NJIT BIOLOGY

Course Syllabus

FALL 2019

BIOLOGY 498-001: COMPUTATIONAL NEUROSCIENCE

INSTRUCTOR:	Dr. Horacio Rotstein (horacio@njit.edu)	**OFFICE HOURS:** By Appointment Only (Email)	
COURSE SCHEDULE:	M,W: 1:00pm-2:20pm in CKB 219	**COURSE WEBSITE:**	https://canvas.njit.edu/ BIOL 498

OBJECTIVE:

A mathematical and computational introduction to the biophysical mechanisms that underlie physiological functions of single neurons and synapses. Topics include voltage-dependent channel gating mechanisms, the Hodgkin-Huxley model for membrane excitability, repetitive and burst firing, nerve impulse propagation in axons and dendrites, single- and multi-compartmental modeling, synaptic transmission, calcium handling dynamics and calcium dependent currents and processes, dynamical systems tools for the analysis of mechanisms of neural activity.

PREREQUISITE: Permission by instructor.

REQUIRED TEXT:

"An Introductory Course in Computational Neuroscience" by P. Miller – MIT Press (2018), 1st edition, ISBN: 978-0262038256. Be sure to have access to Canvas (https://canvas.njit.edu/, login with UCID) and visit the website designed for BIOL 498

RECOMMENDED BOOKS: "Mathematical Foundations of Neuroscience" by G. B. Ermentrout & D. H. Terman – Springer (2010), 1st edition - ISBN: 978-0-387-87707-5.

"Foundations of Cellular Neurophysiology" by D. Johnston & S. Wu – The MIT Press (1995) - ISBN: 0-262-100053-3.

"Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting" by E. M. Izhikevich – The MIT Press (2007), 1st edition – ISBN: 0-262-09043-8.

"Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems" by P. Dayan & L. Abbott – The MIT Press (2001), 1st edition– ISBN: 0-262-04199-5.

"Biophysics of Computation: Information Processing in Single Neurons" by C. Koch – Oxford University Press (1999) – ISBN: 0-19-510491-9

CLASS POLICIES:

Students must attend all classes.

Absences from class will inhibit your ability to fully participate in class discussions and problem solving sessions and, therefore, affect your grade

Tardiness to class is very disruptive to the instructor and students and will not be tolerated

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MAKEUP EXAM POLICY:

There will be no makeup exams, except in rare and extenuating situations where the student has a legitimate reason for missing an exam. The student must notify the NJIT Math office and the Instructor that he/she will miss an exam. In all cases, the student must present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc., clearly stating the date AND times of the mitigating problem.

CELLULAR PHONES:

All cellular phones, beepers and other electronic devices must be switched off during class and exam times (except when specifically allowed by the instructor). Chatting in class using electronic devices will not be tolerated.

GRADING POLICY:

GRADE DISTRIBUTION	Percentage
Homework, Quizzes & Class Participation	40%
Midterm Exam	30%
Final Exam	30%
TOTAL	**100%**

A	90-100
B+	80-89
B	73-79
C+	67-72
C	59-65
F	0-58

IMPORTANT DATES	
FIRST DAY OF SEMESTER	Sep 3, 2019
LAST DAY TO ADD/DROP	Sep 13, 2019
THANKSGIVING RECESS	Nov 28-Dec. 01, 2019
LAST DAY TO WITHDRAW	Nov 11, 2019
LAST DAY OF CLASSES	December 11, 2019
FINAL EXAM PERIOD	December 14-20, 2019

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IMPORTANT RULES AND POLICIES

- The Academic Integrity Code is strictly enforced.
- **Plagiarized assignments will receive an automatic zero grade; the student will receive an F in the course and will be reported to the Dean of Student Affairs.**
- There will be no make-up assignments.
- The grade of assignments/ classes missed because of a valid excuse will be determined on a case-by-case basis.

SCHEDULE AND COURSE OUTLINE:

WEEK OF		LECTURE TOPICS	NOTES
Week 1	9/4	Introduction to Mathematical and Computational Neuroscience Passive membrane properties – The passive membrane equation	**9/2:** Labor Day – No Classes
Week 2	9/9 9/11	Ordinary differential equations (ODEs): Review of analytical methods Ordinary differential equations (ODEs): Review of numerical methods and Matlab	
Week 3	9/16 9/18	Dynamics of the passive membrane The passive membrane equation	
Week 4	9/23 9/25	Integrate-and-fire models The Hodgkin-Huxley model	
Week 5	9/30 10/2	Hodgkin-Huxley type models with additional ionic currents The cable equation	
Week 6	10/7 10/9	Introduction to dynamical system methods for neural models Reduced one- and two-dimensional neural model	
Week 7	10/14 10/16	One-dimensional neural models: Phase-space analysis	
Week 8	10/21 10/23	Two-dimensional neural models: Phase-space analysis I	
Week 9	10/28 10/30	Two-dimensional neural models: Phase-space analysis II	
Week 10	11/4 11/6	Sub-threshold oscillations: Two and Three dimensional models Bursting	
Week 11	11/11 11/13	Synaptic dynamics	
Week 12	11/18 11/20	Overview on network dynamics	
Week 13	11/25 11/27	Student Presentations.	
Week 14	12/2 12/6	Student Presentations	
Week 15	12/9 12/11	Student Presentations	
FINAL EXAM WEEK: DECEMBER 14-20, 2019			