  o Final – Fri, Dec 7th
• Exams
  o Midterm – Wed, Oct 17th
  o Final – TBA
• No class on
  o Mon, Oct 8th (Columbus Day)
  o Fri, Oct 19th
  o M-F, Nov 19th, 21st, 23rd (Thanksgiving break)
Syllabus in Brief (see schedule on the website for more details):

I. **Introduction and Overview of the Class**
II. **Nervous tissue and its components: Neurons and Glia**
   i. BBB and Neuro-metabolism
   ii. Subcellular organization and key circuits/cell types
III. **Electrical Properties of Neurons**
   i. Membrane Potential
   ii. Passive and Active Properties of the Membrane
   iii. Modeling the basis of the Action Potential
IV. **Voltage Gated Ion Channels**
   i. Current Function and Diversity
   ii. Structural Mechanism of Selectivity and Gating
V. **NT Release**
   i. Electrical Synapses
   ii. Quantal Analysis of Release
   iii. Mechanisms of Exocytosis
   iv. Mechanisms of Endocytosis
   v. NT diversity in the CNS
VI. **NT Receptors**
   i. Ionotrophic Excitatory Receptors
   ii. Ionotrophic Inhibitory Receptors
   iii. Metabotropic Receptors and Second Messengers
VII. **Plasticity**
   i. Intrinsic Plasticity
   ii. Short Term Plasticity
   iii. Long Term Plasticity
VIII. **Signal Transduction in Sensory Neurons**
IX. **Information Processing**
   i. In dendrites
   ii. In circuits