Bioengineering 6460 Electrophysiology and Bioelectricity of Tissues
Fall Semester, 2011
Syllabus

Rob MacLeod, John Bridge, Derek Dosdall, Alonso Moreno, Ravi Ranjan,
Mark Warren, and Frank Sachse

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Description

The goal of this class is to provide an intermediate level overview of electrophysiology and bioelectricity at the tissue level to graduate students with special interest in cardiology and neurosciences. We will develop the central electrical mechanisms from sets of coupled cells to the intact organ, building on those that are common to many electrically active cells in the body. The approach will be a combination of qualitative explanations, quantitative analysis, and mathematical simulation. The class format will include didactic lectures, group discussion of primary literature, quantitative problem solving exercises, writing assignments, and laboratory experiences. The prerequisite for the course are Bioengineering 6000 or equivalent or permission of the instructor and knowledge of university undergraduate level calculus and physics. Homework assignments will require the use of Matlab and the use of web based transfer of computer files.

Class time and venue

Class times: Tuesday and Thursday, 10:45–12:05
Classroom: CVRTI Library/Meeting room
Credits: three credit-hours

Instructors

Name	Phone	Email	Office	Hours
Rob MacLeod (RM)	7-9511	macleod@sci.utah.edu	WEB	by appt.
John Bridge (JB)	7-9533	bridge@cvrti.utah.edu	CVRTI	by appt.
Derek Dosdall (DD)	7-3789	derek.dosdall@carma.utah.edu	CARMA	by appt.
Alonso Moreno (AM)	7-5845	moreno@cvrti.utah.edu	CVRTI	by appt.
Ravi Ranjan (RR)	3-2273	ravi.ranjan@hsc.utah.edu	CARMA	by appt.
Frank Sachse (FS)	7-9514	fs@cvrti.utah.edu	CVRTI	by appt.
Mark Warren (MW)	1-8183	warren@cvrti.utah.edu	CVRTI	by appt.

Text

- **Bioelectricity: A Quantitative Approach**, Third Edition by Robert Plonsey and Roger C. Barr, Kluwer Academic/Plenumm Press

There should be copies of the book at the bookstore but I encourage you to use the web to search down copies. The third edition is the current edition and please try to get this one.

Resource materials

- **www.sci.utah.edu/~macleod/bioen/be6460/** The class web page and the dynamic source of all useful information.
- **Bioelectricity and Biomagnetism** by Ramesh M. Gulrajani. This book is perhaps the best of its genre but now out of print. If you find a cheap copy somewhere, grab it! There are ongoing efforts to get the rights to this book and make it freely available....stay tuned.
- **Computational Cardiology: Modeling Of Anatomy, Electrophysiology, And Mechanics** by Frank Sachse. Springer-Verlag New York, Inc. Secaucus, NJ, USA 2004 ISBN:3540219072. (ask Frank and he might even sign your copy).
- **Bioelectromagnetism** by Jaakko Malmivuo and Robert Plonsey. Good too and very cheap–free in fact on the web site `http://www.bem.fi/book/`
- **Mathematical Physiology** by James Keener and James Sneyd. Springer Verlag. (great all around book on modeling and simulation in physiology).
- **Mathematically Modeling the Electrical Activity of the Heart: From Cell to Body Surface and Back** by Andrew Pullan. World Scientific Publishing Company (September 30, 2005).
- Articles and selected readings from the literature.

Grading

The grade for the course will be based on homework assignments, writing assignments, and laboratory exercises/reports.

Lectures and Reading Material

Week#, Date	Instructor	Topic*	Reading†
1, Aug. 23/25	RM	Introduction and Biophysical background	1–3
2, Aug. 30–Sept. 1	JB	Cellular EP Review	4, 5
3, Sept. 6/8	AM	Cell to cell coupling	9.1
Sept. 6–8	**Multielectrode Measurement Lab**		
4, Sept. 13/15	FS	Micro-structural basis of cardiac conduction	6
5, Sept. 20/22	FS	Simulation of spread of activation	9.1, 9.2
6, Sept. 27/29	DD	Spread of excitation, extracellular potentials	6, 9.1
7, Oct. 4/6	DD	Measurement/signal processing of bioelectric fields	Notes
Oct. 10–15	**Fall Break**		
8, Oct. 18/20	MW	Fundamentals of arrhythmias	Notes
9, Oct. 25/27	FS	Simulation of arrhythmias	Notes
10, Nov. 1/3	MW	Arrhythmias II	Notes
Nov 1–3	**Arrhythmia Lab**		
11, Nov. 8/10	RR	Clinical EP studies	Notes
12, Nov. 15/17	RM	Biophysics of ECG & EEG/MEG	9.3
13, Nov. 22	RR	Clinical ECG & EEG	Notes
Nov 24–25	**Thanksgiving**		
14, Nov. 29/Dec. 1	RM	Bioelectric Forward and Inverse problems	8, 9.3
Nov. 15–17	**ECG Lab**		
15, Dec. 6/8	RM	Bioelectric Forward and Inverse problems	Notes

† Chapter numbers are from Plonsey and Barr Third Edition.

Instructor absences

Rob MacLeod

- Aug. 29 – Sept. 2
- Sept. 19–22

John Bridge

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Derek Dosdall

- Sept. 16–19
- Nov. 16–19

Alonso Moreno

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Ravi Ranjan

- Aug. 31-Sept 2
- Sept. 20–24
- Oct. 25
- Nov. 12–18

Frank Sachse

- Sept. 6
- Sept. 20
- Sept. 25–28

Mark Warren

- Oct. 3–7