MS IN NEURAL ENGINEERING

Overview

The interdisciplinary MS program in Neural Engineering delivers a rigorous training and the necessary skills required to solve complex problems at the interface of engineering, medicine and neuroscience. Graduates are prepared for successful careers in the biomedical industries, academia, or government (FDA, US Patent Office), or for further study in doctoral or health-related programs. The interdisciplinary MS students will receive a graduate degree in Neural Engineering from the Department Biomedical Engineering.

The interdisciplinary nature of the departments and our strong ties with the University of Miami Miller School of Medicine provides students with many opportunity to collaborate with clinicians and researchers at several world-renowned research and clinical centers, including the Bascom Palmer Eye Institute, The Miami Project to Cure Paralysis, the Diabetes Research Institute, the University of Miami Ear Institute, the Biomedical Nanotechnology Institute (BioNIUM), the McKnight Brain Institute, the Sylvester Comprehensive Cancer Center, and the Miami Veterans Administration Research Service. There are opportunities to develop collaboratively courses, training, and new foci that take advantage of our existing institutional strengths and will foster new avenues for collaborations across each of the departments listed above.

Neural engineers build tools, techniques, and methods to understand, interface with and manipulate the nervous system. They are trained to solve problems and provide rehabilitative solutions for various pathologies or disorders afflicting the nervous system. Graduates with neural engineering background often find positions in industry, research and development, regulatory affairs, and quality engineering. Many graduates complete advanced degrees and join academic ranks.

Admission Requirements

Students apply directly with the College of Engineering for the Graduate Program. Students must have undergraduate degree in Physics, Mathematics, Neuroscience, Computer Science, Chemistry, Biology or other fields of natural or health science and seek to diversify their career opportunities by acquiring an engineering degree. Or students must have undergraduate degrees in biomedical engineering and other engineering disciplines and seek advanced professional training or specialization in a particular area of neural engineering

Curriculum Requirements

Code	Title	Credit Hours
Core Courses		
BME 615	Current Trends in Neural Engineering	3
Graduate Level Neuroscience Course chosen from the following:		3
BME 603	Neurophysiology for Engineers	
NEU 762	NEU II - Systems Neuroscience	
NEU 797	Neuroanatomy	
PHS 741	Principles of Membrane Physiology and Biophysics I	
Statistics Course Chosen from the Following:		3
PIB 705	Biostatistics for the Biosciences	
ECE 730	Statistical Learning	
MTH 642	Statistical Analysis	
MTH 625	Introduction to Mathematical Statistics	
BST 605	Statistical Principles of Clinical Trials	
BIL 618	Advanced Biostatistics	
Neural Engineering Interdisciplinary Electives		**15**
To be selected from the following any graduate level courses for the neural engineering track (some courses may have pre-requisites that must be met prior to enrollment):		
CSC 646	Introduction to Machine Learning with Applications	
CSC 649	Biomedical Data Science	
CSC 650	Computational Neuroscience	
BIL 668	Developmental Neuroscience	
BME 735	Auditory and Visual Neural Systems	
BME 612	Regulatory Control of Biomedical Devices	
BME 695	Current Trends in Regenerative Medicine	
BME 635	Advanced Biomaterials	
BME 640	Microcomputer-Based Medical Instrumentation	
BME 624	Neuromotor Engineering	

BME 610	Introduction to Medical Robotics	
ECE 753	Pattern Recognition and Neural Networks	
ECE 637	Principles of Artificial Intelligence	
ECE 648	Machine Learning	
ECE 677	Data Mining	
CSC 645	Introduction to Artificial Intelligence	
CSC 746	Neural Networks and Deep Learning	
MTH 613	Partial Differential Equations I	
MTH 614	Partial Differential Equations II	
MTH 615	Ordinary Differential Equations	
MTH 621	Numerical Methods in Differential Equations	
NEU 762	NEU II - Systems Neuroscience	
NEU 797	Neuroanatomy	
PHS 741	Principles of Membrane Physiology and Biophysics I	
Project		**6**
BME 725	Special Problems	
Industry Project		
This can be a three-summer month or six-month (equivalent of 2 semesters) industry project. The project will culminate with a report detailing the work done and knowledge gained, and a presentation to faculty and students in the program.		
Capstone Project		
To complete the project, the student will have at least one supervisor within an appropriate academic unit in the program. Prior to initiating the thesis project, approvals from the academic advisor and BME department chair are required.		
BME / Miami Project / NEU Seminars		**0**
Students must attend at least 9 seminars in topics on neural engineering and neuroscience at the University.		
Total Credit Hours		**30**

The MS program in Neural Engineering provide competency in one of the three areas:

- neurostimulation
- neurorehabilitation
- regenerative medicine

Sample Plan of Study (2 Years)

Year One		
Fall		**Credit Hours**
CSC 646	Introduction to Machine Learning with Applications	3
BME 615	Current Trends in Neural Engineering	3
CSC 650 or BME 624	Computational Neuroscience or Neuromotor Engineering	3
BST 605	Statistical Principles of Clinical Trials	3
	Credit Hours	**12**
Spring		
NEU 762	NEU II - Systems Neuroscience	4
CSC 746	Neural Networks and Deep Learning	3
BME 725	Special Problems	3
	Credit Hours	**10**
Year Two		
Fall		
BME 612	Regulatory Control of Biomedical Devices	3
BME 695	Current Trends in Regenerative Medicine	3
BME 725	Special Problems	3
	Credit Hours	**9**
	Total Credit Hours	**31**

Sample Plan of Study (1 Year)

Year One		
Fall		**Credit Hours**
CSC 646	Introduction to Machine Learning with Applications	3
BME 615	Current Trends in Neural Engineering	3
CSC 650 or BME 624	Computational Neuroscience or Neuromotor Engineering	3
BST 605	Statistical Principles of Clinical Trials	3
	Credit Hours	**12**
Spring		
NEU 762	NEU II - Systems Neuroscience	4
CSC 746	Neural Networks and Deep Learning	3
BME 695	Current Trends in Regenerative Medicine	3
BME 612	Regulatory Control of Biomedical Devices	3
	Credit Hours	**13**
Summer		
BME 725	Special Problems	3
BME 725	Special Problems	3
	Credit Hours	**6**
	Total Credit Hours	**31**

The minimum residence requirement for the MS degree is two semesters in full-time study or the equivalent in part-time work.

Mission

The mission of the BS/MS and MS programs in Neural Engineering is to:

• Provide high-quality graduate education in translational neuroscience and neural engineering that will

prepare graduates for professional careers and a lifetime of learning.

• Conduct high-quality research that will advance the current body of knowledge and engage in new discoveries to improve the quality of human life; and

• Serve the engineering profession and society through active involvement in professional organizations and contribution of professional expertise.

The program mission will be accomplished by providing an integrated and multidisciplinary scientific and technical education. Graduates will be involved in translating scientific discoveries to modern technologies and novel products that benefit human health. The graduates will be trained to address brain health, develop new technologies and tools to study, interface with and replace lost function of the nervous system, producing novel and superior materials, brain-machine interfaces, or therapies. They will be involved in the development and manufacture of products as well as research in the field of translational neuroscience.

Goals

The educational objectives of the Neural Engineering program are to produce graduates with:

- advanced technical knowledge in neuroscience and neural engineering
- advanced capability to apply scientific, technical and clinical knowledge to engineering problems
- potential to make significant contributions in neurostimulation, neurorehabilitation, regenerative medicine or computational neuroscience.

Student Learning Outcomes

- Students will demonstrate an advanced knowledge of the discipline (mathematics, science, medicine, and engineering), including methodology relevant to a specialty area.
- Students will demonstrate an advanced ability to identify, formulate, and solve engineering problems to carry out supervised research.
- Students will demonstrate an advanced ability to generate technical contributions and effectively communicate them to the scientific community.