BMED 4400 Neuroengineering Fundamentals (Elective)

Catalog Description: BMED 4400 Neurogengineering Fund (2-6-4)
Prerequisite(s): BMED 3110 and BMED 4752
Lab and lecture on current topics in Neuroengineering, including electrophysiology, clinical and diagnostic neuroengineering, neural prosthetics, sensory-motor integration, neuromorphic VLSI, neurodynamics and neurorobotics.

Textbook: Neuroscience, 5th ed., Purves et al, Sinauer Associates, Inc. (2012)

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Topics Covered:

1. Review of basic neurobiology
2. Research models of neural systems
3. Hybrid neural microsystems
4. Neural interfacing for sensory and motor prosthetics, diagnostic neural interfacing, neural interfacing for treatment of disease (e.g., functional electrical stimulation), neural interfacing for basic science research, optical neural interfaces
5. Real-time neural data analysis and feedback
6. Neurally-controlled robots
7. Neuro-bio MicroElectroMechanical Systems (MEMS)
8. Neural enhancement, neuroethics of neuroengineering
9. Laboratory component of the course will:
    a. Employ multi-unit recording and stimulation with multi-electrode arrays with cultured mammalian neurons.
    b. Literature searching
    c. Experimental design in a problem-based learning context
    d. Building and debugging equipment
    e. Data visualization and analysis
    f. Scientific note-taking, writing, and oral presentations

Course outcomes:

Students who complete this course will be able to:
Outcome 1: Converse in all of the fields where technology and neural tissue meet, in both clinical and basic research settings (Student Outcomes a, e, and j).
Outcome 2: Demonstrate self-directed inquiry skills through the design and execution of laboratory experiments (Student Outcomes b and i)
Outcome 3: Apply modeling and data analysis tools to real data obtained during lab (Student Outcomes b and k).
Outcome 4: Demonstrate group skills, working as small teams in and out of the lab (Student Outcome d).
Outcome 5: Carry out multi-unit neurophysiology and neural cell culture (Student Outcomes a and k).

Outcome 6: Appreciate neural dynamics, including sensory-motor integration and closed-loop feedback (Student Outcome a).
Outcome 7: Appreciate and debate ethical issues surrounding neuroengineering and cognitive enhancement (Student outcomes f and j).

Correlation between course outcomes and student outcomes:

BMED 4400											
	Biomedical Engineering Student Outcomes										
Course outcomes	a	b	c	d	e	f	g	h	i	j	k
1	X				X					X	
2		X							X		
3		X									X
4				X							
5	X										X
6	X										
7						X				X	

The Wallace H. Coulter Department of Biomedical Engineering Student Outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, societal, political, ethical, health and safety, manufacturability, and sustainability;
d. an ability to function on multidisciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
i. a recognition of the need for, and an ability to engage in lifelong learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;