Bioengineering and Behavioral Neuroscience, BSBioE (Boston)

This combined major from the College of Engineering and College of Science serves students who wish to develop both a scientific and an engineering mindset to solve problems in bioengineering and behavioral neuroscience. The program includes multidisciplinary fundamentals in bioengineering, developing a tool set to quantitatively model biological and engineered systems as well as design and implement devices, instruments, and implants with a focus on neurological systems. It also combines foundational topics in neuroscience with a rigorous background in life sciences, physical sciences, and mathematics, enabling students to connect the anatomy of the brain, neurons, and networks to the behavior in healthy and pathological states.

Program Educational Objectives

See Accreditation—Department of Bioengineering (https://bioe.northeastern.edu/academics/undergraduate-studies/bioe-accreditation/) for program educational objectives.

Program Requirements

Complete all courses listed below unless otherwise indicated. Also complete any corequisite labs, recitations, clinicals, or tools courses where specified and complete any additional courses needed beyond specific college and major requirements to satisfy graduation credit requirements.

Universitywide Requirements

All undergraduate students are required to complete the Universitywide Requirements (https://catalog.northeastern.edu/undergraduate/university-academics/university-wide-requirements/).

NUpath Requirements

All undergraduate students are required to complete the NUpath Requirements (https://catalog.northeastern.edu/undergraduate/university-academics/nupath/).

NUpath requirements Interpreting Culture (IC), Understanding Societies and Institutions (SI), Engaging Differences and Diversity (DD), and Integrating Knowledge and Skills Through Experience (EX) are not explicitly satisfied by required engineering coursework. Successful completion of a cooperative education experience may fulfill the EX requirement. Students are responsible for satisfying unfulfilled NUpath requirements with general elective coursework.

Engineering Requirements

Code	Title	Hours
Required Engineering		
BIOE 2350	Biomechanics	4
BIOE 2355	Quantitative Physiology for Bioengineers	4
BIOE 2365 and BIOE 2366	Bioengineering Measurement, Experimentation, and Statistics and Lab for BIOE 2365	5
BIOE 3210	Bioelectricity	4
BIOE 3310	Transport and Fluids for Bioengineers	4
BIOE 3380	Biomolecular Dynamics and Control	4
Bioengineering Capstone		
BIOE 4790	Capstone Design 1	4
BIOE 4792	Capstone Design 2	4
Supplemental Credit		
2 semester hours from the following course count toward the engineering requirement:		2
GE 1501	Cornerstone of Engineering 1 [1]	
3 semester hours from the following course count toward the engineering requirement:		3
GE 1502	Cornerstone of Engineering 2 [1]	

Mathematics/Science Requirements

Code	Title	Hours
Required Mathematics/Science		
BIOL 1111 and BIOL 1112	General Biology 1 and Lab for BIOL 1111	5
BIOL 2301 and BIOL 2302	Genetics and Molecular Biology and Lab for BIOL 2301	5

CHEM 1151 and CHEM 1153	General Chemistry for Engineers and Recitation for CHEM 1151	4
CHEM 2311 and CHEM 2312	Organic Chemistry 1 and Lab for CHEM 2311	5
MATH 1341	Calculus 1 for Science and Engineering	4
MATH 1342	Calculus 2 for Science and Engineering	4
MATH 2321	Calculus 3 for Science and Engineering	4
MATH 2341	Differential Equations and Linear Algebra for Engineering	4
Complete one of the following:		5
PHYS 1151 and PHYS 1152 and PHYS 1153	Physics for Engineering 1 and Lab for PHYS 1151 and Interactive Learning Seminar for PHYS 1151	
or PHYS 1171 and PHYS 1172 and PHYS 1173	Physics 1 for Bioscience and Bioengineering and Lab for PHYS 1171 and Interactive Learning Seminar for PHYS 1171	
Complete one of the following:		5
PHYS 1155 and PHYS 1156 and PHYS 1157	Physics for Engineering 2 and Lab for PHYS 1155 and Interactive Learning Seminar for PHYS 1155	
PHYS 1175 and PHYS 1176 and PHYS 1177	Physics 2 for Bioscience and Bioengineering and Lab for PHYS 1175 and Interactive Learning Seminar for PHYS 1175	
PSYC 1101	Foundations of Psychology	4
Behavioral Neuroscience Electives		
Complete two of the following:		8
BIOL 3415	Current Topics in Behavioral Neuroscience	
BIOL 3601	Neural Systems and Behavior	
BIOL 3605	Developmental Neurobiology	
BIOL 4705	Neurobiology of Cognitive Decline	
BIOL 4709	Neurobiology of Learning and Memory	
BIOL 5587	Comparative Neurobiology	
BIOL 5595	Cell and Molecular Neuroscience	
BIOL 5601	Multidisciplinary Approaches in Motor Control	
PSYC 3506	Neuropsychology of Fear	
PSYC 3508	Behavioral Endocrinology	
PSYC 3510	Brain, Behavior, and Immunity	
PSYC 4510	Psychopharmacology	
PSYC 4512	Neuropsychology	
PSYC 4514	Clinical Neuroscience	
PSYC 4570	Behavioral Genetics	
Supplemental Credit		
1 semester hour from the following course counts toward the mathematics/science requirement:		1
GE 1501	Cornerstone of Engineering 1 [1]	

Concentration in Bioengineering of Neural Structure and Function

Code	Title	Hours
Required Courses		
BIOL 3405	Neurobiology	4
PSYC 3200	Clinical Neuroanatomy	4-5
or PT 5410 and PT 5411	Functional Human Neuroanatomy and Lab for PT 5410	
PSYC 3458	Biological Psychology	4
Electives		
Complete two of the following:		8
BIOE 4991	Research	

BIOE 5115	Dynamical Systems in Biological Engineering
BIOE 5235	Biomedical Imaging
BIOE 5250	Regulatory and Quality Aspects of Medical Device Design
BIOE 5410	Molecular Bioengineering
BIOE 5411	Applied Molecular Bioengineering
BIOE 5420	Cellular Engineering
BIOE 5430	Principles and Applications of Tissue Engineering
BIOE 5630	Physiological Fluid Mechanics
BIOE 5640	Computational Biomechanics
BIOE 5648	Biomedical Optics
BIOE 5650	Multiscale Biomechanics
BIOE 5660	Integrative Mechanobiology
BIOE 5710	Experimental Systems and Synthetic Bioengineering
BIOE 5720	Physical Bioengineering
BIOE 5750	Modeling and Inference in Bioengineering
BIOE 5800	Systems, Signals, and Controls for Bioengineers
BIOE 5810	Design of Biomedical Instrumentation

Professional Development

Code	Title	Hours
Professional Development		
ENCP 2000	Introduction to Engineering Co-op Education	1
ENCP 3000	Professional Issues in Engineering	1
GE 1000	First-Year Seminar	1
Additional Required Courses		
1 semester hour from the following course counts toward the professional development requirement:		1
GE 1501	Cornerstone of Engineering 1 [1]	
1 semester hour from the following course counts toward the professional development requirement:		1
GE 1502	Cornerstone of Engineering 2 [1]	

Writing Requirements

Code	Title	Hours
A grade of C or higher is required:		
ENGW 1111	First-Year Writing	4
ENGW 3302	Advanced Writing in the Technical Professions	4

Required General Electives

Code	Title	Hours
Complete 8 semester hours of academic, nonremedial, nonrepetitive courses.		8

Integrative Courses

Code	Title	Hours
These courses are already required above and also fulfill the integrative requirement:		
BIOE 4790	Capstone Design 1	
BIOE 4792	Capstone Design 2	

[1] Students can substitute Engineering Design (GE 1110) and Engineering Problem Solving and Computation (GE 1111) for Cornerstone of Engineering 1 (GE 1501) and Cornerstone of Engineering 2 (GE 1502) in approved situations.

Major GPA Requirement

2.000 minimum GPA required

Program Requirement

137 total semester hours required

Plan of Study

Sample Plans of Study

FOUR YEARS, ONE CO-OP IN SUMMER SECOND HALF/FALL

Year 1

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
CHEM 1151 (ND)	4	MATH 1342 (FQ)	4	PHYS 1155 or 1175 (ND)	3	Vacation	
CHEM 1153	0	PSYC 1101 (SI)	4	PHYS 1156 or 1176 (AD)	1		
MATH 1341 (FQ)	4	PHYS 1171 or 1151 (ND)	3	PHYS 1157 or 1177	1		
GE 1501	4	PHYS 1172 or 1152 (AD)	1	BIOL 1111	4		
ENGW 1111 (WF)	4	PHYS 1173 or 1153	1	BIOL 1112	1		
GE 1000	1	GE 1502 (ER)	4				
	17		**17**		**10**		**0**

Year 2

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
PSYC 3458	4	BIOE 2355	4	Vacation		Vacation	
BIOE 2350	4	PSYC 3200 or PT 5410 ***and*** PT 5411	4-5				
BIOE 2365 (AD, WI)	4	CHEM 2311	4				
BIOE 2366	1	CHEM 2312	1				
MATH 2341	4	MATH 2321 (FQ)	4				
		ENCP 2000	1				
	17		**18-19**		**0**		**0**

Year 3

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
BIOE 3380	4	BIOE 3210	4	BIOE 3310	4	Co-op	0
BIOL 3405	4	BIOE elective	4	BIOE 4790 (EI, CE, WI)	4		
BIOL 2301	4	BNS elective	4				
BIOL 2302	1	General elective	4				
General elective	4						
	17		**16**		**8**		**0**

Year 4

Fall	Hours	Spring	Hours
Co-op	0	BIOE elective	4
		BNS elective	4
		BIOE 4792 (EI, CE, WI)	4
		ENCP 3000	1
		ENGW 3302 or 3315 (WD)	4
	0		**17**

Total Hours: 137-138

FOUR YEARS, ONE CO-OP IN SPRING/SUMMER FIRST HALF

Year 1

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
CHEM 1151 (ND)	4	MATH 1342 (FQ)	4	PHYS 1155 or 1175 (ND)	3	Vacation	
CHEM 1153	0	PSYC 1101 (SI)	4	PHYS 1156 or 1176 (AD)	1		
MATH 1341 (FQ)	4	PHYS 1171 or 1151 (ND)	3	PHYS 1157 or 1177	1		
GE 1501	4	PHYS 1172 or 1152 (AD)	1	BIOL 1111	4		
ENGW 1111 (WF)	4	PHYS 1173 or 1153	1	BIOL 1112	1		
GE 1000	1	GE 1502 (ER)	4				
	17		**17**		**10**		**0**

Year 2

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
PSYC 3458	4	BIOE 2355	4	Vacation		Vacation	
BIOE 2350	4	PSYC 3200 or PT 5410 ***and*** PT 5411	4-5				
BIOE 2365 (AD, WI)	4	CHEM 2311	4				
BIOE 2366	1	CHEM 2312	1				
MATH 2341	4	MATH 2321 (FQ)	4				
		ENCP 2000	1				
	17		**18-19**		**0**		**0**

Year 3

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
BIOE 3380	4	Co-op	0	Co-op	0	BIOE 3210	4
BIOL 3405	4					BIOE 4790	4
BIOL 2301	4						
BIOL 2302	1						
General elective	4						
	17		**0**		**0**		**8**

Year 4

Fall	Hours	Spring	Hours
BIOE 3310	4	BIOE elective	4
BNS elective	4	BIOE elective	4
BIOE 4792	4	BNS elective	4
ENCP 3000	1	General elective	4
ENGW 3302 or 3315 (WD)	4		
	17		**16**

Total Hours: 137-138

FIVE YEARS, THREE CO-OPS IN SUMMER SECOND HALF/FALL

Year 1

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
CHEM 1151 (ND)	4	MATH 1342 (FQ)	4	BIOL 1111	4	Vacation	
CHEM 1153	0	PSYC 1101 (SI)	4	BIOL 1112	1		
MATH 1341 (FQ)	4	PHYS 1171 or 1151 (ND)	3	PHYS 1155 or 1175	3		
GE 1501	4	PHYS 1172 or 1152 (AD)	1	PHYS 1156 or 1176	1		
ENGW 1111 (WF)	4	PHYS 1173 or 1153	1	PHYS 1157 or 1177	1		
GE 1000	1	GE 1502 (ER)	4				
	17		**17**		**10**		**0**

Year 2

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
PSYC 3458	4	BIOE 2355	4	Vacation		Co-op	0
BIOE 2350	4	PSYC 3200 or PT 5410 ***and*** PT 5411	4-5				
BIOE 2365 (AD, WI)	4	CHEM 2311	4				
BIOE 2366	1	CHEM 2312	1				
MATH 2341	4	MATH 2321	4				
		ENCP 2000	1				
	17		**18-19**		**0**		**0**

Year 3

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
Co-op	0	BIOE 3380	4	Vacation		Co-op	0
		BIOL 3405	4				

		BIOL 2301	4				
		BIOL 2302	1				
		ENGW 3302 or 3315	4				
	0		**17**		**0**		**0**

Year 4

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
Co-op	0	BIOE 3210	4	BIOE 3310	4	Co-op	0
		BIOE elective	4	BIOE 4790	4		
		BNS elective	4				
		General elective	4				
		ENCP 3000	1				
	0		**17**		**8**		**0**

Year 5

Fall	Hours	Spring	Hours
Co-op	0	BIOE elective	4
		BNS elective	4
		BIOE 4792	4
		General elective	4
	0		**16**

Total Hours: 137-138

FIVE YEARS, THREE CO-OPS IN SPRING/SUMMER FIRST HALF

Year 1

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
CHEM 1151 (ND)	4	MATH 1342 (FQ)	4	BIOL 1111	4	Vacation	
CHEM 1153	0	PSYC 1101 (SI)	4	BIOL 1112	1		
MATH 1341 (FQ)	4	PHYS 1171 or 1151 (ND)	3	PHYS 1155 or 1175	3		
GE 1501	4	PHYS 1172 or 1152 (AD)	1	PHYS 1156 or 1176	1		
ENGW 1111 (WF)	4	PHYS 1173 or 1153	1	PHYS 1157 or 1177	1		
GE 1000	1	GE 1502 (ER)	4				
	17		**17**		**10**		**0**

Year 2

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
BIOE 2350	4	Co-op	0	Co-op	0	Vacation	
BIOE 2365 (AD, WI)	4						
BIOE 2366	1						
MATH 2341	4						
ENCP 2000	1						
General elective	4						
	18		**0**		**0**		**0**

Year 3

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
PSYC 3458	4	Co-op	0	Co-op	0	Vacation	
BIOE 2355	4						
BIOL 2301	4						
BIOL 2302	1						
MATH 2321	4						
	17		**0**		**0**		**0**

Year 4

Fall	Hours	Spring	Hours	Summer 1	Hours	Summer 2	Hours
BIOE 3380	4	Co-op	0	Co-op	0	BIOE 3210	4
BIOL 3405	4					BIOE 4790	4

CHEM 2311	4				
CHEM 2312	1				
PSYC 3200 or PT 5410 ***and*** PT 5411	4-5				
	17-18		**0**	**0**	**8**

Year 5

Fall	**Hours**	**Spring**	**Hours**
BIOE 3310	4	BIOE elective	4
BNS elective	4	BIOE elective	4
BIOE 4792	4	BNS elective	4
ENCP 3000	1	General elective	4
ENGW 3302 or 3315 (WD)	4		
	17		**16**

Total Hours: 137-138