Table of Contents

The School of Biomedical Engineering, Science and Health Systems: Undergraduate Programs

The School of Biomedical Engineering, Science and Health Systems

The School of Biomedical Engineering, Science, and Health Systems (formerly the Biomedical Engineering and Science Institute, founded in 1961) is a nationally recognized center for research in biomedical engineering and science offering multidisciplinary instruction on a full- and part-time basis at the graduate and undergraduate levels.

The School of Biomedical Engineering, Science, and Health Systems offers two undergraduate Bachelor of Science degree programs:

- Biomedical Engineering
- Health Systems and Technology

Because of the interdisciplinary nature of both programs, personalized faculty advising is stressed. In both programs, students work closely with faculty advisors to select core and elective courses offered by the School of Biomedical Engineering, Science, and Health Systems as well as other academic units of the University, including the College of Engineering; the College of Arts and Sciences; the LeBow College of Business; the College of Information Systems and Technology; and the School of Environmental Science, Engineering, and Policy.

The School is the beneficiary of a major endowment that sponsors chair professorships and assistantships. Areas of strength in research and education include biosensors, biomedical ultrasound, biomedical imaging, biomedical systems and signal processing, biomechanics, biomaterials, tissue and cellular engineering, neuroengineering, human performance, and cardiovascular systems. New academic initiatives focus on biomedical optics and bioinformatics and computational biomedicine.

The faculty includes individuals with specialties in engineering, physics, mathematics, biostatistics, life science, medicine, and clinical work. Of the 93 associated full-time Drexel faculty members, 20 are core faculty members and 73 have joint appointments. Some 52 adjunct faculty members from regional institutions and industry participate in research and academic programs of the School.

Metropolitan Philadelphia has one of the highest concentrations of medical institutions and pharmaceutical, biotechnology, and medical devices and systems industries in the nation. In 2002, Drexel University merged with MCP Hahnemann University, which includes the MCP Hahnemann School of Medicine—one of the nation's largest medical schools. The School has also formed an academic alliance with Thomas Jefferson University, another prominent medical university, and has entered into a joint initiative in bioinformatics with the Coriell Institute for Medical Research and the Windber Research Institute. These initiatives ensure that students will have ample opportunities in basic research and clinical experience as well as innovative new academic programs.

Program Description
Biomedical engineering is concerned with the application of engineering and science methodologies to the analysis and solution of biological and physiological problems and to the delivery of health care. The biomedical engineer requires the analytical tools and broad physical and mathematical knowledge of modern engineering and science, a fundamental understanding of the biological or

physiological system, and familiarity with recent technological breakthroughs. The biomedical engineer connects traditional engineering disciplines with living systems and may work in either direction, applying the patterns of living organisms to engineering design or engineering new approaches to human health. Thus on the one hand, the biomedical engineer may use his or her knowledge of physiological systems to develop artificial tissues or neural networks. On the other hand, he or she may use engineering know-how to create new equipment or environments for such purposes as maximizing human performance, accelerating wound healing, or providing noninvasive diagnostic tools.

The School of Biomedical Engineering, Science, and Health Systems, in collaboration with the College of Engineering, offers a unique B.S. degree program in biomedical engineering. This program differentiates itself from those offered at other institutions in several ways, including an emphasis on a fundamental and comprehensive education in the principles and methods of engineering, case-study and interdisciplinary courses, professional electives, a capstone design project, and several terms of employment in industry, in clinics or medical research laboratories (co-op program).

The School of Biomedical Engineering, Science and Health Professions

Co-operative education and career opportunities available to students include employment in the medical device, equipment, and systems industry; the biomaterial and implant industry; the pharmaceutical industry; the biotechnology and agricultural industry; the telemedicine and tele-health industry; health care; medical and clinical information and management systems; and biomedical technology transfer. Preprofessional options available in the academic programs of the School prepare students for admission to schools of medicine, dentistry, and veterinary medicine. Students may also choose to continue their education at the graduate level to prepare for careers in research and development in biomedical engineering and science.

Visit the Drexel Steinbright Career Development Center page for more detailed information on co-op and post-graduate opportunities.

The School of Biomedical Engineering, Science and Health Systems

Accelerated Program and Bachelor's/Master's Dual Degree Program
The Accelerated Program provides opportunities for highly competitive and strongly motivated students to progress toward their educational goals at their own pace. Primarily through advanced placement, credit by examination, flexibility of scheduling, and independent study, the program makes it possible to complete the undergraduate curriculum and initiate graduate study in less than the five years required by the standard curriculum.

Bachelor's/Master's Dual Degree Program
Drexel offers a combined MS/BS degree program for our top engineering students who want to obtain both degrees in the same time period as most students obtain a Bachelors degree.

Preprofessional Programs
Students who want to prepare for admission to schools of medicine, dentistry, or veterinary medicine, including the B.A./B.S./M.D. and early assurance programs at the Drexel College of Medicine, may obtain professional counseling and assistance from the Office of Preprofessional Programs, 215-895-2437.

University Honors
Program Students in the Biomedical Engineering program may apply for admission to the University Honors Program. Admission depends on superior academic performance at Drexel and may be approved after a personal interview with the Honors Committee.

University Leadership Program
Drexel graduates in Biomedical Engineering will be the leaders of their profession--and their communities-- in the twenty-first century. The University Leadership Program helps cultivate leadership skills and engages students in exploring the complex aspects of successful leadership by offering multi-dimensional courses featuring service learning.

Biomedical Engineering

Bachelor of Science Degree: 192.0 credits

About the major

Biomedical engineering is an innovative Bachelor of Science degree program developed and delivered in collaboration with the College of Engineering. It prepares students to conceive, design, and develop devices and systems that improve human health and quality of life. Biomedical engineering is the convergence of life sciences with engineering. Biomedical engineers combine the strengths of both fields. From child car seats and football helmets to drug-delivery systems, minimally invasive surgery, and noninvasive imaging technology, the work of the biomedical engineer makes a difference in everyone's life.

As preparation for the major in biomedical engineering, students are strongly encouraged to take AP biology courses in high school.

Program objectives

The undergraduate biomedical engineering curriculum is designed to strike a balance between academic breadth in biomedical engineering and specialization in an area of concentration:

- Biomaterials and Tissue Engineering
- Biomechanics and Human Performance Engineering
- Biomedical Informatics
- Biomedical Systems and Imaging
- Neuroengineering

Following the tDEC model, the program provides innovative experiences in hands-on experimentation and engineering design as well as opportunities for personal growth and development of leadership and communication skills.

Working with a faculty advisor, students can select their core and elective courses from the curricula offered by the School of Biomedical Engineering, Science, and Health Systems and the Departments of Bioscience and Biotechnology, Chemistry, Physics, Mathematics, Computer Science, Chemical Engineering, Mechanical Engineering, Materials Engineering, Electrical and Computer Engineering, and the College of Information Science and Technology.

For more information, visit the The School of Biomedical Engineering, Science, and Health Systems' web site.

Biomaterials and Tissue Engineering

Bachelor of Science Degree in Biomedical Engineering: 198.0 credits

About the concentration

The concentration in Biomaterials and Tissue Engineering includes courses from the Departments of Chemical and Materials Engineering.The program builds on the fundamental knowledge of natural and synthetic biomaterials and cellular biology and educates students in the emerging field of cellular and tissue engineering.

Biomaterials research has recently expanded to include fibrous materials and various prosthetic devices requiring the use of both synthetic and natural fibers. The emphasis is on improved materials and design of biological replacement tissues through cellular tissue engineering.

For more information about this concentration, see Drexel's School of Biomedical Engineering, Science, and Health Systems web site.

Biomedical Engineering

Biomaterials and Tissue Engineering Concentration
Bachelor of Science Degree: 192.0 credits

General education requirements		Credits
HIST 285	Technology in Historical Perspective	3.0
ENGL 101	Expository Writing and Reading	3.0
ENGL 102	Persuasive Writing and Reading	3.0
ENGL 103	Analytical Writing and Reading	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives (3)	9.0
	General studies electives* (2)	6.0

Engineering core courses		Credits
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 200	Multivariate Calculus	4.0
PHYS 101	Fundamentals of Physics I	4.0
PHYS 102	Fundamentals of Physics II	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 141	Essential Biology	4.5
CS 121	Computational Laboratory I	1.0
CS 122	Computational Laboratory II	1.0
CS 123	Computational Laboratory III	1.0
ENGR 101	Engineering Design Laboratory I	2.0
ENGR 102	Engineering Design Laboratory II	2.0
ENGR 103	Engineering Design Laboratory III	2.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0

Required Biomedical Engineering courses		
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 125	Foundations of Biomedical Engineering	2.0
BMES 212	The Body Synthetic	3.0
BMES 221	Engineering Principles of Living Systems I	4.0
BMES 222	Engineering Principles of Living Systems II	4.0
BMES 301	Experimental Biomechanics Laboratory	2.0

BMES 338	**Biomedical Ethics and Law**	4.0
BMES 491	**Senior Design I**	3.0
BMES 492	**Senior Design II**	3.0
BMES 493	**Senior Design III**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0

Biomaterials and Tissue Engineering concentration courses

BIO 214	**Principles of Cell Biology**	3.0
BIO 215	**Techniques of Cell Biology**	2.5
BIO 218	**Principles of Molecular Biology**	3.0
BIO 219	**Techniques of Molecular Biology**	2.5
BMES 375	**Computational Bioengineering**	4.0
BMES 451	**Transport Phenomena in Living Systems I**	4.0
BMES 461	**Biomaterials I**	3.0
BMES 462	**Biomaterials II**	3.0
BMES 471	**Foundations of Tissue Engineering I**	4.0
BMES 472	**Foundations of Tissue Engineering II**	4.0
BMES 473	**Foundations of Tissue Engineering III**	4.0
CHEM 241	**Organic Chemistry I**	4.0
CHEM 242	**Organic Chemistry II**	4.0
CHEM 244	**Organic Chemistry Laboratory I**	3.0
CHEM 245	**Organic Chemistry Laboratory II**	3.0
MEM 202	**Engineering Mechanics: Statics**	3.0
MEM 230	**Mechanics of Materials I**	4.0
MATE 280	**Advanced Materials Laboratory**	4.0
MATE 214	**Introduction to Polymers**	4.0

*General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject area of are science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses (at the end of this document, on page 22).

Writing-Intensive Course Requirements
In order to graduate, all students beginning with the entering class of 2002/01 (fall, 2002) must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog indicates that this course can fulfill a writing-intensive requirement. Departments will designate specific sections of such courses as writing-intensive. Sections of writing-intensive courses are not indicated in this catalog. Students should check the section comments in Banner when registering. Students scheduling their courses in Banner can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term. For more information on writing-intensive courses, see the Drexel University Writing Program's Writing-Intensive Course page.

Biomechanics and Human Performance Engineering

Bachelor of Science Degree in Biomedical Engineering: 192.0 credits

About the concentration

The Biomechanics concentration applies engineering principles to study the interactions between humans and various machine systems in both working and living environments. Courses in this area of specialization cover such topics as the mechanics of materials, chronobiology, biomechanics, and human factors and cognitive engineering.

For more information about this concentration, see Drexel's School of Biomedical Engineering, Science, and Health Systems web site.

Biomedical Engineering

Biomechanics and Human Performance Engineering Concentration
Bachelor of Science Degree: 192.0 credits

General education requirements		Credits
HIST 285	Technology in Historical Perspective	3.0
ENGL 101	Expository Writing and Reading	3.0
ENGL 102	Persuasive Writing and Reading	3.0
ENGL 103	Analytical Writing and Reading	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives (2)	6.0
	General studies electives* (2)	6.0
	Free elective	2.0

Engineering core courses		Credits
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 200	Multivariate Calculus	4.0
PHYS 101	Fundamentals of Physics I	4.0
PHYS 102	Fundamentals of Physics II	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 141	Essential Biology	4.5
CS 121	Computational Laboratory I	1.0
CS 122	Computational Laboratory II	1.0
CS 123	Computational Laboratory III	1.0
ENGR 101	Engineering Design Laboratory I	2.0
ENGR 102	Engineering Design Laboratory II	2.0
ENGR 103	Engineering Design Laboratory III	2.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0

Required Biomedical Engineering courses		
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 125	Foundations of Biomedical Engineering	2.0
BMES 212	The Body Synthetic	3.0
BMES 221	Engineering Principles of Living Systems I	4.0
BMES 222	Engineering Principles of Living Systems II	4.0

BMES 301	**Experimental Biomechanics Laboratory**	2.0
BMES 338	**Biomedical Ethics and Law**	4.0
BMES 491	**Senior Design I**	3.0
BMES 492	**Senior Design II**	3.0
BMES 493	**Senior Design III**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0

Biomechanics and Human Performance Engineering concentration courses

BMES 302	**Biomeasurements Laboratory**	2.0
BMES 303	**Biomedical Electronics Laboratory**	2.0
BMES 304	**Ultrasound Images Laboratory**	2.0
BMES 375	**Computational Bioengineering**	4.0
or		
BMES 401	**Biosensors I**	4.0
BMES 411	**Chronoengineering I**	3.0
BMES 412	**Chronoengineering II**	3.0
BMES 440	**Biodynamics**	3.0
BMES 441	**Biomechanics I**	4.0
BMES 442	**Biomechanics II**	4.0
BMES 451	**Transport Phenomena in Living Systems I**	4.0
MEM 202	**Engineering Mechanics: Statics**	3.0
MEM 230	**Mechanics of Materials I**	4.0
MEM 238	**Engineering Mechanics: Dynamics**	4.0
PSY 101	**General Psychology**	3.0
	Biomechanics and Human Peformance electives (4)	12.0

Suggested Biomechanics and Human Performance concentration electives

BMES 443	**Biomechanics III**	4.0
PSY 213	**Sensation and Perception**	3.0
PSY 332	**Human Factors and Cognitive Engineering**	3.0
PSY 410	**Neuropsychology**	3.0
BMES 310	**Biomedical Statistics**	4.0

*General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject area of are science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses (at the end of this document, on page 22).

Writing-Intensive Course Requirements
In order to graduate, all students beginning with the entering class of 2002/01 (fall, 2002) must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog indicates that this course can fulfill a writing-intensive requirement. Departments will designate specific sections of such courses as writing-intensive. Sections of writing-intensive courses are not indicated in this catalog. Students should check the section comments in Banner when registering. Students scheduling their courses in Banner can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term. For more information on writing-intensive courses, see the Drexel University Writing Program's Writing-Intensive Course page.

Bioinformatics

Bachelor of Science Degree in Biomedical Engineering: 192.0 credits

About the concentration

Bioinformatics is an emerging field of science that is concerned with the management, analysis and visualization of the flood of data being generated in molecular and cellular biology, genomics and other areas of biology and biomedicine. The field of bioinformatics enables information at the gene, protein, cell, tissue, organ, and system level to be integrated and interpreted for early detection, accurate diagnosis, and effective treatment of complex diseases such as cancer.

The Bioinformatics concentration includes courses in biology, computer science, and information technology. The concentration introduces information handling systems for people in the allied health professions, with specific examples drawn from health care and covers locating, manipulating, and displaying information in the health system setting. Students are also introduced to the mathematical and computational analysis of biological systems. The systems analyzed include the genome, protein and gene networks, cell division cycles, and cellular level disease. Mathematical tools include matrix algebra, differential equations, cellular automata, and cluster analysis.

For more information about this concentration, see Drexel's School of Biomedical Engineering, Science, and Health Systems web site.

Biomedical Engineering

Biomedical Informatics Concentration
Bachelor of Science Degree: 192.0 credits

General education requirements		Credits
HIST 285	Technology in Historical Perspective	3.0
ENGL 101	Expository Writing and Reading	3.0
ENGL 102	Persuasive Writing and Reading	3.0
ENGL 103	Analytical Writing and Reading	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives (3)	9.0
	General studies electives* (2)	6.0

Engineering core courses		Credits
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 200	Multivariate Calculus	4.0
PHYS 101	Fundamentals of Physics I	4.0
PHYS 102	Fundamentals of Physics II	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 141	Essential Biology	4.5
CS 121	Computational Laboratory I	1.0
CS 122	Computational Laboratory II	1.0
CS 123	Computational Laboratory III	1.0
ENGR 101	Engineering Design Laboratory I	2.0
ENGR 102	Engineering Design Laboratory II	2.0
ENGR 103	Engineering Design Laboratory III	2.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0

Required Biomedical Engineering courses		
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 125	Foundations of Biomedical Engineering	2.0
BMES 212	The Body Synthetic	3.0
BMES 221	Engineering Principles of Living Systems I	4.0
BMES 222	Engineering Principles of Living Systems II	4.0

BMES 301	**Experimental Biomechanics Laboratory**	2.0
BMES 338	**Biomedical Ethics and Law**	4.0
BMES 491	**Senior Design I**	3.0
BMES 492	**Senior Design II**	3.0
BMES 493	**Senior Design III**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0

Biomedical Informatics concentration courses

BIO 122	**Cells and Genetics**	4.5
BIO 218	**Principles of Molecular Biology**	3.0
BIO 219	**Techniques of Molecular Biology**	2.5
BMES 302	**Biomeasurements Laboratory**	2.0
BMES 303	**Biomedical Electronics Laboratory**	2.0
BMES 304	**Ultrasound Images Laboratory**	2.0
BMES 375	**Computational Bioengineering**	4.0
BMES 401	**Biosensors I**	4.0
CS 171	**Computer Programming I**	3.0
CS 172	**Computer Programming II**	3.0
INFO 110	**Human-Computer Interaction I**	3.0
INFO 200	**Systems Analysis I**	3.0
INFO 210	**Database Management Systems**	3.0
INFO 355	**Systems Analysis II**	3.0
	Bioinformatics concentration electives (2)	6.0

Suggested Bioinformatics electives

BMES 335	**Biomedical Informatics I**	3.0
BMES 336	**Biomedical Informatics II**	3.0

*General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject area of are science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses (at the end of this document, on page 22).

Writing-Intensive Course Requirements
In order to graduate, all students beginning with the entering class of 2002/01 (fall, 2002) must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog indicates that this course can fulfill a writing-intensive requirement. Departments will designate specific sections of such courses as writing-intensive. Sections of writing-intensive courses are not indicated in this catalog. Students should check the section comments in Banner when registering. Students scheduling their courses in Banner can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term. For more information on writing-intensive courses, see the Drexel University Writing Program's Writing-Intensive Course page.

Top

Biomedical Systems and Imaging

Bachelor of Science Degree in Biomedical Engineering: 192.0 credits

About the concentration

Biomedical imaging focuses on the theoretical and practical issues related to machine vision, image processing and analysis, and signal processing associated with such medical applications as ultrasound, optics, magnetic resonance, and autoradiographic imaging.

The concentration covers the fundamentals of modern imaging methodologies, covering aspects of light imaging, ultrasound imaging, and volumetric and functional imaging systems, and the principles of Magnetic Resonance Imaging (MRI).

For more information about this concentration, see Drexel's School of Biomedical Engineering, Science, and Health Systems web site.

Biomedical Engineering

Biomedical Systems and Imaging Concentration
Bachelor of Science Degree: 192.0 credits

General education requirements		Credits
HIST 285	Technology in Historical Perspective	3.0
ENGL 101	Expository Writing and Reading	3.0
ENGL 102	Persuasive Writing and Reading	3.0
ENGL 103	Analytical Writing and Reading	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives (3)	9.0
	General studies electives* (2)	6.0
	Free elective	3.0

Engineering core courses		Credits
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 200	Multivariate Calculus	4.0
PHYS 101	Fundamentals of Physics I	4.0
PHYS 102	Fundamentals of Physics II	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 141	Essential Biology	4.5
CS 121	Computational Laboratory I	1.0
CS 122	Computational Laboratory II	1.0
CS 123	Computational Laboratory III	1.0
ENGR 101	Engineering Design Laboratory I	2.0
ENGR 102	Engineering Design Laboratory II	2.0
ENGR 103	Engineering Design Laboratory III	2.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0

Required Biomedical Engineering courses		
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 125	Foundations of Biomedical Engineering	2.0
BMES 212	The Body Synthetic	3.0
BMES 221	Engineering Principles of Living Systems I	4.0
BMES 222	Engineering Principles of Living Systems II	4.0

BMES 301	**Experimental Biomechanics Laboratory**	2.0
BMES 338	**Biomedical Ethics and Law**	4.0
BMES 491	**Senior Design I**	3.0
BMES 492	**Senior Design II**	3.0
BMES 493	**Senior Design III**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0

Biomedical Systems and Imaging concentration courses

BMES 302	**Biomeasurements Laboratory**	2.0
BMES 303	**Biomedical Electronics Laboratory**	2.0
BMES 304	**Ultrasound Images Laboratory**	2.0
BMES 375	**Computational Bioengineering**	4.0
BMES 401	**Biosensors I**	4.0
BMES 421	**Biomedical Imaging I**	4.0
BMES 422	**Biomedical Imaging II**	4.0
BMES 423	**Biomedical Imaging III**	4.0
BMES 432	**Biomedical Systems and Signals**	3.0
ECES 302	**Transform Methods and Filtering**	4.0
ECES 304	**Dynamic Systems and Stability**	4.0
ECES 306	**Introduction to Modulation and Coding**	4.0
or		
ECES 356	**Theory of Control**	4.0
ECES 352	**Digital Signals**	4.0
MATH 311	**Probability and Statistics I**	4.0
	Biomedical Systems and Imaging electives (2)	6.0
	Technical elective	3.0

Suggested Biomedical Systems and Imaging electives

BMES 391	**Biomedical Instrumentation I**	3.0
BMES 392	**Biomedical Instrumentation II**	3.0

*General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject area of are science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses (at the end of this document, on page 22).

Writing-Intensive Course Requirements
In order to graduate, all students beginning with the entering class of 2002/01 (fall, 2002) must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog indicates that this course can fulfill a writing-intensive requirement. Departments will designate specific sections of such courses as writing-intensive. Sections of writing-intensive courses are not indicated in this catalog. Students should check the section comments in Banner when registering. Students scheduling their courses in Banner can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term. For more information on writing-intensive courses, see the Drexel University Writing Program's Writing-Intensive Course page.

Neuroengineering

Bachelor of Science Degree in Biomedical Engineering: 192.5 credits

About the concentration

This concentration focuses on the theory of neural signaling, as well as addressing issues that have a neuroscientific basis, such as locomotion and pattern generation, central control of movement, and the processing of sensory information. Students pursing this concentration will learn the fundamental theory of cellular potentials and chemical signaling, the Hodgkin Huxeley description of action potential generation, circuit representations of neurons and be able to derive and integrate equations describing the circuit as well as design computer models.

For more information about this concentration, see Drexel's School of Biomedical Engineering, Science, and Health Systems web page.

Biomedical Engineering

Neuroengineering Concentration
Bachelor of Science Degree: 192.5 credits

General education requirements		Credits
HIST 285	Technology in Historical Perspective	3.0
ENGL 101	Expository Writing and Reading	3.0
ENGL 102	Persuasive Writing and Reading	3.0
ENGL 103	Analytical Writing and Reading	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives (2)	6.0
	General studies electives* (2)	6.0

Engineering core courses		Credits
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 200	Multivariate Calculus	4.0
PHYS 101	Fundamentals of Physics I	4.0
PHYS 102	Fundamentals of Physics II	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 141	Essential Biology	4.5
CS 121	Computational Laboratory I	1.0
CS 122	Computational Laboratory II	1.0
CS 123	Computational Laboratory III	1.0
ENGR 101	Engineering Design Laboratory I	2.0
ENGR 102	Engineering Design Laboratory II	2.0
ENGR 103	Engineering Design Laboratory III	2.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0

Required Biomedical Engineering courses		
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 125	Foundations of Biomedical Engineering	2.0
BMES 212	The Body Synthetic	3.0
BMES 221	Engineering Principles of Living Systems I	4.0
BMES 222	Engineering Principles of Living Systems II	4.0
BMES 301	Experimental Biomechanics Laboratory	2.0

BMES 338	**Biomedical Ethics and Law**	4.0
BMES 491	**Senior Design I**	3.0
BMES 492	**Senior Design II**	3.0
BMES 493	**Senior Design III**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0

Neuroengineering concentration courses

BIO 214	**Principles of Cell Biology**	3.0
BIO 215	**Techniques of Cell Biology**	2.5
BMES 302	**Biomeasurements Laboratory**	2.0
BMES 303	**Biomedical Electronics Laboratory**	2.0
BMES 304	**Ultrasound Images Laboratory**	2.0
BMES 375	**Computational Bioengineering**	4.0
or		
BMES 401	**Biosensors I**	4.0
BMES 411	**Chronoengineering I**	3.0
BMES 451	**Transport Phenomena in Living Systems I**	4.0
BMES 477	**Neuroengineering I**	4.0
BMES 478	**Neuroengineering II**	4.0
ECES 302	**Transform Methods and Filtering**	4.0
ECES 304	**Dynamic Systems and Stability**	4.0
ECES 356	**Theory of Control**	4.0
PSY 101	**General Psychology**	3.0
PSY 213	**Sensation and Perception**	3.0
	Neuroengineering electives (2)	6.0
	Technical electives (2)	6.0

Suggested Neuroengineering concentration electives

BMES 310	**Biomedical Statistics**	4.0
MEM 202	**Engineering Mechanics: Statics**	3.0

*General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject area of are science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses (at the end of this document on page 22).

Writing-Intensive Course Requirements
In order to graduate, all students beginning with the entering class of 2002/01 (fall, 2002) must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog indicates that this course can fulfill a writing-intensive requirement. Departments will designate specific sections of such courses as writing-intensive. Sections of writing-intensive courses are not indicated in this catalog. Students should check the section comments in Banner when registering. Students scheduling their courses in Banner can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term. For more information on writing-intensive courses, see the Drexel University Writing Program's Writing-Intensive Course page.

Biomedical Engineering

Liberal Studies/General Studies Electives List

Students obtaining an undergraduate degree in biomedical engineering from the School of Biomedical Engineering, Science and Health Systems are required to take a minimum of five general/liberal studies courses. Of these five, two must form a sequence (such as ECON 201 and ECON 202 or SOC 335 and SOC 336).

The School offers two general studies courses, BMES 340 – Health Care Administration and BMES 409 – Entrepreneurship for Biomedical Engineers, which are highly recommended. However, students are free to choose any of the courses listed below to fulfill this requirement.

Approved subjects

ARCH	**Any Architecture course**
AFAS	**Any Africana course**
ANTH	**Any Anthropology course**
ARTH	**Any Art History course**
BLAW	**Any Legal Studies course**
COM	**Any Communications course (except COM 230)**
DSMR	**Any Design and Merchandising course**
ECON	**Any Economics course**
ENGL	**Any English course (except ENGL 101, 102, 103 & 105)**
ENTR	**Any Entrepreneurship course**
FASH	**Any Fashion Design course**
VSCM	**Graphic Design**
HIST	**Any History course**
IAS	**Any International Area Studies course**
INTB	**Any International Business course**
AS-A	**Any International Studies Abroad course**
LEAD	**Any Leadership course**
MGMT	**Any Management course**
MKTG	**Any Marketing course**
ORGB	**Any Organizational Behavior course**
PHIL	**Any Philosophy course**
OPM	**Any Operations Management course**
PSCI	**Any Political Science course**
PSY	**Any Psychology course (except PSY 212, 213, 332, 360, and 410)**
SCRP	**Any Screenwriting and Playwriting course**
SMT	**Any Sport Management course**
SOC	**Any Sociology course**
THTR	**Any Theatre course (except THTR 131, 132)**
WMST	**Any Women's Studies course**
WRIT	**Any Writing course**

Approved language courses

Any language course may be taken as long as the course is 200-level or above.

Additional courses

The following subjects have restrictions on what courses can be taken. The approved courses are listed below:

BMES 336	**Health Care Administration**	3.0
BMES 409	**Entrepreneurship for Biomedical Engineers**	3.0
CULA 405	**Culture and Gastronomy I**	3.0
CULA 410	**Culture and Gastronomy II**	3.0
DANC 201	**Dance Appreciation**	3.0
DANC 220	**History of Dance**	3.0
DANC 325	**20th-Century Dance**	3.0
EDUC 112	**Integrative Instruction**	3.0
EDUC 301	**Introduction to Personalized System of Instruction**	3.0
EDUC 302	**Advanced Seminar in Personalized System of Instruction**	3.0
FMVD 150	**American Classic Cinema**	3.0
FMVD 160	**European Cinema**	3.0
FMVD 245	**Non-Western Cinema**	3.0
FMVD 250	**The Documentary Tradition**	3.0
FMVD 260	**The Western**	3.0
FMVD 262	**Film Comedy**	3.0
FMVD 265	**Special Topics***	3.0
FMVD 280	**Copywriting**	3.0
FMVD 355	**Contemporary Cinema**	3.0
SCRP 220	**Playwriting I**	3.0
SCRP 225	**Playwriting II**	3.0
SCRP 270	**Screenwriting I**	3.0
SCRP 275 WI	**Screenwriting II**	3.0
SCRP 285	**Writing for Nonfiction Film and Video**	3.0
HNRS 201	**Introduction to the Honors Program***	3.0
HNRS 202	**Colloquium I***	3.0
HNRS 301	**Colloquium II**	3.0
HNRS 302	**Honors Colloquium**	3.0
HNRS 303	**Honors Colloquium**	3.0
HNRS 304	**Honors Colloquium**	3.0
HNRS 306	**Honors Colloquium**	3.0
HNRS 307	**Honors Colloquium**	3.0
LANG 180	**Special Topics in Language**	3.0
LING 101	**Introduction to Linguistics**	3.0
LING 102	**Language and Society**	3.0
MUSC 121	**Music Theory I**	3.0
MUSC 122	**Music Theory II**	3.0
MUSC 123	**Music Theory III**	3.0
MUSC 130	**Introduction to Music**	3.0
MUSC 232 WI	**Music History II**	3.0
MUSC 236	**Rock Music Through the Mid 60's**	3.0
MUSC 238	**Rock Music Since the Mid 60's**	3.0
MUSC 331	**World Musics**	3.0
MUSC 333	**Afro-American Music USA**	3.0
MUSC 336	**History of Jazz**	3.0
MUSC 338	**American Popular Music**	3.0

PHTO 275 WI	**History of Photography I**	3.0
PHTO 276	**History of Photography II**	3.0
PHTO 236	**Photojournalism**	4.0
PHTO 350 WI	**Photography and Culture**	3.0
PHTO 452	**Contemporary Photography**	3.0
UNIV 241 WI	**Great Works Symposium**	3.0

*On a case by case approval.

Top