BS/MS IN NEURAL ENGINEERING

Overview

The interdisciplinary BS/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 BS/MS program is designed for undergraduate students enrolled at the University of Miami in Neuroscience, Psychology, Computer Science, Biology, Mathematics, Physics, Biomedical Engineering, or Electrical and Computer Engineering. The BS/MS students will receive undergraduate degrees in their selected majors and a graduate degree in Neural Engineering administered by the Department Biomedical Engineering. 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

The BS/MS program in Neural Engineering welcome students from diverse backgrounds, including

- Students enrolled in UM undergraduate degrees in biomedical engineering and other engineering disciplines who seek advanced professional training or specialization in a particular area of neural engineering;
- Students enrolled in UM undergraduate programs in Physics, Mathematics, Neuroscience, Computer Science, Chemistry, Biology or other fields of natural or health science who seek to diversify their career opportunities by acquiring an engineering degree;
- Students preparing for admission to advanced health-related or other professional programs such as medical school.

When to apply:

For BS/MS: Qualified students must apply prior to the advising period but at the latest before the final exams in the second semester of their junior year. Students are strongly advised to apply to the BS/MS program as early as possible in their junior year to facilitate academic advising and course selection in the second semester of their junior year. Before submitting an application, interested students should discuss the program and the possibility of entering the program with an academic advisor.

Curriculum Requirements

The graduate component of the BS/MS in Neural Engineering curriculum consists of three components: core courses, elective courses on neural engineering, and an industry or capstone project. Students must complete at least 30 credits of graduate level courses to complete the degree.

The core courses teach the fundamental skills of neuroscience, neuroanatomy, and physiology. The interdisciplinary electives in neural engineering courses are designed to fit the student's chosen competency in specific areas of neural engineering supported by the program. The academic units participating in the graduate program will each offer courses relevant to their discipline.

The industry or capstone project will be taken for 6 credits. Projects are done typically within two semesters, supervised by a faculty member in an appropriate academic unit within the program (Biomedical Engineering, Computer Science, Neuroscience, Biology, Physics, Physiology and Biophysics, Psychology, or Electrical Engineering). Students can also complete their projects in an industry-setting. The project culminates with a report (or a research manuscript) detailing the milestones achieved/work completed and knowledge gained, and a presentation to faculty and students in the program.

Curriculum Requirements

Code	Title	Credit Hours
BACHELOR'S DEGREE REQUIREMENTS		**120**
Refer to the links below for more information on the BS requirements.		
https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/biology/biology-bs (https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/biology/biology-bs/)/		

https://bulletin.miami.edu/undergraduate-academic-programs/engineering/biomedical-engineering/biomedical-engineering-bs-biomaterials-tissue (https://bulletin.miami.edu/undergraduate-academic-programs/engineering/biomedical-engineering/biomedical-engineering-bs-biomaterials-tissue/)/		
https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/computer-science/computer-science-bs-students-arts-sciences (https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/computer-science/computer-science-bs-students-arts-sciences/)/		
https://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/#text		
https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/mathematics/mathematics-ba-bs (https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/mathematics/mathematics-ba-bs/)/		
https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/neuroscience/neuroscience-bs (https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/neuroscience/neuroscience-bs/)/		
https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/physics (https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/physics/)/		
https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/psychology/psychology-ba-bs (https://bulletin.miami.edu/undergraduate-academic-programs/arts-sciences/psychology/psychology-ba-bs/)/		
MASTER'S DEGREE REQUIREMENTS		
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		**150**

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

- neurostimulation
- neurorehabilitation
- regenerative medicine

Curriculum setup:

Students admitted in the dual degree BS/MS program can take a maximum of six (6) graduate credits per semester in their senior year, for a maximum of twelve (12) graduate credits per year, without incurring additional costs if they are full-time undergraduate students during this period. Graduate technical electives taken in the senior year must be chosen with the approval of their academic advisor. The credits of graduate technical electives completed in the fourth year are counted toward the 30 credits required for the MS degree. In the fifth year, BS/MS students complete the rest of their 18 credits of graduate course requirements, including completion of the MS Project.

Pre-requisites:

Applicants for BS/MS may be enrolled in any undergraduate major. However, they will be expected to have taken and passed a course each (or equivalent training) in Statistics and Probability, and Programming.

Sample Plan of Study (5 Years)

BS in Computer Science/MS in Neural Engineering

Freshman Year		
Fall		**Credit Hours**
Undergraduate Courses		15
	Credit Hours	**15**
Spring		
Undergraduate Courses		15
	Credit Hours	**15**
Sophomore Year		
Fall		
Undergraduate Courses		15
	Credit Hours	**15**
Spring		
Undergraduate Courses		15
	Credit Hours	**15**
Junior Year		
Fall		
Undergraduate Courses		18
	Credit Hours	**18**

Spring		
Undergraduate Courses		18
	Credit Hours	**18**
Senior Year		
Fall		
Undergraduate Courses		12
CSC 646	Introduction to Machine Learning with Applications	3
BME 603	Neurophysiology for Engineers	3
	Credit Hours	**18**
Spring		
Undergraduate Courses		12
CSC 650	Computational Neuroscience	3
BME 615	Current Trends in Neural Engineering	3
	Credit Hours	**18**
Fifth Year (Graduate)		
Fall		
BME 640	Microcomputer-Based Medical Instrumentation	3
CSC 746	Neural Networks and Deep Learning	3
BME 725	Special Problems	3
	Credit Hours	**9**
Spring		
BME 612	Regulatory Control of Biomedical Devices	3
ECE 753	Pattern Recognition and Neural Networks	3
BME 725	Special Problems	3
	Credit Hours	**9**
	Total Credit Hours	**150**

Sample Plan of Study (5 Years)

BS in Neuroscience/MS in Neural Engineering

Freshman Year		
Fall		**Credit Hours**
Undergraduate Courses		15
	Credit Hours	**15**
Spring		
Undergraduate Courses		15
	Credit Hours	**15**
Sophomore Year		
Fall		
Undergraduate Courses		15
	Credit Hours	**15**
Spring		
Undergraduate Courses		15
	Credit Hours	**15**
Junior Year		
Fall		
Undergraduate Courses		18
	Credit Hours	**18**
Spring		
Undergraduate Courses		18
	Credit Hours	**18**

Senior Year		
Fall		
Undergraduate Courses		12
CSC 646	Introduction to Machine Learning with Applications	3
BME 615	Current Trends in Neural Engineering	3
	Credit Hours	**18**
Spring		
Undergraduate Courses		12
CSC 650	Computational Neuroscience	3
BME 624	Neuromotor Engineering	3
	Credit Hours	**18**
Fifth Year (Graduate)		
Fall		
CSC 746	Neural Networks and Deep Learning	3
NEU 762	NEU II - Systems Neuroscience	4
BME 725	Special Problems	3
	Credit Hours	**10**
Spring		
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	**151**

Sample Plan of Study (5 Years)

BS in Biomedical Engineering/MS in Neural Engineering

Freshman Year		
Fall		**Credit Hours**
Undergraduate Courses		15
	Credit Hours	**15**
Spring		
Undergraduate Courses		15
	Credit Hours	**15**
Sophomore Year		
Fall		
Undergraduate Courses		15
	Credit Hours	**15**
Spring		
Undergraduate Courses		15
	Credit Hours	**15**
Junior Year		
Fall		
Undergraduate Courses		18
	Credit Hours	**18**
Spring		
Undergraduate Courses		18
	Credit Hours	**18**
Senior Year		
Fall		
Undergraduate Courses		12
BME 603	Neurophysiology for Engineers	3

CSC 646	Introduction to Machine Learning with Applications	3
	Credit Hours	**18**
Spring		
Undergraduate Courses		12
BME 612	Regulatory Control of Biomedical Devices	3
BME 615	Current Trends in Neural Engineering	3
	Credit Hours	**18**
Fifth Year (Graduate)		
Fall		
BME 640	Microcomputer-Based Medical Instrumentation	3
CSC 746	Neural Networks and Deep Learning	3
BME 725	Special Problems	3
	Credit Hours	**9**
Spring		
BME 635	Advanced Biomaterials	3
PHS 741	Principles of Membrane Physiology and Biophysics I	2
BME 725	Special Problems	3
Additional Elective		1
	Credit Hours	**9**
	Total Credit Hours	**150**