Overview:
This course covers the basics of neurophysiology and electrophysiology. How cells in the brain work and they communicate with each-other is introduced. A basic electrical circuit’s background but no Biology/Neuroscience background is assumed. The course centers on developing a quantitative understanding of the effect of electricity on the body. The course works towards analyzing current papers/topics in neural engineering; this will include debates about current medical technology. Students in the course will also work on critical paper/legal document analysis in the area of neural engineering.

Students are highly encouraged to attend BME Seminar Lectures (Wednesday at 3 PM) which deal with Neural Engineering Topics.

Textbook:
There is no required text-book for the course. Additional course material will be made available through class hand-outs and the class web-site. The course is based largely on class lectures/notes. Attendance of all classes is required and students are responsible for all material lectured on.

Text-books will be made available for short-term loan through the Department of Biomedical Engineering.

Topics Covered: (topics may not be covered serially)
Basics of ‘excitable cells’: the resting membrane potential, action potentials, action potential conduction
Basics of excitable cell communication: chemical synaptic and ‘non-synaptic transmission’ (including field/ephaptic effects, ionic waves, gap junctions)
Basics of neuronal networks – ‘coherent’ network activity and field potentials
Fields generated by mono-polar sources: a tool to interpret ‘field recordings’ and EEG
Basic analog circuit for electrophysiology
Applications of functional electrical stimulation (Deep Brain Stimulation): Overview
Overview: But what mechanisms can electricity effect cells?
Cable theory
Electrical ‘activation’/excitation with a mono-polar stimulating source
‘Uniform field’ and multi-polar electrical stimulation
Practical Issues in Electricity Safety / Regulations – Analysis of legal reports
Measurement of ion concentration and extracellular resistivity
Joule heating of the brain: bio-heat transfer model
Functional electrical stimulation: Current papers/topics

**GRADING:**

**Quizzes 10%**  
**Homework / Projects 80%**.  
**Attendance / Participation 10%**.

**Homework:** Unless otherwise stated, homework is due at the beginning of the next class. No extensions will be given. Homework will not be accepted after the lecture begins. If you are tardy for class your homework will not be accepted.

Collaboration with other students on homework is allowed. If you work with another student directly on a home-work problem and receive or provide information directly related to a home-work problem you must list the names of any collaborators on your home-work. Failure to do so will be considered cheating. Students may be asked questions about handed in home-work during or after class.

Collaboration can include exchanging of ideas on how to approach solving a problem or how to solve a specific step in a given problem. Collaboration does not allow direct copying of (even a portion) of someone else’s work. You must derive all equations and run all numerical calculations yourself.

Each home-work will be given a ‘point’ value. Unless otherwise stated, a single homework is worth one point. In calculating your homework grade, each assignment will be weighted by its point value (i.e. a 3-point assignment counts as much a three 1-point assignments). One homework will involves analysis/debate of a legal document/issue. The final home-work/project will involve individual presentations to the class.

**Quizzes:** There may be a (surprise) quiz at the beginning of a class. A quiz will be based on material directly covered in previous lectures, homework (including a homework due that day), or any assigned reading material.

**Attendance:** Because the course material is largely lecture (rather than text-book) based, students are discouraged from missing any classes. If a student cannot attend a lecture they are responsible for obtaining the lecture notes/homework assignments from another student. Homework may be handed in by another student or dropped at my office or mail-box before it is due.

You may use a computer to take notes. You may not use the internet for any purpose (including checking e-mail) during class. Cell phones: If your phone rings during class (including vibrate) you final grade may be reduced by as much as 5% each incident. If it is absolutely necessary to answer a call during class (e.g. an emergency), do so at a distance down the hallway. Do not send/check text messages.