

NEUROPHYSIOLOGY - BIO 5433.001

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Text: Cellular and Molecular Neurobiology, 3rd Edition
C. Hammond, Editor
Academic Press

Prerequisites: BIO 3433 – Neurobiology or equivalent

Grading: 4 regular exams - Lowest grade dropped (60%)
Comprehensive Final – May 8 7:30-10:00 AM (40%)

There will be no make-up exams and there is no extra credit available for this course.

Summary:

The major goal of the course is to familiarize the student with general principles underlying the excitability of neurons, the biophysics of synaptic transmission, and the behavior of simple neuronal circuits. The course begins with a discussion of how the flow of ions across membranes provides the basis for membrane potentials and the generation of electrical signals in neurons (i.e. resting potential, generator potentials, synaptic potentials, pacemaker potentials, and action potentials). The ionic basis for the action potential is discussed in depth. This will lead to a general survey of major types of voltage-gated channels and their function. The course then transitions toward the biophysics and molecular physiology of synaptic transmission including quantal analysis, the calcium-dependence of synaptic transmission, ligand-gated and metabotropic receptors, and synaptic plasticity. Finally, simple neural systems are used as models of more complex neural circuits and how the fundamental cellular properties of neurons result in emergent network behavior.

Tentative Schedule*

Date		Hammond	Topic	
January		13	Introduction and overview	
		15	3	Ion Gradients
		20	3	Nernst Equation & Resting Potential
		22	3	Generator potentials and Synaptic potentials
		27		Voltage-response
		29		Exam 1
February		3	Intro to core conductor theory	
		5	8	Chemical and electrical synaptic transmission
		10	8, 9	Ionotropic receptors (Nicotinic acetylcholine and GABA _A receptors)
		12	10	Ionotropic receptors (AMPA, KA, and NMDA receptors)
		17	13	Passive synaptic integration
		19		Exam 2
		24	4	Action potentials & fast Na channels
March		26	4	Intro to Ion Channels
		3	4	Propagation of action potentials
		5	5	Voltage-gated Ca channels
		10		SPRING BREAK
		12		SPRING BREAK
		17	14	“Subliminal conductances”: LVA Ca channels, NaP, I _h , K _A & K _D , M-current, K _{IR}
		19		Exam 3
		24	6, 7	Transmitter release: Calcium-dependence
		26	7, 8	Transmitter release: Quantal nature
April		31		Short-term plasticity
		2	11	Metabotropic receptors - GABA _B
		7	12	Metabotropic receptors - mGluR
		9		Exam 4
		14	15	Non-linear dendrites
		16	16	Backpropagating spikes
		21	17	Firing patterns of neurons
		23	18	Synaptic plasticity
May		28	19	“Simple” circuits: reflexes, retina
		7		Final Exam – 7:30-10:00 AM

* Exam dates are *not* tentative, they are as scheduled.