Medical Devices for Electrically Excitable Tissues!

- Instructed by Physician-Engineer
- Real-world Industry-like Environment

What students are saying ...

"by far the best course I have taken at Rutgers"
"an incredible amount of learning about different systems in the body"
"the first class that I actually looked forward to every week"
"put the field into perspective - something that no other course I've taken has"
"convinced me that a PhD in the field of <BME> is an achievable goal"
"completely rekindled my interest in the field"
"I have recommended this course to all ... BME students I know"
"brilliant course and the best course taught during my time here at Rutgers"
"would take again if allowed just to go through it all again"

Grads and UG Seniors*

* With permission from les42@rci.rutgers.edu

Student Rating = 5.0 (Summer 2016)
Instructor: Dr. Hilton Kaplan, MBBCh FCSSA PhD  
Email: hilton.kaplan@rutgers.edu  
Office: LSB-101  
Office hours: By appointment

Pre-requisite: Senior standing in BME or other related field. *Undergraduates and non-engineering students should contact Larry Stromberg in BME for permission numbers (les42@rci.rutgers.edu).

Class hours and location (Tue 09/06/2016 - Tue 12/13/2016)  
Lecture: Mondays 6:40-8:00 PM ARC-108  
Labs: Tuesdays 5:00-8:00 PM BME-121

Course Website: https://sakai.rutgers.edu

Textbooks:  
Kindle edition at: http://amzn.com/B009LHFYNG.  

Laboratory: In BME-121 teaching lab, each team will be provided with a BioRadio™ system. These wearable, Bluetooth wireless, biomedical monitors have 8 programmable channels for recording and transmitting a wide variety of human physiological signals. Data is captured for analysis in MATLAB®, integration with LabVIEW™, etc. See more at: http://glneurotech.com/bioradio/bioradio-wireless-physiological-monitor.

Overview:

This course provides the theoretical basis and applied design principles for medical devices and instrumentation that interact with all the electrically excitable tissues of the body.

Each week we’ll cover a new electrophysiological system (e.g., cardiac muscle, skeletal muscle, the central and peripheral nervous systems involved in sensing, control of movement, control of autonomic functions, etc.), and its related technologies (e.g., pacemakers, defibrillators, cochlear implants, retinal implants, epidural stimulators, transcutaneous electrical stimulators, neuromuscular stimulators, electrocardiography, electromyography, electrooculography, electroencephalography, etc.).

This course is based on my real-life experience as a physician, in industry, and as an instructor in applied electrophysiology for many years. It is therefore designed to follow a real-world, industry-like experience: We will explore problems by arriving well-read and prepared for a detailed discussion (during Lectures); followed by proposing hypotheses, designing and conducting experiments to investigate these, and finally documenting our findings (during Labs). Readings are therefore essential, and there is no other weekly "homework."

We will work in teams of 2-5 (ideally with at least 1 graduate per team), but keep individual lab notebooks. The topic of each Lab is keyed to the preceding Seminar/Lecture. There are no set "cookbook" experiments. Rather, following our seminar each team identifies a particular question they wish to explore; and then designs and executes this experiment in the upcoming lab, documenting the objectives, methods and outcomes in their lab notebooks. At the beginning of each lab, teams will share their hypotheses verbally with each other; and at the end, will summarize their findings with each other.
# Applied Clinical Electrophysiology

**Course Code:** 16:125:565:01  
**Index:** 20141  
**Credits:** 3  
**Status:** Open to Graduates and Undergraduate Seniors*  
**Fall 2016**

**Lecture / Seminar:**  
ARC-108  
Mondays 6:40-8:00 pm

**Laboratory / Workshop:**  
BME-121  
Tuesdays 5:00-8:00 pm

## Class Schedule

*(Topic Order and *Guest Lecturers Provisional)*

<table>
<thead>
<tr>
<th>Week</th>
<th>Readings (+ posted)</th>
<th>Lecture / Seminar (ARC-108, Mon 6:40-8:00 pm)</th>
<th>Lab / Workshop (BME-121, Tue 5:00-8:00 pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>09/05+09/06 P 6, 7  B 2</td>
<td>NO CLASS (Last day of summer break)</td>
<td>Biophysics of excitable tissues (LECT); BioRadio™ equipment orientation (LAB)</td>
</tr>
<tr>
<td>W2</td>
<td>09/12+09/13 B 6</td>
<td>Biophysics of heart and ECG</td>
<td>ECG recording</td>
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<tr>
<td>W3</td>
<td>09/19+09/20 B 23</td>
<td>Cardiac pacing</td>
<td>ECG analysis for pacing</td>
</tr>
<tr>
<td>W4</td>
<td>09/26+09/27 B 24</td>
<td>Cardiac defibrillation</td>
<td>Defibrillation circuit simulations</td>
</tr>
<tr>
<td>W5</td>
<td>10/03+10/04 P 34</td>
<td>Muscle function and EMG</td>
<td>EMG recording and signal processing</td>
</tr>
<tr>
<td>W6</td>
<td>10/10+10/11 P 24</td>
<td>Pain</td>
<td>MIDTERM + REPORT IDEAS DUE</td>
</tr>
<tr>
<td>W7</td>
<td>10/17+10/18 P 37, 38</td>
<td>TIME 3:20-4:40 pm in BME-128 Microelectrodes &amp; cortical interfaces (* Javanmard, ECE)</td>
<td>Electrochemistry and impedance (* Sherba, ACE Alumni)</td>
</tr>
<tr>
<td>W8</td>
<td>10/24+10/25 P 47</td>
<td>REPORT TOPICS DUE</td>
<td>Autonomic function (LECT; including Micturition &amp; Visual-Analog Scales)</td>
</tr>
<tr>
<td>W9</td>
<td>10/31+11/01 P 34, 36, 41  B 21</td>
<td>Neuromuscular electrical stimulation (NMES)</td>
<td>TENS + Surface NMES via nerves vs. muscle directly</td>
</tr>
<tr>
<td>W10</td>
<td>11/07+11/08 P 22, 35, 42, 43  B 21</td>
<td>Proprioception, tremor, spasticity</td>
<td>Reflexes; Nerve conduction velocity</td>
</tr>
<tr>
<td>W11</td>
<td>11/14+11/15 P 30, 31  B 21</td>
<td>Hearing, cochlear implants</td>
<td>Acoustic signals and vocoders</td>
</tr>
<tr>
<td>W12</td>
<td>11/21+11/22 P 16, 37  B 14</td>
<td>EEG, evoked potentials, MEG</td>
<td>NO LAB (Designated THURS CLASSES)</td>
</tr>
<tr>
<td>W13</td>
<td>11/28+11/29 P 39, 40  B 28</td>
<td>Vestibulo-oculomotor</td>
<td>EOG recording</td>
</tr>
<tr>
<td>W14</td>
<td>12/05+12/06 P 25, 26, 27</td>
<td>Vision</td>
<td>FIELD TRIP - fMRI (RUBIC, Newark, 1:00-4:00 pm): fMRI of visual cortical processing (* Hanson, Psychology)</td>
</tr>
<tr>
<td>W15</td>
<td>12/12+12/13 -</td>
<td>Exam Prep</td>
<td>FINAL EXAM + REPORTS DUE</td>
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* *Guest Lecturers Provisional*