NEURAL ENGINEERING, BS

for the degree of Bachelor of Science in Neural Engineering

The Bachelor of Science in Neural Engineering provides training at the intersection of neuroscience and engineering fundamentals. The program focuses on skill development in electrical and imaging systems, molecular and cellular engineering, biological interfacing, and computational data sciences. The first two years of the program provide foundational knowledge in applied formal sciences, physical sciences, and life sciences. Years three and four provide focused training in neural engineering fundamentals and applications through core courses, neuroscience courses, and neural engineering electives. Students will be prepared for employment as engineers in growing healthcare industry sectors related to neurological devices, brain-computer interfaces, neurological disease treatments, and brain imaging technologies. Graduates will also be positioned to pursue professional degrees in medicine and graduate studies in clinical, life, and behavioral sciences.

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Minimum Hours for Graduation: 128

To graduate, students must satisfy all University requirements as to residency, scholarship, and fees and must complete the University's general education requirements.

Highest honors/departmental distinction: Students completing a Bachelor's thesis with a minimum GPA of 3.8 will be eligible for highest honors.

Graduation Requirements
Minimum hours required for graduation: 128 hours.
Minimum Overall GPA: 2.0

University Requirements
Minimum of 40 hours of upper-division coursework, generally at the 300- or 400-level. These hours can be drawn from all elements of the degree. Students should consult their academic advisor for additional guidance in fulfilling this requirement.

The university and residency requirements can be found in the Student Code (https://studentcode.illinois.edu/article3/part8/3-801/) (§ 3-801) and in the Academic Catalog (http://catalog.illinois.edu/general-information/degree-general-education-requirements/).

General Education Requirements
Follows the campus General Education (Gen Ed) requirements (https://courses.illinois.edu/gened/DEFAULT/DEFAULT/). Some Gen Ed requirements may be met by courses required and/or electives in the program.

Code	Title	Hours
	Composition I	4-6
	Advanced Composition	3
	Humanities & the Arts (6 hours)	6
	Natural Sciences & Technology (6 hours)	6
	fulfilled by CHEM 102, CHEM 104, MCB 150, PHYS 211, PHYS 212	
	Social & Behavioral Sciences (6 hours)	6
	fulfilled by PSYC 100 and other any other course approved as Social & Behavioral Sciences	
	Cultural Studies: Non-Western Cultures (1 course)	3
	Cultural Studies: US Minority Cultures (1 course)	3
	Cultural Studies: Western/Comparative Cultures (1 course)	3
	Quantitative Reasoning (2 courses, at least one course must be Quantitative Reasoning I)	6-10
	fulfilled by MATH 220 or MATH 221; and MATH 231, MATH 241, MATH 285, PHYS 211, PHYS 212; and CS 101 or CS 124	
	Language Requirement (Completion of the third semester or equivalent of a language other than English is required)	0-15

Major Requirements

Orientation and Professional Development

Code	Title	Hours
ENG 100	Grainger Engineering Orientation Seminar (External transfer students take ENG 300.)	1
Total Hours		**1**

Foundational Mathematics and Science

Code	Title	Hours
CHEM 102	General Chemistry I	3
CHEM 103	General Chemistry Lab I	1
CHEM 104	General Chemistry II	3
CHEM 105	General Chemistry Lab II	1
CHEM 232	Elementary Organic Chemistry I (May be taken for 3 or 4 credit hours; the extra hour may be used to help meet free elective requirements.)	4
MATH 221	Calculus I (MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.)	4
MATH 231	Calculus II	3
MATH 241	Calculus III	4
MATH 285	Intro Differential Equations	3
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
Total Hours		**34**

Neural Engineering Technical Core

Code	Title	Hours
BIOE 205	Signals & Systems in Bioengrg	3
BIOE 210	Linear Algebra for Biomedical Data Science	3
BIOE 310	Computational Tools for Biological Data	3
NE 100	Introduction to Neural Engineering	2
NE 330	Neuroscience for Engineers	3
NE 402	Neural Engineering Senior Design	4
NE 412	Neural Data Analysis	3

NE 422	Introduction to Neuroimaging	3
NE 430	Neural Cell and Tissue Engineering	3
NE 431	Neural Cell & Tissue Engineering Lab	4
ECE/NE 410	Neural Circuits and Systems	3
ECE 421/NE 420	Neural Interface Engineering	3
CS 101	Intro Computing: Engrg & Sci (CS 124 may be taken instead of CS 101.)	3
MCB 150	Molecular & Cellular Basis of Life	4
MCB 250	Molecular Genetics	3
MCB 252	Cells, Tissues & Development	3
PSYC 100	Intro Psych	4
Total Hours		**54**

Technical Electives
(List of Pre-Approved Neural Engineering Electives)

Code	Title	Hours
Must choose 12 hours from the following:		**12**
Bioengineering:		
BIOE 420	Intro Bio Control Systems	
BIOE 430	Intro Synthetic Biology	
BIOE 434	Immunoengineering	
BIOE 450	Introduction to Quantitative Pharmacology	
BIOE 460	Gene Editing Lab	
BIOE 476	Tissue Engineering	
BIOE 483	Biomedical Computed Imaging Systems	
BIOE 484	Statistical Analysis of Biomedical Images	
BIOE 485	Computational Mathematics for Machine Learning and Imaging	
BIOE 486	Applied Deep Learning for Biomedical Imaging	
BIOE 487	Stem Cell Bioengineering	
BIOE 488	Applied High-Performance Computing for Imaging Science	
BIOE 489	Regulations, Ethics and Logistics in Biomedical Applications of Machine Learning	
BIOE 498	Special Topics (Soft Robotics)	
Electrical and Computer Engineering		
ECE 416	Biosensors	
ECE 442	Silicon Photonics	
ECE 459	Communications Systems	
ECE 460	Optical Imaging	
ECE 461	Digital Communications	
ECE 467	Biophotonics	
ECE 470	Introduction to Robotics	
ECE 480	Magnetic Resonance Imaging	
Mechanical Engineering		
ME 483	Mechanobiology	
Psychology		
PSYC 210	Behavioral Neuroscience	
PSYC 404	Cognitive Neuroscience	

Physics

PHYS 475	Introduction to Biophysics	

Free Electives

Code	Title	Hours
Additional coursework, subject to the Grainger College of Engineering restrictions to Free Electives, so that there are at least 128 credit hours earned toward the degree. (https://go.grainger.illinois.edu/FreeElectives/)		12
Total Hours of Curriculum to Graduate		**128**

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Sample Sequence

This sample sequence is intended to be used only as a guide for degree completion. All students should work individually with their academic advisors to decide the actual course selection and sequence that works best for them based on their academic preparation and goals. Enrichment programming such as study abroad, minors, internships, and so on may impact the structure of this four-year plan. Course availability is not guaranteed during the semester indicated in the sample sequence.

Students must fulfill their Language Other Than English requirement by successfully completing a third level of a language other than English. See the corresponding section on the Degree and General Education Requirements.

Free Electives: Additional course work, subject to the Grainger College of Engineering restrictions to Free Electives, so that there are at least 128 credit hours earned toward the degree.

First Year

First Semester	Hours	Second Semester	Hours
ENG 100	1	MATH 231	3
MATH 221 (MATH 220 may be substituted)	4	PHYS 211	4
NE 100	2	CS 101	3
CHEM 102	3	MCB 150 (or Composition I course)	4
CHEM 103	1	CHEM 104	3
Composition I or MCB 150	4	CHEM 105	1
General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3		
	18		**18**

Total Hours 36

Second Year

First Semester	Hours	Second Semester	Hours
MATH 241	4	MATH 285	3
PHYS 212	4	CHEM 232	4
MCB 250	3	MCB 252	3
BIOE 210	3	BIOE 310	3
PSYC 100	4	BIOE 205	3
	18		16

Total Hours 34

Third Year

First Semester	Hours	Second Semester	Hours
NE 330	3	NE 420 or ECE 421	3
NE 410 or ECE 410	3	NE 422	3
Neural Engineering Technical Elective course	3	Neural Engineering Technical Elective course	3
General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3	Language Other than English (3rd level)	4
		General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3
	12		16

Total Hours 28

Fourth Year

First Semester	Hours	Second Semester	Hours
NE 412	3	NE 402	4
NE 430	3	General Education course (choose a Humanities or Social/Behavioral Science course that is also Advanced Composition)	3
NE 431	4	Neural Engineering Technical Elective course	3
Neural Engineering Tecnical Elective course	3	Free Elective course	4
Free Elective course	3		
	16		14

Total Hours 30

Total Hours: 128

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The Neural Engineering program prepares graduates to achieve the following seven outcomes by the time of graduation:

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 computational bioengineering 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, analysis and interpretation of data, and to use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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B.S. in Neural Engineering (https://bioengineering.illinois.edu/academics/undergraduate/neural-engineering/)
Bioengineering Faculty (https://bioengineering.illinois.edu/people/faculty/)

The Grainger College of Engineering Admissions (https://grainger.illinois.edu/admissions/)
The Grainger College of Engineering (https://grainger.illinois.edu/)