Neural Circuits

Instructors
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All class-related email must:
- include “3SN3 2015” in the subject line
- originate from McMaster accounts
- use proper forms of address
- be free of inappropriate abbreviations

Do not send email through Avenue if you need or expect an answer.
Email that fails to conform to these guidelines will not be answered.
Responses will normally be made within 48 hours.

Course logistics
Lectures:  Mondays 19:00-22:00; ABB 136
Office hours:  Wednesdays 12:00-14:00, PC 310
TA office hours:  by appointment
course website:  Avenue

Course description
Neural Circuits is an introductory course in neural circuits and systems neuroscience. During the first few weeks of the term students will review basic neuroscience and begin to delve into key concepts and techniques needed to read original articles in systems neuroscience. In the latter portion of the course, students will learn about model neural circuits and will explore specific areas of systems neuroscience in more depth through reading and discussion of original research articles (assigned discussion groups ≤ 25).

Course Objectives
This course aims to introduce students to concepts and techniques in neural circuits/systems neuroscience and to give students tools for reading, discussing, and thinking critically about original work in the field. After successfully completing the course, the student should be able to:
- explain how neurons may be connected to perform specific tasks
- describe commonly used techniques in systems neuroscience
- logically present arguments from experimental systems neuroscience
- read and intelligently discuss original articles in systems neuroscience
- clearly and concisely present experimental data from original neuroscience articles

Materials
All readings will be posted on Avenue. Please let your instructor or TA know how the text and all other readings for this course work for you.

Required Text  Principles of Neuroscience (5th ed.), Kandel et al.
Optional Texts  For review of neuroscience fundamentals, we recommend From Neuron to
For review of cell biology concepts, we recommend Molecular Biology of the Cell, by Alberts et al, or Essential Cell Biology, a more condensed and accessible version of the same text. Molecular Cell Biology (Lodish et al), used for other courses on this campus, is also appropriate.

For review of general molecular biology, Molecular Biology of the Gene, by Watson et al is a good choice.

**Articles**

Within the modules section of the course, each student will be required to read 8-12 original research articles. These articles are freely available through the university servers and will be linked from the course website on Avenue.

**Calculator**

The McMaster Standard Calculator (Casio FX-991) will be permitted in tests and in class.

**Evaluation**

**Distribution of marks**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-class exercises</td>
<td>10%</td>
<td>group/individual</td>
</tr>
<tr>
<td>Discussion</td>
<td>15%</td>
<td>individual</td>
</tr>
<tr>
<td>Quizzes/written work</td>
<td>20%</td>
<td>individual</td>
</tr>
<tr>
<td>Midterm examination</td>
<td>20%</td>
<td>individual</td>
</tr>
<tr>
<td>Final examination</td>
<td>35%</td>
<td>individual</td>
</tr>
</tbody>
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**In-class exercises (ICE)**

Each lecture session will include at least one of these individual and/or group activities. An ICE consists of a statement of the question, followed by submission of a short written component and group discussion.

**Discussion**

Each student will make two brief (<3 min) oral presentations during the modules section of the course. Oral presentations will be evaluated by peers, the TA, and the instructor. Additionally, students will be evaluated on the quality and relevance of their contribution(s) to the general discussion.

**Quizzes/written work**

At the beginning of most class sessions, students will submit homework or take a short quiz covering the assigned reading for that session. The lowest mark of these will be dropped. Written work will be marked based on content, organization, grammar, and clarity. Some of the written assignments may also be used for anonymous peer-editing. Students are warned that their writing may be held to a higher standard than that to which they are accustomed.

**Midterm**

Covering content from lectures and readings up through Feb 2

**Final**

A cumulative exam covering material from all class lectures and all required readings, including the primary research articles discussed in class.
The instructor reserves the right to adjust final marks up or down, in light of special circumstances and/or overall performance.

**Missed Work**

Late work will be assessed a 10% penalty for each day (or portion thereof) overdue. All requests for academic relief for missed work must be accompanied by a McMaster Student Absence Form or other notification from the appropriate Faculty or Program office. Discretionary notes will generally not be accommodated. Missed in-class work for which university approval is presented may be replaced with the average of other in-class work. If a student misses a test and has obtained appropriate university approval, the grade may be redistributed or a make-up test may be given, at the discretion of the instructor. Students must contact the instructor promptly to discuss relief for missed work, or logistics for make-up tests. Note that a missed test may be replaced by a test of a different format, including possibly an oral exam in the presence of the instructor and a TA.

**Academic Integrity** (approved language)

We expect university students to follow the highest standards of academic integrity at all times. Note that, according to the McMaster University Academic Integrity Policy, Section 17, “Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage.” Students who engage in academic dishonesty will receive a zero on the relevant test or assignment and will be reported to the Office of Academic Integrity. This can result in more serious consequences including loss of credit with a notation on the transcript, “Grade of F assigned for academic dishonesty,” and even suspension/expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty and to avoid any appearance of academic dishonesty. Three examples of academic dishonesty include: plagiarism, improper collaboration, and copying or using unauthorized aids. For additional information and clarification, consult the Academic Integrity Policy at [http://www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

**Schedule**

January 5  
Introduction to neural circuits  
Dissecting neural pathways  
Channels and transporters  
The membrane potential

12  
The action potential  
Measuring neuronal activity (suprathreshold and multi-unit)  
Neurotransmitters  
The presynaptic terminal

19  
The post-synaptic element  
Synaptic transmission  
Measuring neuronal activity (subthreshold)
Synaptic integration

26  Short-term synaptic plasticity
    Long-term synaptic plasticity
    Stimulating neurons
    Reading, thinking, and writing about science

February 2  Midterm review
    Module I: Building neuronal circuits: Axon guidance

9    Midterm
    Professional development workshop

16   Reading Week – no class

23   Module I: Discussion
    Circuits I: Circadian rhythms

Mar 2  Module II: Building neural circuits: Developmental plasticity
    Circuits II: Locomotion

9    Module II: Discussion
    Circuits III: Gaze control; the VOR

16   Module III: Coordinating audio and visual maps in the optic tectum
    Circuits IV: The cerebellar circuit

23   Module III: Discussion
    Circuits V: Bat echolocation

30   Module IV: Addiction
    Circuits VI: Central pattern generators; regulatory circuits

April 6  Module IV: Discussion

TBA  Final Exam

Notes
1) The instructor and university reserve the right to modify portions of the course or course schedule, depending on special circumstances. Any such changes will be announced in class and posted on the course website. It is each student’s responsibility to check the course website on Avenue regularly for updates.

2) Anyone who wishes to record any part of the class must obtain the consent of all individuals present prior to recording the session; such consent must be obtained for each instance.