NSC 241: Neurons, Circuits, and Systems

Term: Fall 2018
Meeting Day/Time: Tuesdays, Thursdays 9:40AM-10:55AM
Meeting Location: Harkness Hall Room 210

4 Credits: In addition to the 3 credit hours (150 minutes) of in-class instructed time per week, students will meet for 1 credit hour (50 minutes) per week to discuss original research papers prior to in-class discussions. Refer to Credit Hour Policy below.

Pre-requisites: NSC 201/BCS 240
Cross listed: BCS 241, CVS 241, NSC 241 (P)

Instructor: Farran Briggs, PhD, Associate Professor of Neuroscience and Brain and Cognitive Sciences
Instructor email: farran_briggs@urmc.rochester.edu
Instructor office: 314 Meliora
Office Hours: Mondays 1-3PM, Wednesdays 3-5PM (for alternative appointments, please email the instructor)

Course Description:
This course takes a bottom-up approach to understanding the neurons and circuits of the sensory systems in the mammalian brain. Thematic topics will include: structural and functional diversity among sensory neuronal populations, common themes across sensory systems such as parallel information processing, coordination among feedforward/feedback circuits, and neuronal plasticity during development of functional domains. The final course module will focus on exploring the neuronal mechanisms of attention, again from a neuron- and circuit-centric perspective. Visual, auditory, and somatosensory systems will be discussed with most emphasis on the visual system as a model for understanding structure/function relationships. The course will also introduce students to modern methodological approaches in systems neuroscience aimed at measuring and manipulating the activity of large populations of neurons while also incorporating information about individual neuronal identity, structure, and circuit connectivity.

Evaluations:
• 20% of final grade will be based on participation throughout the course. Students must attend all classes to receive the full participation credit (excused absences must be requested in writing prior to absence). Participation includes asking questions, active participation in discussions, and answering pop quiz questions based on recently covered material. Participation in independent out-of-class, student-led small group discussions (to satisfy the Credit Hour Policy, see below) will be assessed through a short write-up that will be turned in prior to the next class. All write-ups must be turned in on time in order to receive full participation credit. A write-up template is attached.

• 45% of final grade will be based on performance on three written take-home examinations. These will be short (2-3 pages) critical evaluations of original research papers (papers will be assigned) relevant to topics covered in class.
• 35% of final grade will be based on performance on a final take-home examination. This longer format essay (6-page limit) will be on a subject chosen by each student under the topic of cellular and circuit mechanisms of perceptual phenomena. A topic proposal will be due two weeks prior to the due date for the final exam (Wednesday, Dec. 19th at 4PM). The instructor will review each topic with each student to ensure it will satisfy the final exam requirements.
• Any late submissions of assignments will be given a maximum of half credit.

Resources:
• Blackboard will be used to access reading materials, submit assignments, and receive grades. Additional resources and resource links will also be available through the course page on Blackboard.
• Course texts will be listed in this syllabus and included on Blackboard, listed in reference to each class session.
• Library resources can also be accessed through the course page on Blackboard and include published research databases such as PubMed.

Assessment and Student Support:
• *Course Learning Outcomes:* The objectives of this course are to provide a foundation of knowledge about the structure, organization, and function of sensory systems, to provide students with skills to critically evaluate scientific literature, and to advance students' skills at critical scientific writing. Assessment of these acquired skills will be through participation in discussions and through written assignments.

• *Academic Support Services:* Center for Excellence in Teaching and Learning (https://www.rochester.edu/college/cetl/); Writing, Speaking, and Argument Program (https://writing.rochester.edu)

Policies:
• *Academic Honesty:* All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy. You are encouraged to discuss course readings and assignments with your fellow students. However, all written work must be done independently and not in collaboration with another. In order to make appropriate help available for your essays, I encourage you to consult with me and with the College Writing, Speaking and Argument Program. The final research paper will require citations and "Works Cited" following the MLA format. More information is available at: www.rochester.edu/college/honesty

• *Plagiarism:* Please refer to the Honesty Policy (www.rochester.edu/college/honesty) for a definition of plagiarism. In scientific writing, plagiarism includes improper citation of primary sources. All citations in written assignments must follow the MLA format and include page numbers for cited articles and materials. Sources must be given regardless of whether the idea, phrase or other material is quoted directly, paraphrased

or summarized in the student-writer's own words. Direct quotes must always be placed in quotation marks in addition to the other citation information that is required.

• *Rules for Collaboration:* The intent of these rules is to help you share ideas with other students that can help you to do the assignments well, while preventing you from substituting (accidentally or intentionally) the words of other students for your own in your written work. 1) You may verbally discuss any aspects of any assignment (including ideas about how to do it well) with anyone face-to-face or via phone or video call. 2) Do NOT discuss any aspect of any assignment with classmates via email, text message, chat/IM, online discussion forum, social media post or any other written means. Please note that you are encouraged to discuss any aspect of any assignment with the course instructor and you are welcome to take notes on the basis of these interactions. Only primary sources are acceptable citations in your written assignments (e.g. commentary about original research that is not your own is not permitted). All assignments will be checked for overlapping wording. If the instructor suspects that you have violated the rules on collaboration or use of sources, the instructor will report this as a violation of the University's policy on academic honesty, and this can result in severe sanctions.

• *Disability Resources:* The University of Rochester respects and welcomes students of all backgrounds and abilities. In the event you encounter any barrier(s) to full participation in this course due to the impact of disability, please contact the Office of Disability Resources. The access coordinators in the Office of Disability Resources can meet with you to discuss the barriers you are experiencing and explain the eligibility process for establishing academic accommodations. You can reach the Office of Disability Resources at: http://disability@rochester.edu or (585) 276-5075, Taylor Hall.

• *Attendance Policy:* Any excused absences must be requested in writing prior to the absence. Students are expected to attend all classes to receive full credit for the participation portion of their grade.

• *Credit Hour Policy:* This course follows the College credit hour policy for 4-credit courses. This course meets twice weekly for 3 hours (150 minutes) per week. The course also includes independent out-of-class, student-led small group discussions for 1 hour (50 minutes) per week. In this course, students will complete the enriched independent out-of-class, student-led small group discussions of original research papers that will be assigned each week and made available through Blackboard. These small group discussions will prepare students for in-class discussions of the readings in which student participation will count toward the participation portion of the final grade. Part of the participation portion of the grade will be on-time submission of write-ups of small group discussions. These will be due prior to the next class meeting. These independent small group discussions should not be considered "additional" or "extra" activities, but required course sessions and on-time completion of write-ups will count toward the participation grade.

• *Inclusivity Policy:* All interactions within and associated with this course should adhere to the University's mission to support a diverse and inclusive community. For further information, please refer to: https://www.rochester.edu/diversity/reports/mission/

• *Incomplete Policy:* This course follows the University's policy on incomplete grades: https://www.rochester.edu/college/ccas/handbook/incompletes.html

• *S/F Policy:* The Satisfactory/Fail (S/F) option is available for this course. Please refer to: https://www.rochester.edu/college/ccas/handbook/satisfactory-fail-option.html

• *Withdrawal Policy:* This course follows the University's policy on course withdrawals: https://www.rochester.edu/college/ccas/handbook/withdrawal.html

Course Schedule:
(Schedule of class sessions with reading assignments)
Thurs. Aug. 30th – Course requirements; Introduction to sensory systems plus some techniques and tools [Kandel Chapter 21; Briggs 2017]

Tues. Sept. 4th – Retina 1: Cell types, organization [Field & Chichilnisky, 2007; Dacey et al, 2014; Kandel Chapter 26]

Thurs. Sept. 6th – Retina 2: Building receptive fields [Field et al, 2010]

Tues. Sept. 11th – Thalamus 1: Organization [Kaplan 2004; Weyand 2016; Hirsch et al, 2015]

Thurs. Sept. 13th – Thalamus 2: Functional properties [Soto-Sanchez et al, 2017]

Tues. Sept. 18th – Primary Visual Cortex 1: Functional architecture [Van Hooser 2007; Nauhaus & Nielsen, 2014]

Thurs. Sept. 20th – Primary Visual Cortex 2: Receptive field transformations [Alonso & Reid, 1995]

Tues. Sept. 25th – Primary Visual Cortex 3: Neurons, circuits [Callaway Chapter 25]

Thurs. Sept. 27th – Primary Visual Cortex 4: Computations [Lee et al, 2016]
**Fri. Sept. 28th 4PM – Assignment 1 due [Roy et al, 2017 PNAS]

Tues. Oct. 2nd – Extrastriate Cortex 1: Streams, connections [Sincich & Horton, 2005; Manning & Britten, 2017; Pasupathy et al, 2017; Roe et al, 2012]

Thurs. Oct. 4th – Extrastriate Cortex 2: Functional transformations [Freeman et al, 2013]

Tues. Oct. 9th – Corticothalamic Interactions 1: Structure, organization [Briggs & Usrey, 2008; Hasse & Briggs, 2017a; Sherman & Guillery, 2011]

Thurs. Oct. 11th – Corticothalamic Interactions 2: Function [Hasse & Briggs, 2017b]

Tues. Oct. 16th – No class (Fall Break)

Thurs. Oct. 18th – Color vision [Conway 2009; Mancuso et al, 2009]

Tues. Oct. 23rd – Eye movements 1: Sensorimotor integration [Sommer & Wurtz, 2008; Wurtz et al, 2011]

Thurs. Oct. 25th – Eye movements 2: Neuronal mechanisms [Zirnsak et al, 2014]
**Fri. Oct. 26th 4PM – Assignment 2 due [Kondo & Ohki, 2016 + Roth et al, 2016]

Tues. Oct. 30th – Plasticity/Development 1: Neurons, circuits [Espinosa & Stryker, 2012]

Thurs. Nov. 1st – Plasticity/Development 2: Functional properties [Li et al, 2008]

Tues. Nov. 6th – Guest Lecture Dr. Laurel Carney: Early auditory processing [Romanski & Averbeck, 2009]

Thurs. Nov. 8th – Guest Lecture Dr. Liz Romanski: Auditory cortex structure, function [Rauschecker et al, 1995]

Tues. Nov. 13th – Somatosensory System 1 [Estebanez et al, 2018]

Thurs. Nov. 15th – Somatosensory System 2

Tues. Nov. 20th – Olfaction [Cohen et al, 2017]
**Weds. Nov. 21st 4PM – Assignment 3 due [Joiner et al, 2017]

Thurs. Nov. 21st – No class (Thanksgiving Break)

Tues. Nov. 27th – Multisensory integration 1 [Choi et al, 2018]

Thurs. Nov. 29th – Multisensory integration 2 [Wimmer et al, 2015]

Tues. Dec. 4th – Attention 1 [Maunsell Chapter; Maunsell 2015]
**Weds. Dec. 5th 4PM – Final written exam proposal due

Thurs. Dec. 6th – Attention 2

Tues. Dec. 11th – Attention 3 (Last class) [Zenon & Krauzlis, 2012]

**Weds. Dec. 19th 4PM – Final written exam due