ELEC ENG 3BB3:

Cellular Bioelectricity

Notes for Lecture #1

Tuesday, January 7, 2014

Instructor:

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Web Site:

http://www.ece.mcmaster.ca/faculty/debruin/debruin/

Course Mailing List:

(To be determined)

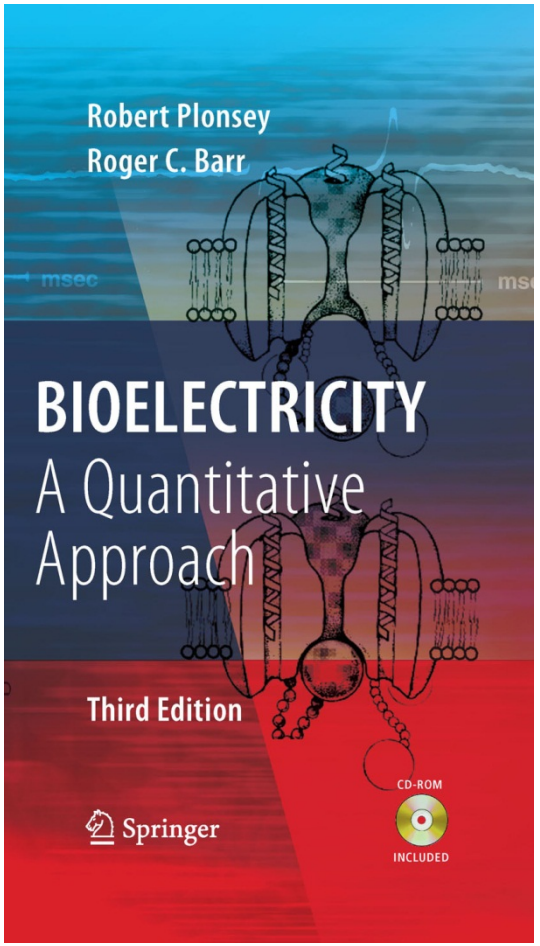
- This mailing list will be used as a primary means of communication for this course — please make sure that you check your email regularly!
- Only for instructor and TA use
- If you are not currently on this mailing list, please email me with your name, student number and email address.

Textbooks:

Required text:

R. Plonsey and R. C. Barr, "Bioelectricity: A Quantitative Approach," 3rd Edition, Springer, 2007.

Electronic copies (PDF files for each chapter) are free to download from the McMaster Library (available only for computers on the McMaster campus or logged in to the LibAccess system).



Textbooks (cont.):

Secondary references:

- D. Johnston and S. M.-S. Wu, “Foundations of cellular neurophysiology,” MIT Press, 1994.
- A. C. Guyton and J. E. Hall, “Textbook of Medical Physiology,” 10th Edition, W. B. Saunders, 2001. (12th Edition now available.)
- C. Koch, “Biophysics of computation: information processing in single neurons,” Oxford University Press, 1998.
- P. L. Nunez and R. Srinivasan, “Electric fields of the brain: the neurophysics of EEG,” 2nd Edition, Oxford University Press, 2005.
- B. Hille, “Ion Channels of Excitable Membranes,” 3rd Edition, Sinauer Associates, 2001.

Classes:

There will be ≤36 one-hour lectures (3/week) at:

8:30–9:20 am on Tuesdays, Thursdays and Fridays in ITB 139
and

≤12 one-hour tutorials (1 per week) at:

2:30 – 3:20 pm on Tuesdays in T13/105

Lecture notes in PDF format will be posted on the course web site.

Assessment:

- 1 Lab Assignment (10%)
- 3 Math Assignments (3£ 5% = 15%)
- 2 Midterm Quizzes (2£ 15% = 30%)
- Final exam (45%)

Assignments:

- 1 assignment will be a computer lab conducted during 2 class times in groups of 2 students
- 3 assignments will consist of take-home mathematical problems sets to be completed individually

Preparation:

Read:

- *Chapters 1 and 2 of the textbook*
  (these will not be comprehensively covered in class)

Review:

- *electrical circuit theory*
  (especially if you didn't do well in EE2CI5 and EE2CJ4)

Course Policies:

Calculator Requirement for Tests and Exams:

- McMaster Standard Calculator (Casio fx991) only

Deferred Exam Format:

- The instructor reserves the right to choose the format (i.e., written or oral) of any deferred midterm or final exam in this course.

Announcements re. graded material:

- Please note that announcements concerning any type of graded material may be in any format (e.g., announcements may be made only in class, via the course e-mailing list, or on the course web site). Students are responsible for completing the graded material regardless of whether they received the announcement or not.

Policy Reminders:

“The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons concerned, individuals are reminded they should contact the Departmental Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.”

“Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: 'Grade of F assigned for academic dishonesty'), and/or suspension or expulsion from the university.

“It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf

“The following illustrates only three forms of academic dishonesty:

1. **Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.**
2. **Improper collaboration in group work.**
3. **Copying or using unauthorized aids in tests and examinations.”**

Course Objectives:

To develop both a *qualitative* and a *quantitative* understanding of the generation and transmission of bioelectricity in and between excitable cells.

- qualitative) *describe* the fundamental biological, chemical, electrical and physical behaviours of excitable cells
- quantitative) *model* the electrical behaviour of excitable cells, primarily using *electrical circuit theory* and *electrical field theory*

Main Topics:

- Introduction to Bioelectricity and Excitable Cells
- Bioelectric Potentials and Currents
- Membrane Channels
- Action Potentials
- Impulse Propagation
- Electrical Stimulation of Excitable Tissue

Main Topics (cont.):

- Extracellular Fields
- Neural Electrophysiology
- Cardiac Electrophysiology
- The Neuromuscular Junction
- Skeletal Muscle
- Functional Electrical Stimulation

Setting Learning Goals:

In order reach the course objectives, as a class we will set learning goals based on:

- What do we already know of excitable cells and how can we deepen/strengthen our understanding?
- What do we understand qualitatively about excitable cells for which we could develop a quantitative (math/physics) framework?
- What gaps do we have in our fundamental knowledge of excitable cells?
- What do we need to learn in order to understand technologies such as biopotential measurement (EEG/EMG/ECG) and functional electrical stimulation?