

# Fall 2025 Course Syllabus

## Math430

<b>Course Title:</b>	Analytical & Computational Neuroscience
<b>Textbook:</b>	“An Introductory Course in Computational Neuroscience” by P. Miller – MIT Press (2018), 1 <sup>st</sup> edition, ISBN: 978-0262038256
<b>Recommended Books:</b>	<p>“Mathematical Foundations of Neuroscience” by G. B. Ermentrout &amp; D. H. Terman – Springer (2010), 1<sup>st</sup> edition - ISBN: 978-0-387-87707-5.</p> <p>“Foundations of Cellular Neurophysiology” by D. Johnston &amp; S. Wu – The MIT Press (1995) - ISBN: 0-262-100053-3.</p> <p>“Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting” by E. M. Izhikevich – The MIT Press (2007), 1<sup>st</sup> edition – ISBN: 0-262-09043-8.</p> <p>“Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems” by P. Dayan &amp; L. Abbott – The MIT Press (2001) , 1<sup>st</sup> edition– ISBN: 0-262-04199-5.</p> <p>“Biophysics of Computation: Information Processing in Single Neurons” by C. Koch – Oxford University Press (1999) – ISBN: 0-19-510491-9</p>
<b>Prerequisites:</b>	<a href="#">NJIT Catalog</a> or Permission by instructor
<b>Website:</b>	<a href="http://web.njit.edu/~horacio/IntroCompNeuro/IntroCompNeuroF25.html">http://web.njit.edu/~horacio/IntroCompNeuro/IntroCompNeuroF25.html</a>

Week	Topic	Assignment
1	General Discussion about the course Introduction to Mathematical and Computational Neuroscience Passive membrane properties – The passive membrane equation	See course website
2	Ordinary differential equations (ODEs): Review of analytical methods Ordinary differential equations (ODEs): Review of numerical methods (MATLAB, Python)	“
3	Dynamics of the passive membrane The passive membrane equation	“
4	Integrate-and-fire models. The Hodgkin-Huxley model	“

5	Hodgkin-Huxley type models with additional ionic currents The cable equation	“
6	Reduced models and reduction of dimensions	“
7	Introduction to dynamical system methods for neural models	“
8	One-dimensional neural models: Phase-space analysis I	“
9	Two-dimensional neural models: Phase-space analysis II	“
10	Sub-threshold and mixed-mode oscillations, resonance, entrainment, bursting	“
11	Synaptic dynamics & short-term plasticity	
12	Network dynamics: small networks	“
13	Network dynamics: large networks	“
14	Student Presentations	“
15	Student Presentations	“

IMPORTANT DATES	
FIRST DAY OF SEMESTER	Sep 2, 2025
LAST DAY TO ADD/DROP	Sep 8, 2025
THANKSGIVING RECESS	Nov 27 - 30, 2025
LAST DAY TO WITHDRAW	Nov 11, 2025
LAST DAY OF CLASSES	December 11, 2025
READING DAYS	December 12, 2025
FINAL EXAM PERIOD	December 14-20, 2025

### Grading Policy (tentative)

Assignment Weighting	
Homework, Quizzes, Mini Projects & Class Participation	40
Midterm Exam / Project	30
Final Project / Presentation	30

Tentative Grading Scale	
A	90 -- 100
B+	85 -- 89
B	80 -- 84
C+	75 -- 79
C	70 -- 74
D	60 -- 69
F	0 -- 59

Course Policies: See course website.

