This course will present a quantitative description of electrical activity in excitable cells. We will discuss microscopic and macroscopic mechanisms that generate membrane potentials; voltage-current characteristics of the cell membrane; the Hodgkin-Huxley model of action potential in the squid giant axon; and cell-to-cell and tissue-level propagation of the action potential. After successfully completing this course you will be able to:

**Understand**
1. state how diffusion and the electromotive force contribute to the cell resting potential
2. compute the resting potential from intra- and extracellular ion concentrations
3. develop an analog circuit model of an excitable cell membrane
4. describe the ionic currents that constitute the action potential

**Question**
5. interpret how changes in ion conductivities affect the action potential
6. predict the effects of channel blocking drugs on electrophysiological recordings

**Design**
7. design software to simulate an action potential waveform
8. implement a finite difference algorithm to integrate a differential equation

**Lead**
9. complete a software development project

**Communicate**
10. present simulation results in a formal written report

Instructor: Fred Vetter  
phone: 401-874-5141  
e-mail: vetter@ele.uri.edu  
mailbox: Pastore Hall 125  
office hours: W 10-11 am (Pastore Hall 125) or by appointment (Schneider Elect)  
web: www.ele.uri.edu/faculty/vetter/BME307

Classes: MWF 8:00 – 8:50 am, University Club 113


Prerequisites: ELE 212 (or ELE 220) and MTH 362 (or MTH 243)

<table>
<thead>
<tr>
<th>Grade distribution</th>
<th>Quizzes/Homework</th>
<th>10%</th>
<th>Grade</th>
<th>90–100%</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exam 1</td>
<td>20%</td>
<td>scale:</td>
<td>80–89%</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Exam 2</td>
<td>20%</td>
<td></td>
<td>70–79%</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Final</td>
<td>35%</td>
<td></td>
<td>60–63%</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>Simulation project</td>
<td>15%</td>
<td></td>
<td>&lt; 63%</td>
<td>F</td>
</tr>
</tbody>
</table>
Calculators  Scientific calculators should be used on exams and quizzes, unless otherwise specified. Cell phones and tablets (or any wireless devices) may not be used.

Exams  Exams will be closed-book. One notebook sheet for notes will be allowed. Pertinent reference material (tables, charts, etc.) will be provided with each exam. The exams will be comprehensive, covering all the material presented previously during the semester.

Quizzes  Quizzes will be modeled after the current homework assignment, and will be closed book/closed notes. You should bring a calculator to work the quizzes.

Homework  Homework will be assigned frequently and is the best way of keeping up with the course material. Answers to the problems are provided, but not the solutions. Discuss the homework problems with your classmates, but make a strong effort to solve the problems on your own; this will pay off on the exams and simulation project.

On some weeks, one homework problem will be collected and graded instead of having a quiz. During the prior class meeting I will announce whether the next class will end with a quiz or a collected homework problem.

Reading  weeks 1–2  Chapter 1, section 1.1–1.7.1

Schedule  weeks 3–5  Chapter 3, through 3.13.4. Skip sections 3.8.1 and 3.8.2.

weeks 6  Chapter 4, through 4.4

weeks 7–8  Chapter 4, skip material on the Bernoulli distribution and binomial theorem (between Equations 4.17 and 4.25)

weeks 9–12  Chapter 5, through 5.5

Academic Integrity  Cheating and plagiarism will be handled according to the University Manual section 8.27.10 through 8.27.21 (see web.uri.edu/manual/chapter-8/chapter-8-2/). The penalty for cheating or plagiarism can range from a zero score on the assignment to a failing grade for the course.

Important Dates  September 11  Last day for “Open Add”

September 18  Last day to add courses via permission number

September 26  Last day to drop courses without a W on transcript

October 8  No class, Columbus Day (Monday)

October 12  Exam 1 (Friday); room TBA

October 17  Last day to drop courses – W will appear on transcript

November 12  no class, Veteran’s Day (Monday)

November 13  Monday classes meet (Tuesday)

November 16  Exam 2 (Friday); room TBA

November 21, 23  no class, Thanksgiving (Wednesday, Friday)

December 10  last class meeting (Monday)

December 17  Final Exam, 8–11 am (Monday); room TBA

December 27  course grades posted in eCampus by noon (Thursday)
Attendance Attendance does not figure into your course grade. Late homework will not be accepted, nor will quizzes or exams missed due to an unexcused absence. Make-up exams are difficult to prepare and administer, therefore approval for a make-up exam will be given only with a strong justification. Contact me before the scheduled quiz or exam to request a make-up. In case of illness, a physician’s note will be required. University-Sanctioned Events and Religious Holidays: please notify me at least one week in advance if you plan to absent for a University-sanctioned event or a religious holiday. Note that “visiting my cousin in Florida” or “road trip to Montreal” (or similar things) are not a University-sanctioned event, hence the absence will be unexcused with no make-up exam/quiz/etc. available. A good rule-of-thumb: if class is in session, the University expects you and me to be here.

University Manual, section 8.51.11: Students who plan to be absent from classes or examinations for religious holy days that traditionally preclude secular activity… shall discuss this with the appropriate instructor(s) in advance of the holy day. Section 8.51.12: Students who expect to be absent from classes or examinations for University sanctioned events shall discuss this with the appropriate instructor(s) at least one week in advance of the sanctioned event(s)…

Time Commitment The expected weekly time commitment for this course is three hours of study time for every hour of class time. Hence, students are expected to spend an average of 7.5 hours per week outside of class to study and complete the assignments.

Accommodations Any student with a documented disability should contact me early in the semester so that we can make reasonable accommodations to support your success in this course. You should also contact Disability Services for Students, Office of Student Life, 302 Memorial Union, 874-2098.

ABET Program Outcomes covered in this course:
A. an ability to apply knowledge of mathematics, science, and engineering;
E. an ability to identify, formulate, and solve engineering problems;
K. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET Professional Component contribution of this course:
Engineering Science: 3 credit hours