

THE SYNAPTIC ORGANIZATION AND PHYSIOLOGY OF THE BRAIN

NROC69

UNIVERSITY OF TORONTO SCARBOROUGH
WINTER 2015

Tuesday 11am-1pm, SW128

Instructor: Rutsuko Ito - Office hours: Tuesday 2-4pm, SW627

TAs: David Nguyen - Office hours (Lecture 1-4): Wednesday 5-6pm, SW625B

Bilgehan Cavdaroglu - Office hours (Lectures 5-10): Wednesday 5-6pm, SW625B

***Website:** Blackboard

***E-mail:** nro69.utsc@gmail.com

** Please post course/content related questions to relevant blackboard discussion forum for the benefit of other students. All other questions must be sent to nro69.utsc@gmail.com. Please note that emails pertaining to NROC69 sent to Professor Ito's or the TAs' personal accounts will NOT be answered.*

COURSE OVERVIEW

Synaptic organization is the study of principles underlying the organization of synapses and neurons into circuits that mediate the functional operations of different brain regions. It is a multidisciplinary and multi-level subject that integrates experimental findings from a vast number of disciplines including molecular neurobiology, neuroanatomy, neurochemistry, neurophysiology, neuropharmacology and behavioural neuroscience. We start with a focus on the property of the synapse as a basic unit of neural circuit organization, moving up to the property of whole neurons and multi-neuronal local circuits characteristic of a given brain region, then explore the interactions between various circuits forming a neural system, right up to system-system interactions that occur in a normal and abnormal brain. We will also explore some exciting new developments in the field such as the use of receptor knockouts in rodents to establish causal functions of specific receptors, optogenetic techniques in the investigation of neural circuitries in brain function, and the approach of looking at network oscillations in the brain as underlying certain functions.

COURSE OBJECTIVES

By the end of the course:

- You will understand the core principles of how the brain is organised at the systems, circuit, and synaptic level to achieve complex information processing.
- You will understand how electrical signals are generated, and transmitted throughout the brain.
- You will understand how synaptic organization in a particular brain area is related to its function.
- You will understand the methodologies (some of which are very current!) used in the field of cellular neurobiology.
- You will be able to read critically, and appreciate at a fairly sophisticated level, articles written in the field of cellular neurobiology.

COURSE READING

The lecture series will be loosely based on a book entitled Synaptic Organization of the Brain, (Gordon M Shepherd, 5th Ed). However, there will be no assigned readings from this book. Instead, assigned readings will consist of a lecture handout and original empirical articles pertaining to the lecture topic. You will be assessed on the content of the handouts/papers.

TENTATIVE COURSE OUTLINE

Date	Topic
Jan 6	Organizational principles of the mammalian brain
Jan 13	Pre-synaptic and post-synaptic mechanisms of neurotransmission
Jan 20	Synaptic integration and neuromodulation
Jan 27	Basic and cutting edge techniques in cellular neuroscience
Feb 3	Midterm test on lectures 1-4 (2hrs)
Feb 10	Synaptic organization of the thalamus
Feb 17	Reading Week - no class!
Feb 24	Synaptic organization of the basal ganglia Critical analysis paper assignment due 27th Feb
Mar 3	Synaptic organization of the hippocampus
Mar 10	Synaptic plasticity and learning
Mar 17	Midterm test on lectures 5-8 (2hrs)
Mar 23	Synaptic organization of the neocortex
Mar 30	Synapses in networks: network oscillations
Final exam	Date TBA by Registrar (3hrs)

Resources: Lectures slides and PDFs of papers for assigned reading will be posted on the course website (in the “Content” section) **by midnight at the latest** the night before the lecture. Other resources (such as videolinks, revision notes) will become available throughout the course to supplement the lecture slides.

Scheduling conflict: A web option will not be offered for this course, so it would be your responsibility to ensure that you are able to attend all the lectures. ***We will not answer emails concerning scheduling conflict.***

EVALUATION

The tests will be based on the materials covered in the lectures, the handouts and empirical papers.

Midterm Tests 1 & 2 (25% overall grade each)

Each test will consist of multiple-choice questions and short answer questions (equal weighting of two sections) on the material covered in the preceding 4 lectures.

Critical analysis assignment (15% overall grade):

You will be provided with an empirical article, and you will be required to write a critique on the assigned paper. The article will be assigned the week of January 20th and will be due **Feb 27th**. This will give you practice in developing your analytical and scientific writing skills for the final exam and give you the opportunity to get feedback on areas that require improvement.

The paper must be a maximum of 4 pages, excluding references, double spaced, in Times New Roman font, with 1" margins. References must be cited using Journal of Science format. Details of the content of the assignment will be posted.

Final exam (35% overall grade)

This exam will have 3 sections:

- 1) **Multiple-choice questions (5% overall grade)** on lectures 9 and 10.
- 2) **Short essay (15% overall grade):** Five essay questions covering different topics presented in lectures 1-8 will be given to you *two weeks in advance*. In the final exam itself, you will be presented with 3 of the 5 questions that you have prepared, of which you will only have to answer 1 question. The essay must have an introduction, main body and a conclusion. A guideline for essay writing will be posted on blackboard.
- 3) **Critical analysis of empirical paper (15% overall grade):** You will be provided with an empirical paper to read two weeks before the final exam date. In the exam, you will be required to answer questions that are designed to test your understanding of the paper, as well as the research topic.

The best strategy for the final exam is for you to learn the material for lectures 9 and 10, and then select three or four of the earlier lectures that most interest you to revise in detail. ***It is also essential that you read the assigned papers from each lecture and become familiar with the format of scientific writing. I will also provide some questions that will go with some of the papers that will help you to critically analyse the paper.***

COURSE POLICIES

Missed exams

You are expected to make every effort to take required mid-terms/final exam. Absence from a mid-term/exam will only be granted for genuine, legitimate reasons, including a documented family emergency, or a documented severe illness. If you miss the first midterm, ***your second midterm will be a cumulative exam (based on lecture materials 1-8).*** If you miss the second midterm, ***there will be one make up exam in the week of March 26th.*** However, ***please note that this exam will be very close to your final exam, and will take away from important time that you could be revising for the final exam. Mid-terms/exams that are missed without a genuine, legitimate reason will receive a 0% mark.***

Grading

Scale

NUMERICAL MARKS	LETTER GRADE	GRADE POINT VALUE
90 - 100%	A+	4.0
85 - 89%	A	4.0
80 - 84%	A-	3.7
77 - 79%	B+	3.3
73 - 76%	B	3.0
70 - 72%	B-	2.7
67 - 69%	C+	2.3
63 - 66%	C	2.0
60 - 62%	C-	1.7
57 - 59%	D+	1.3
53 - 56%	D	1.0
50 - 52%	D-	0.7
0 - 49%	F	0.0

Guidelines (<http://www.writing.utoronto.ca/advice/general/grading-policy>):

A+ Outstanding performance, exceeding even the A described below.

A Exceptional performance: strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter with sound critical evaluations; evidence of extensive knowledge base.

B Good performance: evidence of grasp of subject matter; some evidence of critical capacity and analytic ability; reasonable understanding of relevant issues; evidence of familiarity with the literature.

C Intellectually adequate performance: student who is profiting from her or his university experience; understanding of the subject matter and ability to develop solutions to simple problems in the material.

D Minimally acceptable performance: some evidence of familiarity with subject matter and some evidence that critical and analytic skills have been developed.

F Inadequate performance: little evidence of even superficial understanding of the subject matter; weakness in critical and analytic skills; with limited or irrelevant use of literature.

Note: for all written work, consistently poor spelling/grammar will be penalised. Please make use of the UTSC writing centre if you feel you need additional help with writing or want to develop your writing skills further: <http://ctl.utsc.utoronto.ca/twc/>.

Contesting a grade

All requests for a re-grade must be submitted **in writing** within two weeks of the day the grade is received. Only requests that include adequate written justification of an error in the original grading will be considered. *A legitimate request will result in the entire exam or assignment being re-graded. Your overall grade may be raised, lowered, or it may stay the same.* If there has been an error in our arithmetic, please let us know and we will immediately recalculate your grade (no written request necessary). **Arbitrary requests for grade increases will not be entertained (e.g., "I need to get into grad school, so could you please give me a higher grade?").**

Video and Auditory Recording

For reasons of privacy as well as protection of copyright, unauthorized video or audio recording in classrooms is prohibited. This is outlined in the Provost's guidelines on *Appropriate Use of Information and Communication Technology*. Note, however, that these guidelines include the provision that students may obtain consent to record lectures and, "in the case of private use by students with disabilities, the instructor's consent must not be unreasonably withheld."

Copyright of lecture material

As protection of copyright, unauthorized copying, use, or uploading on www of any of the lecture slides, lecture handouts produced by Professor Ito is strictly prohibited.

Accessibility

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca.

Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very

seriously. The University of Toronto's Code of Behaviour on Academic Matters (<http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

On tests and exams:

- Using or possessing unauthorized aids.
- Looking at someone else's answers during an exam or test.
- Misrepresenting your identity.

In academic work:

- Falsifying institutional documents or grades.
- Falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see <http://www.utoronto.ca/academicintegrity/>).