NJIT BIOLOGY

Course Syllabus

FALL 2017

BIOLOGY 640-001: Cellular Neurophysiology

INSTRUCTOR:	Dr. Dirk Bucher	**EMAIL:**	bucher@njit.edu
OFFICE:	420G Central King Bldg.	**OFFICE HOURS:**	M, R: 2:00PM - 3:00PM
COURSE SCHEDULE:	M, R: 4:00PM – 5:25PM ▪ CKB 212	**COURSE WEBSITE:**	http://moodle.njit.edu/

COURSE DESCRIPTION: This course will examine the nervous system from a functional perspective. The goal is to understand how ion channels and other components of nerve cells give rise to electrical excitability and synaptic function, and how those properties are then used for coding information and higher order function in the nervous system.

TEXTBOOK:

"From Neuron to Brain", 5th Ed, Nicholls et al.; Sinauer 2012; ISBN 9780878936090. Be sure to have access to Moodle2, login with UCID).

LEARNING OUTCOMES:

STUDENTS WILL BE ABLE TO:

- To understand in some detail how electrical and chemical signaling within and between nerve cells works.
- To understand the experimental and theoretical approaches used to study neurophysiology, both for basic research and medical diagnostics.
- To understand fundamental principles of how the nervous system uses electrical activity to encode and decode information about the outside world and internal states.
- To further develop critical thinking and communication skills. This will be measured in the ability to interpret graphs, experimental designs, and problem discussion. Students will be required to participate in instructor-led discussions of the material as they analyze problems and propose possible mechanisms used by neurons to solve them. Weekly quizzes will be used to test some of these goals and reinforce the learning of the material.

IMPORTANT RULES AND COURSE POLICIES:

- **Academic Integrity:** The Academic Integrity Code strictly enforced!
- **Electronic Devices:** The use of cell phones and other electronic devices during class or exam times is prohibited.
- **Make-Up Exams and Quizzes:** If you miss an exam due to a valid medical excuse you need to provide a doctor's note or other valid and verifiable documentation. The grade of exams missed for a valid reason will be determined on a case-by-case basis.

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GRADING POLICY: The final grade in this course is determined as follows:

ASSIGNMENT	PERCENTAGE
Participation & Weekly Quizzes	25%
Midterm Exam I:	20%
Midterm Exam II:	20%
Final Exam:	35%
TOTAL:	**100%**

GRADE SCALE:	
A	88.1-100
B+	80.1-88
B	73.1-80
C+	66.1-73
C	60.1-66
F	0-60

***TENTATIVE* COURSE OUTLINE:** Class will meet twice every week, unless otherwise noted.

	LECTURE TOPICS
Week 1	Introduction and course overview – What is Neurophysiology?
	Section 1: Intrinsic neuronal properties
Week 2	*[Sept. 11: last day to Add/Drop a class]* Neurons and glia cells: Morphological and molecular diversity.
	Membrane potential I: Ions, channels, Nernst Equation.
Week 3	Membrane potential II: GHK equation and equivalent circuit
	Passive properties: Input resistance, capacitance, length constant, time constant.
Week 4	Action potential I: Ionic mechanisms
	Action potential II: Hodgkin-Huxley formalism, propagation, myelination
Week 5	Diversity of voltage-gated channels: molecular identities and effect on neuronal firing
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Week 6	***Section 2: Synaptic signaling***
	Review, Q&A session
Week 7	**MIDTERM EXAM I**
	Electrical and chemical transmission: Gap junctions, crayfish escape system, frog neuromuscular junction.
Week 8	Central synapses, small molecule transmitters and ionotropic receptors.
	Metabotropic transmission, GPCRs, 2nd messenger signaling.
Week 9	Transmitter release I: Quantal analysis.
	Transmitter release II: SNARE complex, vesicle pools, postsynaptic receptors.
Week 10	Transmitter types: Synthesis, transport, release, re-uptake and degradation.
	Types of communication: Transmitters, neuromodulators, neurohormones.
Week 11	Synaptic plasticity I: Short-term synaptic dynamics.
	Synaptic plasticity II: Long-term synaptic dynamics. Aplysia gill withdrawal, LTP, LTD
Week 12	**MIDTERM EXAM II**

	THANKSGIVIVING BREAK, NO CLASS! 11/23-26
Week 13	***Section 3: Sensory transduction mechanisms and simple coding principles*** Sensory transduction, modalities, coding principles.
	Somatosensory and auditory coding
Week 14	Visual and chemosensory coding
	Motor coding: posture and movement control
Week 15	Review, Q&A session
	READING DAY, NO CLASS
FINAL EXAM WEEK: DECEMBER 15-21, 2017	