B.S./M.S. 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 a 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.

MS Project

General description

All students enrolled in the BS/MS in Neural Engineering must complete a two-semester 3 credit Master's project (BME 707/ BME 708), under the supervision of a project mentor and departmental project coordinator. The project must demonstrate the candidate's ability to solve complex scientific or technical problems at the interface of engineering and medicine or biology.

The MS project can be a research or design project. The project must include a significant research or design component, in areas directly related to Neural Engineering, contributed by the M.S. student, including, but not limited to, the design of an experiment or process; the development of a device, instrument, or system; the development of a computer program; the analysis of experimental data. Projects cannot be limited solely to the review of literature, the development of research or design proposals, or the collection of experimental data.

At the completion of their project, students must submit a written project report and complete a public oral defense of their project.

Project Mentor
Students must identify a project mentor and select a project before they register for their second semester of full-time study. The project mentor is generally a faculty member from the neural engineering program. The role of the project mentor is to help the student identify a suitable project, to monitor the progress of the student, to provide guidance and training in the relevant topics, and to review the final report and presentation. Students may complete their project under the supervision of a mentor from a different program or from the local biomedical industry, under the following conditions:

- The student must receive the approval of the Department Chairman and Graduate Program Director.
- The student must identify a co-mentor who must be a faculty member in the neural engineering program. The co-mentor must be familiar with the topic of the proposed project. The role of the co-mentor will be to monitor the student progress and ensure that the Master's project report and presentation satisfy all of the relevant requirements.

Project Coordinator
The project coordinator is faculty member of the neural engineering program who is responsible for overseeing the MS project. The role of the project coordinator is to:

- Help students identify a project and mentor.
- Ensure that the projects satisfy the program objectives.
- Provide general guidance and graduate scholarship training.
- Ensure that the students are making suitable progress towards the project goals.

Project Abstract
Students must submit a one-page project abstract to the Neural Engineering Program Director at the time when they register for BME 707. The abstract must include the name of the project mentor (and co-mentor, if any), the title of the proposed project, and a brief description of the goals of the project and proposed methods. The abstract must be approved by the mentor, Project Coordinator, and Neural Engineering Program Director before the student can start work on the project.

Project Report
Students must submit a detailed report describing the work completed during the project. The report must describe the objectives and significance of the work, and summarize the activities completed by the student as part of the MS project. The report must demonstrate that the work performed by the student satisfies the general project criteria. The typical length of M.S. project reports is 20 to 30 pages. If the project resulted in the submission of a full-length peer-reviewed scientific article, the article can be submitted in lieu of a report, as long as the following conditions are satisfied:

- The student must be the first author of the article.
- The article must reflect the work performed by the student as part of the project.
- The article must be submitted for publication in a peer-reviewed journal or conference proceedings volume.
- A one to two page introduction must be submitted to summarize the project goals and main outcomes.

The report must be reviewed and approved by the project mentor (and co-mentor, if any). Once the report is approved by the mentor(s), one printed copy and one electronic version in PDF format must be submitted to the Project Coordinator by the specified deadline. The final report must be approved and signed by the Project Mentor(s), Project Coordinator and Neural Engineering Program Director.

Project presentation
Students must give an oral presentation of their project. The oral presentation is generally scheduled during the scheduled final examination time in the semester of graduation.

Project grade
The final grade for the project is given by the Project Coordinator. The final grade is a combination of a grade submitted by the Project Mentor(s) assessing the overall performance of the student on the project, and a grade given by the Project Coordinator assessing the quality of the oral presentation and report.

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/ (https://bulletin.miami.edu/undergraduate-academic-programs/engineering/biomedical-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	
PHS 741	Principles of Membrane Physiology and Biophysics I	
Statistics Course Chosen from the Following:		3
BIL 618	Advanced Biostatistics	
ECE 677	Data Mining	3
ECE 730	Statistical Learning	
MTH 624	Introduction to Probability Theory	3
MTH 642	Statistical Analysis	
MTH 625	Introduction to Mathematical Statistics	3
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):		
BIL 668	Developmental Neuroscience	
BME 610	Introduction to Medical Robotics	
BME 612	Regulatory Control of Biomedical Devices	
BME 624	Neuromotor Engineering	
BME 635	Advanced Biomaterials	
BME 640	Microcomputer-Based Medical Instrumentation	
BME 695	Current Trends in Regenerative Medicine	
BME 735	Auditory and Visual Neural Systems	
CSC 645	Introduction to Artificial Intelligence	
CSC 646	Introduction to Machine Learning with Applications	
CSC 649	Biomedical Data Science	
CSC 650	Computational Neuroscience	
CSC 746	Neural Networks and Deep Learning	
DSC 615	Introduction to Python Programming for Graduate Students	3
ECE 637	Principles of Artificial Intelligence	
ECE 648	Machine Learning	
ECE 677	Data Mining	
ECE 753	Pattern Recognition and Neural Networks	
MTH 613	Partial Differential Equations I	3
MTH 614	Partial Differential Equations II	3
MTH 615	Ordinary Differential Equations	3
MTH 621	Numerical Methods in Differential Equations	3
NEU 797	Neuroanatomy	
PHS 741	Principles of Membrane Physiology and Biophysics I	

Project		**6**
BME 707	Master's Project I	1
BME 708	Master's Project II	2
Total Credit Hours		**177**

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

- Neuroprosthetics and neuromodulation
- Neurorehabilitation, robotics, and instrumentation
- Machine learning, artificial intelligence, and neural decoding
- Neural tissue engineering and 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 707	Master's Project I	1
Graduate elective		3
	Credit Hours	**10**
Spring		
BME 612	Regulatory Control of Biomedical Devices	3
ECE 753	Pattern Recognition and Neural Networks	3
BME 708	Master's Project II	2
	Credit Hours	**8**
	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 797	Neuroanatomy	3
BME 707	Master's Project I	1
Graduate Elective		3
	Credit Hours	**10**
Spring		
BME 612	Regulatory Control of Biomedical Devices	3
BME 695	Current Trends in Regenerative Medicine	3
BME 708	Master's Project II	2
	Credit Hours	**8**
	Total Credit Hours	**150**

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 707	Master's Project I	1
Graduate Elective		3
	Credit Hours	**10**
Spring		
BME 624	Neuromotor Engineering	3
BME 735	Auditory and Visual Neural Systems	3
BME 708	Master's Project II	2
	Credit Hours	**8**
	Total Credit Hours	**150**