

PHY 5300, Bioelectric Phenomena
4 Credit Hours
Winter 2021

Instructor: Eugene Surdutovich

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Class meets: MWF 1:20 – 2:27pm on Zoom

Office hours: upon request

Text: There is no required text in this course. There is a book that I consider as a supplement:
R. Plonsey and R.C. Barr, *Bioelectricity A Quantitative Approach*

Articles:

1. Hodgkin and Huxley. 1939. Action potentials recorded from inside a nerve fiber. *Nature* 144:710-711.
2. Hodgkin and Katz. 1949. The effect of sodium ions on the electrical activity of the giant axon of the squid. *J. Physiol.* 108:37-77.
3. Hodgkin and Huxley. 1952. A quantitative description of membrane current and its application to conduction and excitation in nerve. *J. Physiol.* 117:500-544.
4. Doyle et al. 1998. The structure of the potassium channel: Molecular basis of K⁺ conduction and selectivity. *Science* 280:69-77.
5. Sigworth and Neher. 1980. Single Na⁺ channel currents observed in cultured rat muscle cells. *Nature* 287:447-449.
6. Hodgkin and Rushton. 1946. The electrical constants of a crustacean nerve fibre. *Proc. Roy. Soc. Lond. B* 133:444-479.
7. Rattay. 1989. Analysis of models for extracellular fiber stimulation. *IEEE Trans. Biomed. Eng.* 36:676-682. *JAMA* 262:538-541.
8. Maccabee et al. 1993. Magnetic coil stimulation of straight and bent amphibian and mammalian peripheral nerve in vitro: Locus of excitation. *J. Physiol.* 460:201-219.
9. Roth et al. 1997. Dipole localization in patients with epilepsy using the realistically shaped head model. *Electroenceph. Clin. Neurophysiol.* 102:159-166.
10. Roth and Wikswo. 1985. The magnetic field of a single axon: A comparison of theory and experiment. *Biophys. J.* 48:93-109
11. Sepulveda et al. 1989. Current injection into a two-dimensional anisotropic bidomain. *Biophys. J.* 55:987-999.
12. Roth. 1995. A mathematical model of make and break electrical stimulation of cardiac tissue using a unipolar anode or cathode. *IEEE Trans. Biomed. Eng.* 42:1174-1184.
13. Frazier et al. 1989. Stimulus-induced critical point: Mechanism for electrical initiation of reentry in normal canine myocardium. *J. Clin. Invest.* 83:1039-1052.
14. Efimov et al. 1998. Virtual electrode-induced phase singularity: A basic mechanism of defibrillation failure. *Circ. Res.* 82:918-925.
15. Weiss et al. 1999. Chaos and the transition to ventricular fibrillation: A new approach to antiarrhythmic drug evaluation. *Circulation* 99:2819-2826.
16. Woods et al. 2006. Virtual electrode effects around an artificial heterogeneity during field stimulation of cardiac tissue. *Heart Rhythm* 3:751-752.
17. Rantner et al. 2013. Terminating ventricular tachyarrhythmias using far-field low-voltage stimuli: Mechanisms and delivery protocols. *Heart Rhythm* 10:1209-1217.

Grading:

Project 1		15%
Project 2		15%
Homework		15%
Discussions		10%
Exam 1		15%
Exam 1		15%
Exam 1		15%
Total		100%

A	96-100
A-	90-95
B+	85-89
B	80-84
B-	75-79
C+	70-74
C	65-69
C-	60-64
D+	55-59
D	50-54
F	< 50

Grading Scale:**Goals**

The main subject of this course is following the history of development of bioelectricity as an application of electromagnetism to biological medium in order to understand the nerve signal propagation, electrodynamics of heart and how this can be affected by external stimuli. We will go through major papers in these fields.

Besides, we will discuss writing a science paper, proposal, making a presentation, and other relevant topics related to doing research in the academic environment.