Neural Circuits

Instructors
Deda Gillespie  Instructor  dgillespie@mcmaster.ca
Sam Molot-Toker  Teaching Assistant  molottsa@mcmaster.ca

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

If you need an answer to your email, do not send email through Avenue.
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; BSB 120
Office hours:  Wednesdays 13:00-15:00, PC 310
TA office hours:  by appointment
course website:  Avenue

Course description
Neural Circuits is an introductory course in 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 modern 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 general principles of systems neuroscience
- 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
We are using this text for the first time. This text is targeted at upper-level undergraduate, and graduate, students. It was chosen primarily because it does a better job than some others of covering specific neural circuits; however, no text is perfect, and you may find this one assumes different levels of background
knowledge for different topics. If you need to review introductory concepts, we recommend Nicholls et al *From Neuron to Brain*. Please let your instructor know what works for you or doesn’t work for you about the text and all other readings for this course.

Readings will be posted on the course website on Avenue.

**Articles:** Within the modules sections 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.

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### Evaluation

**Distribution of marks**

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

Each lecture session will include at least one of these individual and/or group activities. They involve group discussion followed by the submission of a short written component, to be evaluated by the TA.

**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 and the TAs. Additionally, students will be evaluated on the quality and relevance of their contribution(s) to the discussion.

**Quizzes/written work**

At the beginning of most class sessions, students will submit homework or a short written assignment or take a short quiz covering the assigned reading for that session. The lowest mark of the written assignments and the lowest mark of the quizzes will be dropped. Written work will be marked by the TA for content, organization, grammar, and—above all—clarity. Some of the written assignments will 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 to Feb 3

**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**

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.

**Schedule**

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<thead>
<tr>
<th>January</th>
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<tr>
<td>6</td>
<td>Introduction to systems neuroscience</td>
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<td></td>
<td>Dissecting neural pathways</td>
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<td>The resting membrane potential</td>
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<td>13</td>
<td>The action potential</td>
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<td></td>
<td>Measuring neuronal activity (suprathreshold and multi-unit)</td>
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<td></td>
<td>Neurotransmitters</td>
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<td>The presynaptic terminal</td>
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<td>20</td>
<td>The post-synaptic element</td>
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<td></td>
<td>Synaptic transmission</td>
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<td></td>
<td>Measuring neuronal activity (subthreshold)</td>
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<td>Synaptic integration</td>
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<td>27</td>
<td>Long-term synaptic plasticity</td>
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<td>Stimulating neurons</td>
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<td>Reading, thinking, and writing about science</td>
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February

3 Midterm review
Module I: Building neuronal circuits: Axon Guidance

10 Midterm

17 Reading Week – no class

24 Module I: Discussion
Circuits I: Circadian rhythms

March

3 Module II: Building neural circuits: developmental plasticity
Circuits II: Central pattern generators

10 Module II: Discussion
Circuits III: Regulatory circuits

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

24 Module III: Discussion
Circuits V: Cardiovascular circuits

31 Module IV: Addiction
Circuits VI: Central Pattern Generators

Apr

7 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.