REPRESENTATIVE SYLLABUS
CONTENT OF FUTURE COURSES MAY VARY

NEUR 3010

METHODS IN NEUROSCIENCE (3 credit hours)

Instructor - [redacted]

E-mail [redacted]
Office [redacted]
Office hours - [redacted]
Class days/time/place – [redacted]
Laboratory – [redacted]

Description
The goal of the course is to introduce students to a broad range of modern techniques used in neuroscience research. The course will be focused on understanding how information about brain and nervous system function can be determined based on current and new experimental and data analysis techniques. Techniques will span micro to macro scales, direct and indirect measures, invasive and noninvasive techniques. Particular attention to understanding strengths and weaknesses of various techniques, and the importance of strong experimental design and analysis in interpreting results.

Prerequisites:
NEUR 2001; and CS 1301 or CS 1315 or CS 1371; and Physics 2212

Required Textbook:
Matt Carter and Jennifer Shieh (2015) Guide to Research Techniques in Neuroscience. Academic Press.
Other books, reviews, and papers indicated in lecture notes and/or posted on T-square.

Learning Objectives:
Upon completion of this course, students will be able to:

1. Explain fundamental principles underlying a variety of neural measurement techniques
2. Identify advantages and disadvantages of a variety of neural measurement techniques
3. Read and critique the methods section of a neuroscience paper
4. Understand how data is used to answer neuroscientific questions
5. Identify ethical issues related to measuring neural activity

Grading:
Exams (3 in-class exams) – 60%
Weekly quizzes and homework– 20%.
Group project reports – 20%

Academic Integrity: Georgia Tech does not tolerate academic dishonesty. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. Plagiarism includes reproducing the words of others without both the use of quotation marks and citation. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Code of Conduct, available online at www.honor.gatech.edu.

Excused Absences Policy
In the event of a medical emergency or an illness that is severe enough to require medical attention, students are responsible for contacting the Office of the Dean of Students as soon as possible. Additional details are available online: http://www.catalog.gatech.edu/rules/4/

Learning Accommodations: If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services (http://disabilityservices.gatech.edu/)

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Schedule of Topics:

Section 1 ***Principles***

Week 1: What is the signal?
Analog vs digital, Modalities: electrical (spikes), chemical l(neuromodulators), physical (MRI), etc

Week 2: What is measured?
Micro vs macro scale, indirect measurements, invasive vs not

Week 3: What is needed? Experimental design, data analysis, and power analyses
Necessary/sufficient, correlation vs causation, magnitude of effect, replication, confounds & assumptions

Week 4: In-class activity: Deconstructing the methods section in a scientific paper
In-class exam on weeks 1-3

Section 2 ***Observation: from macro to micro scales***

Week 5: Behavior for basic science and clinical evaluation
Psychophysics vs digital tools for monitoring real-world behavior

Week 6: Whole brain activity during behavior
fMRI, EEG, MEG

Week 7: Largescale recordings of spiking activity during behavior
Temporal and spatial resolution and scales

Week 8: In-class activity: What does data look like before it's analyzed and published?
In-class exam on weeks 5-8

Section 3 ***Perturbation: necessary and sufficient***

Week 9: Lesions in humans and other animals
Redundancy and compensation, human vs many other animals studies, conditional gene knock outs

Week 10: Transcranial stimulation
Physical effects of stimulation on complex tissue

Week 11: Optogenetics
Genetics, optics, neuron biophysics

Week 12: In-class activity: Same question, different paper, different method.
In-class exam on weeks 9-11

Section 4 ***Applications and implications***

Week 13: What are the needs for new methods in neuroscience?
Directed reading of primary literature

Week 14: How is does neural measurement data impact science and society?
Group report due: Literature review of a developing method in neuroscience

Week 15: Guest lecture: new methods in neuroscience research
Group report due: Ethical and societal considerations of measuring neural activity