Course Information

Instructor:
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T.A.:
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Lectures and Tutorials:
Lectures: Monday, Wednesday, Friday 11:30 – 12:20 am ALEX 218
Tutorial: Friday 9:30 – 10:20 am MCKN 225

Office Hours:
TBA and by appointment, please email.

Course Website:
Lecture notes, problem sets, and supplementary materials will be available on Courselink.

Course Calendar Description

An intermediate biophysics course with special emphasis on the physical properties of nerve cells and of biological transducers such as the ear and the eye. Prerequisite(s): 1.00 credits in physics (excluding PHYS*1020, PHYS*1600, PHYS*1810)

Objectives

The main objectives of this course are to provide a basic understanding of the physical phenomena underlying nerve and membrane activity, and to illustrate how these phenomena are applied to different types of excitable cells.

By the end of this course students will be able to...

1. Describe how physical principles influence the structure and function of excitable cells.
2. Illustrate how physical phenomena can be applied to different types of excitable cells.
3. Solve numerical problems using circuit analysis with various components including membrane resting and action potentials, membrane conductance and current flowing through cell membranes under different physiological conditions.
4. Explain membrane and nerve activities with reference to the relevant underlying physical phenomena that give rise to them.
5. Analyze how the principles of diffusion and electricity apply to biological membranes and individual nerve cells and how these result in cell resting and action potentials under different conditions.
6. Apply the appropriate physical models to solve numerical problems describing sensory functions including hearing, vision, olfaction and taste.
7. Generate simple circuit models to describe excitable cell membranes for excitable cells specific to the sensory systems.
8. Compare and contrast the mechanisms underlying sensory functions of vision, hearing, olfaction and taste.

Learning Resources

Required Text:

Recommended Texts:
"From Neuron to Brain" by J.G. Nicholls et al. (Library: QP 355.2.K83 2001)
“Principles of Neural Science” by E.R. Kandel et al. (Library: QP 355.2.P76 2013)

Schedule

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<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Assessments</th>
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<tbody>
<tr>
<td>Week 1: Jan 8-12</td>
<td>Introduction to the course, review of mathematics Chapter 1: Neurons, Membrane structure/function</td>
<td>Quiz 1</td>
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<td>Week 2: Jan 15-19</td>
<td>Chapter 2: Diffusion, Fick's Law, active transport</td>
<td>Quiz 2</td>
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<tr>
<td>Week 3: Jan 22-26</td>
<td>Chapter 3: Membrane potential, Coulomb's law, Electric potential, Work, Electric fields, Capacitance Begin Chapter 4</td>
<td>Quiz 3</td>
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<td>Week 4: Jan 29-Feb 2</td>
<td>Chapter 4: Nernst equation, Electric current, mobility, Donnan equilibrium, equivalent circuit of a membrane, Goldman-Hodgkin-Katz equation</td>
<td>Problem Set 1 Due Quiz 4</td>
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<tr>
<td>Week 5: Feb 5-9</td>
<td>Chapter 5: Current injection; the nerve impulse, voltage clamps and ionic currents.</td>
<td>Quiz 5</td>
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<td>Week 6: Feb 12-16</td>
<td>Chapter 6: Synaptic transmission</td>
<td>Quiz 6</td>
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<tr>
<td>READING WEEK: Feb 19-23</td>
<td>NO CLASS</td>
<td></td>
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<tr>
<td>Week 7: Feb 26-Mar 2</td>
<td>Chapters 7: Ion channels</td>
<td>Problem Set 2 Due Midterm Review</td>
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<td>Week 8: Mar 5-9</td>
<td><strong>Midterm Exam (Monday and Wednesday in class)</strong> Chapter 7 and 10: Ion channels continued, begin olfaction and taste</td>
<td>Ch 7 Review/ Midterm take-up</td>
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<td>Week 9: Mar 12-16</td>
<td>Chapter 10: Olfaction and taste</td>
<td>Problem Set 3 Due Quiz 7</td>
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<td>Week 10: Mar 19-23</td>
<td>Chapter 8: Vision, the invertebrate eye</td>
<td>Quiz 8</td>
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<td>Week 11: Mar 26-30</td>
<td>Chapter 8: Vision continued: the vertebrate eye Chapter 9: Hearing</td>
<td>Quiz 9</td>
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<tr>
<td>Week 12: Apr 2-6</td>
<td>Chapter 9: Hearing continued Exam review</td>
<td>Problem Set 4 Due Exam Review</td>
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Course Assessments

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<thead>
<tr>
<th>Assessment</th>
<th>Details</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Tutorial quizzes</td>
<td>Best 7 count</td>
<td>14%</td>
</tr>
<tr>
<td>Problem Sets</td>
<td>4 total</td>
<td>32%</td>
</tr>
<tr>
<td>Midterm</td>
<td>Mar. 5 and Mar. 7 in class</td>
<td>24%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>April 19, 2:30 pm, Room: TBA</td>
<td>30%</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>100%</td>
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**Tutorials:**
Tutorials will be held each week. The tutorials are an important part of the course, since they provide practice and assistance with solving numerical problems. In addition, there will be a short tutorial quiz (usually around 3 questions) at the end of each tutorial (except week 7 and week 12). Of the 9 quizzes, the top 7 will count and make up 14% of the total course grade.

**Problem Sets:**
These contain mainly numerical problem solving questions showcasing the application of physics to biological membranes and sensory systems. There will be four (4) problem sets worth 8% each and have deadlines during tutorial throughout the semester:

- **Problem Set 1:** February 2
- **Problem Set 2:** March 2
- **Problem Set 3:** March 16
- **Problem Set 4:** April 6

**Midterm examination:**
*Two parts: Monday, March 5 and Wednesday, March 7, in class.* In the first half of the course, physics principles are reviewed with specific application to cell membranes. The midterm is worth 24% of the total course grade.

**Final examination:**
*Friday, April 19, 2:30 am -4:30 pm, location TBA.* In the second half of the course, sensory systems are discussed in detail with the application of physics phenomena and circuit models. The final exam is cumulative as the course builds throughout the semester. The final exam is worth 30% of the total course grade.

**Late Assignments and Missed Quizzes:**
1) The penalty for late assignments is a 20% deduction per day, to a maximum of two days. You will be given ample time to complete your assignments; accordingly, you will be required to provide medical documentation if you wish to submit your assignment later than two days after the deadline.
2) There are absolutely no make-up quizzes. If you miss a quiz, remember that only your best 7 quizzes will be counted.

**Other Information and Policies**

**Course Policy regarding use of electronic devices and recording of lectures:**
Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.
**Academic Consideration:**
When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

**Academic Misconduct:**
The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

**Accessibility:**
The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services (SAS) as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: [http://www.uoguelph.ca/csd/](http://www.uoguelph.ca/csd/)

**Course Evaluation Information:**
Information about the date and time of the course evaluation will be made available during the semester.

**Drop date:**
The last date to drop one-semester courses, without academic penalty, is March 9, 2017. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar.