Master Course Description for EE-461

Title: Neural Engineering Tech Studio Capstone

Credits: 4

E E 461 Neural Engineering (3)

The Tech Studio course is designed to provide students with authentic experiences in translational engineering and to promote interactions with end users, industry members, and outreach groups. In addition, the course strives to expose students to technology, software, and other resources that may be useful in their academic and future careers. Students will have the opportunity to be creative and innovative in developing Neurotechnologies and consider key elements of business analysis in their designs. Student teams will get consulting from and eventually pitch their designed products to teams of industry and entrepreneurial experts experienced in the neural engineering space. The ultimate goal of this course is to help students develop practical skills and connections that will serve them long after graduation.

Prerequisite: EE 460 or BIOEN 460;

Coordinator: Kim Ingraham, Assistant Professor, Electrical and Computer Engineering

Goals: This course provides students with exposure to new and valuable tools and skillsets, within the framework of creating and demonstrating a neural engineering team-based project. Students will leave the course with a greater understanding of engineering design, design thinking, prototyping, regulatory standards and product commercialization through the course project, engineering design notebook, and associated lectures and will use the skills developed to create a prototype of new neural engineering-based product.

Learning Objectives: At the end of this course, students will be able to:

1. Design a working prototype that leverages the principals of neural engineering
2. Be familiar with the basic principles of neural engineering
3. Demonstrate the principles of engineering design, including demonstrating how an engineering design notebook is used by professional engineers to support and document their design processes and protect IP
4. Work as a part of a technical team and demonstrate effective team work strategies
5. Acquire technical skills in a variety of areas such as hardware engineering, software development, 3D modeling, electrical engineering, material engineering and engineering design
6. Consider how market factors and end-user needs influence the design engineering process

Textbook: No book, only online PDF files and slides.

Prerequisites by Topic:

1. EE or BioE 460 – Introduction to Neural Engineering. This requires the following prereqs:
    a. Exposure to Neuroscience and Biology concepts (BIOL 130, BIOL 162, or BIOL 220)
    b. Linear models, neural networks & data processing: MATH 308, AMATH 301, or AMATH 352

Topics:

1. Introduction and team formation by interest area
2. Pitching ideas and gathering feedback form experts in round-robin format
3. Customer Discovery
4. Gallery walk to provide and receive feedback on project direction from peers
5. Value Proposition
6. Pitch training – Pitching ideas and presentation skills
7. Midterm practice presentation
8. Regulatory standards in neural engineering, intellectual property and startups
9. Review of lessons learned during design process
10. Final presentations to panel of industry judges with winner selected.

Course Structure: The class meets for one 110-minute interactive session each week. Most sessions begin with an interactive presentation on a topic, followed by time to work in teams with instructors circulating to provide feedback and assistance. Homework assignments involve completing the Engineering Design Notebook, a workbook designed specifically for this course to guide students in user-centered design thinking and prototyping. Most effort in this course is devoted to ideating, creating, documenting and demonstrating a working prototype of a neural engineering device in a team of 4-5 students from diverse disciplinary backgrounds.

Computer Resources: Varies depending on the project.

Grading: Approximate distribution: Final project and completion of design notebook: 40%, Final presentation: 20%, Teamwork and leadership – 20%, Participation in class activates: 15%, Documentation of engineering and regulatory standards: 5%.

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(2) *an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors* **(H)** Students perform customer discovery and user-centered design to formulate and then create a prototype neural engineering device that aims to advance public health and welfare. They consider social contexts of the end-users as well as device safety and usability.

(3) *an ability to communicate effectively with a range of audiences.* **(H)** Students learn to pitch their ideas through 4 iterative practice sessions including to a panel of medical and engineering experts, through poster presentations to peers, a practice presentation and a final pitch to a panel of industry judges in a Shark Tank style competition.

(4) *an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.* **(L)** Students engage in a 'neuroethical' evaluation of their final project, based on fundamentals presented in the pre-requisite course 460. Students must describe how their product fits into the FDA regulatory landscape by examining prior art and identify which industry-standard safety regulations their product would be subject to.

(5) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives* **(H)** The majority of this class is a team-based design project. Students work closely with four to five classmates from diverse backgrounds across engineering and neuroscience to complete their prototype. They share leadership responsibilities to establish goals and complete the project. We set a tone for an inclusive environment respecting gender and racial/ethnic diversity.

(7) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies* **(M)** Students must interview potential customers, as well as access the literature and web resources to learn about competing products and solutions. Learning is independent and self-directed, based on their project topic of interest

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