Fall 2009  BME 45600/ BIOL 59500

Bio Design of Systems for Experimental Physiology Measurements

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Course Design Team: Eric Brandner, BME Grad Student, Samiksha Neroorkar, C&I Grad Student, Sherry Voytk-Harbin, Associate Prof BME, and Nancy J. Pelaez, Associate Prof BIO.

Class Meeting Schedule:  Lecture – Mondays, (11:30-12:20 p.m.) MJIS (BMED) 1083
Lab – Mondays, 2:30-5:20 p.m., MJIS (BMED) 1053

Pre- or Co-requisites:  BME 25600 Human Physiology for Biomedical Engineering, BIOL 39500 Principles of Physiology, OR BIOL 30100/30200 Human Design: Anatomy and Physiology (I and II). Senior standing.

Course Description:
This physiology laboratory course will provide an opportunity for students from both the College of Engineering and the College of Science (Department of Biology) to experience and learn how to operate effectively as part of an interdisciplinary team to address physiological problems in the respiratory system, in biological transport, and in physiological systems where there is much current active research. Specifically, this course will emphasize how teams can use information, tools, techniques, and theories from their disciplines to solve problems that are beyond the scope of any single discipline. In this process, you will practice both engineering design and hypothesis-driven experimental science as tools to solve complex real-world problems. This course will promote effective communication, systems thinking, laboratory skills, self-management, and professional ethics. You will learn to measure and quantify biological changes, analyze data (including statistical analysis) and interpret its meaning as it applies to the larger physiological question at hand. These skills will be necessary for teams of engineering and bioscience students to efficiently function in an interdisciplinary setting both in future courses and more importantly when you enter the workforce. Credits: 2

Course WIKI  http://wiki.bio.purdue.edu/MultidiscPhysioLab/
To accomplish these goals, you will be assigned to a team and your team will write about your work on a WIKI. The course itself will be divided into four modules: biological transport, measurements and regulation of the respiratory system, testing of smooth muscle physiology models, and a capstone project using both design and reason to address a current physiology question (pulmonary edema). In each module, both elements of engineering design as well as hypothesis driven experimental science will be incorporated and emphasized.
<table>
<thead>
<tr>
<th>Course Schedule (subject to change):</th>
<th>Module Topics (draft sequence)</th>
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| Module 0 Physical versus Biological Transport | Week 1  
Week 2  
Week 3 | o Diffusion and Osmosis  
o Physiological solutions, buffers, and osmotic pressures  
o Autonomic regulation  
o Time course analysis  
o Electrodes and probes  
o Experimental design: replication |
| Module 3A Design Project Preparation | Week 4 | o Brainstorming alternatives  
o Researching previous designs  
o Leveraging external research  
o Outlining potential systems interactions  
o Outlining potential constraints |
| Module 1 Measurements and Regulation of the Respiratory System | Week 5  
Week 6  
Week 7 | 1. Spirometry  
• Resistance and flow  
• Dynamic range of a device  
• Device Volume; dead space  
• Correction for gas temperature, humidity  
• Alternative sensors  
2. Mechanics of breathing  
3. Statistical Analyses  
4. Construct and optimize a pneumotach flow head to meet specific design criteria/clinical needs |
| Module 3B Design Reviews | Week 8  – oral and visual presentations | Consider the challenges and opportunities offered in proposed ideas and begin to focus on those options that show the most merit and promise overall. |
| Module 2 Problems in Smooth Muscle Biology | Week 9  
Week 10  
Week 11 | o Modeling regulation of smooth muscle contraction  
o “Neurogenic” and “myogenic” muscle activity  
o Video data analysis  
o Perfusion and pressure-diameter analysis  
o Design of devices to interact with changing muscle compliance at rest and with contractile tone |
| Module 3C Using Design and Reason to Address Current Physiology Questions | Week 12  
Week 13  
Week 14  
Week 15 | Final Presentations |
**Design Project (Module 3):** Details regarding the design project will be provided during the third week of the course. Time for teamwork will be provided after the first and second modules. Construction will occur during module 4 and will conclude with an oral presentation.

**Anticipated Outcomes:**
Upon completion of the course successful students will have demonstrated abilities relevant to the 3 course objectives as outlined below:

**New Knowledge and Skills:**
- Discuss and apply knowledge and tools beyond the boundaries of your own discipline

**Knowledge and Application of Scientific and Engineering Process**
- Implement experimental design and engineering design processes for solving problems at the interface of engineering and science
- Think creatively and solve problems at the interface of living and non-living systems

**Multidisciplinary Teamwork**
- Consult and communicate with peers across traditional disciplinary boundaries
- Recognize and deal with professional issues that arise when working with a team to address biomedical problems.

**Purdue College of Science Related Information:**
This course is designed to meet the Multidisciplinary Requirement of the College of Science undergraduate curriculum with the following outcomes:
- Knowledge of other scientific/technological disciplines
- Understanding how one’s major is related to other scientific/technological disciplines
- Experience in applying multiple disciplines toward a common problem
This course is also designed to meet the Teambuilding and Collaboration Requirement of the College of Science undergraduate curriculum with the following outcomes:
- Ability to function in different capacities in different team settings
- Ability to discuss and evaluate ideas with others on the team
- Ability to integrate part of a solution with the rest of the team

**Books, Handouts and Other Materials:**

**GRADING SYSTEM:** Your final grade will be determined by your average based on a cumulative point total, with points assigned for WIKI homework, laboratory reports, oral and visual presentations, ability to work as part of an interdisciplinary team, and creative participation, with the major weight given to your project design:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>WIKI Homework and Laboratory Reports</td>
<td>35%</td>
</tr>
<tr>
<td>Oral and Visual Presentations</td>
<td>50%</td>
</tr>
<tr>
<td>Teamwork and Creative participation</td>
<td>15%</td>
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</table>
Course grades are based upon mastery, not a normal curve. The number of A's depends only on how well you perform. Because there will be no grading on the curve you should cooperate and not compete with your fellow classmates. Give advice to help others meet the standards for each assignment. All scores will be posted on Blackboard so that you will know your grade in the course at any time. Since all exams and written work will be given a numerical score, you can estimate where you stand in the course at any time. It is difficult to determine the exact grade cut-offs in advance, but the following letter grades and their corresponding values, are expected:

<table>
<thead>
<tr>
<th>Percent of Possible Points</th>
<th>Letter Grade</th>
<th>Grade Points</th>
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<tbody>
<tr>
<td>above 90%</td>
<td>A</td>
<td>4.0</td>
</tr>
<tr>
<td>75.01% - 89%</td>
<td>B</td>
<td>3.0</td>
</tr>
<tr>
<td>65.01% - 75%</td>
<td>C</td>
<td>2.0</td>
</tr>
<tr>
<td>50% - 65%</td>
<td>D</td>
<td>1.0</td>
</tr>
<tr>
<td>below 50%</td>
<td>F</td>
<td>0.0</td>
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- No extra credit or 'plus' or 'minus' grades will be given.
- The cut-offs may be lower, but they will not be higher.

**GRADES ON BLACKBOARD.** It is your responsibility to make sure the grades recorded on Blackboard are correct. You should let your instructor know within one week if you think something was graded incorrectly. All of this should be done in a timely manner. Grades in Blackboard (other than the final exam) should be finalized by the end of Dead Week.

**MAKE-UP POLICY**
Missed assignments can be made up or rescheduled ONLY under the following conditions:
1. Arrangements are made a week or more prior to the exam or assignment for important, unavoidable conflicting activities (e.g., surgery, out-of-town job interview, etc.). Documentation is required.
2. Please do not come to class if you feel ill. For illness, personal tragedy, or unavoidable emergencies, call the instructor or leave a message with the department before the assignment or within two days thereafter.

All make-up assignments will be done during the time of our final exam (not during the course of the semester). Contact your instructor to confirm whether you meet the requirements for make-up exams or assignments. That is **your** responsibility. Failure to follow the above guidelines will result in a zero grade for an exam or assignment. Failure to complete any graded assignment may result in a grade of “incomplete” for the course.

**ACADEMIC HONESTY:** You are encouraged to discuss homework assignments and laboratory reports with instructors and peers, but all assignments that you hand in must represent your own work. Academic dishonesty usually involves an attempt by a student to show possession of a level of knowledge or skill that he or she does not possess. Acts of academic dishonesty will not be tolerated, meaning that collaboration on assignments is not allowed, and will result in a grade of zero on the assignment for all parties involved. To become familiar with Purdue's official policy, see [http://www.purdue.edu/ODOS/osrr/academicdishonesty.htm](http://www.purdue.edu/ODOS/osrr/academicdishonesty.htm) and read the university regulations. With the start of fall semester, instructors will be able to check the originality of their students’ papers through a service called SafeAssign, which is built into Blackboard, Purdue’s course management system. For this class we will use a SafeAssignment.
depository to which you can directly submit your paper or I can upload all of the papers directly (See http://www.itap.purdue.edu/newsroom/detail.cfm?NewsId=1955).

**SPECIAL NEEDS.** If you have been certified by the Office of the Dean of Students as someone needing a course adaptation or accommodation because of a disability OR if you need special arrangements when a building must be evacuated, please contact your instructor during the first week of classes.

If you have a letter from ODOS stating that you may have extra time on the exams or use the testing center, you will also need to make arrangements with your instructor at least a week before each scheduled exam to let us know your situation and to find out if the accommodation can be done during the regularly scheduled exams. Otherwise, you will take the exam in the ODOS testing center or with the other make-up exam students after the final exam.

**CAMPUSED EMERGENCY:** In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Information regarding changes in the course will be made available through email (npelaez@purdue.edu), phone (49-63261), and the course web page.

**We value your perceptions about the course and your instructors**
Periodically throughout the semester and especially during the last two weeks of the semester, you will be provided opportunities to evaluate this course and your instructors. Our goal is to provide you with a challenging and useful research experience. If at any time you have concerns, please talk to us. In fact, we will periodically give you the chance to provide your feedback. We encourage you to keep us informed of any issues at all times. Your participation in this evaluation is an integral part of the development for this course. To this end, Purdue has transitioned to online course evaluations. On Monday of the fifteenth week of classes, you will receive an official email from evaluation administrators with a link to the online evaluation site. You will have two weeks to complete this evaluation. Your feedback is vital to improving education at Purdue University. We strongly urge you to participate in the evaluation system.