

# ECE 5070: Neuroengineering and Neuroprosthetics

## Course Description

An overview of the broad field of Neuroengineering for graduate and senior undergraduate students with engineering or neuroscience backgrounds. Focusing on neural interfaces and prostheses, this course covers from basic neurophysiology and computational neuronal models to advanced neural interfaces and prostheses currently being actively developed in the field.

**Transcript Abbreviation:** Neur Eng & Prosth

**Grading Plan:** Letter Grade

**Course Deliveries:** Classroom

**Course Levels:** Undergrad, Graduate

**Student Ranks:** Junior, Senior, Masters, Doctoral

**Course Offerings:** Autumn

**Flex Scheduled Course:** Never

**Course Frequency:** Even Years

**Course Length:** 14 Week

**Credits:** 3.0

**Repeatable:** No

**Time Distribution:** 3.0 hr Lec

**Expected out-of-class hours per week:** 6.0

**Graded Component:** Lecture

**Credit by Examination:** No

**Admission Condition:** No

**Off Campus:** Never

**Campus Locations:** Columbus

**Prerequisites and Co-requisites:** Prereq: 3050 or BME 3703; or Neurosc 3010; or Grad standing in Engineering or Neurosc.

**Exclusions:** Not open to students with credit for 5194.03 or Neurosc 5070.

**Cross-Listings:** Cross-listed in Neurosc.

**Course Rationale:** Introduce students a vibrant, interdisciplinary field which integrates engineering and neuroscience principles for treating neurological disorders.

**The course is required for this unit's degrees, majors, and/or minors:** No

**The course is a GEC:** No

**The course is an elective (for this or other units) or is a service course for other units:** Yes

**Subject/CIP Code:** 14.1001

**Subsidy Level:** Doctoral Course

## Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

## Course Goals

Master principles of neural interfaces.
Be competent with computational neural models.

Be competent with design of common neuroprostheses.
Be familiar with neuroscience basics.
Be familiar with other neural technologies
Be exposed to regulatory and ethic issues.

## Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Overview of Neuroengineering	1.5							
Neuroscience Basics	6.0							
Computational Neuronal Models	4.5							
Neural Interfacing Technologies	6.0							
Overview of Neuroprosthetics	1.5							
Brain Computer Interface	3.0							
Deep Brain Stimulation	3.0							
Retinal Prostheses	1.5							
Functional Electrical Stimulation	3.0							
Optogenetics	3.0							
Neural Imaging	3.0							
Neural Tissue Engineering	3.0							
Regulatory and Ethic Issues	3.0							

## Grades

Aspect	Percent
Class Participation and Homework	20%
Midterm I	20%
Midterm II	20%
Final Project	40%

## Representative Textbooks and Other Course Materials

Title	Author
<i>Lecture Notes</i>	

## ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	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.
***	d	An ability to function on multi-disciplinary 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 and societal context.

Course Contribution		College Outcome
***	i	A recognition of the need for, and an ability to engage in life-long learning.
***	j	A knowledge of contemporary issues.
***	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
**	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	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
***	3	an ability to communicate effectively with a range of audiences
*	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
***	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
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
***	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

### EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
**	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	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
***	3	an ability to communicate effectively with a range of audiences
*	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
***	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
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
***	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

### Additional Notes or Comments

Make consistent with university version 4/5/14

Expand course goals 4/7/16

Update new starts -6/4/-19 BLA

Prepared by: Betty Lise Anderson