Drexel University
CATALOG 2011-2012

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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 leader in biomedical engineering and biomedical science research and education. The undergraduate program was inaugurated in September 1998 and has steadily grown to attract the highest ability students at the University. The program has received accreditation by the Accreditation Board of Engineering Technology (ABET) in 2002 and again in 2008.

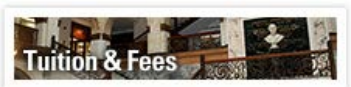
Our academic thrust areas, both in research and education, are at the forefront of biosensing, bioimaging, bioinformation engineering and integrated bioinformatics, drug delivery, biomedical ultrasound & optics, bionanotechnology, cellular tissue engineering, neuroengineering and human performance. Emerging initiatives include skin bioengineering, pediatric engineering and homeland security technologies. Various departments at Drexel University offer courses that are suited for students in biomedical engineering and biomedical science. Our curriculum complements the strengths of the Colleges of Arts & Sciences, Business, Engineering, Information Science, Law and Medicine. As a whole, our curriculum offers the advanced knowledge needed for industrial careers, health professions, graduate research or careers in highly specialized fields such as pre-professional health (medical, dental, and veterinary) and pre-law.

The marriage of technology with biology and medicine drives the 21st Century industrial enterprise. Consistent with this mission, we strive for clinical and industrial relevance in our academic pursuits. We enjoy a strong entrepreneurship program in biomedical technologies. Our alliance with regional economic development agencies and corporations together with our advisors from business development, legal, and investment communities sustains the growth of this program. The students and faculty of the School are committed to move their discoveries from our laboratories to clinical practice or home use. The success of our Translational Research in Biomedical Technologies Program has been recognized and funded regionally as well as nationally.

Our School has experienced remarkable growth in recent years thanks to our outstanding research portfolio, high quality and innovative undergraduate program, and our multidisciplinary approach to education and research. Another competitive advantage of our School is the unique free-standing university-level administrative structure with its own tenure-track faculty lines, budget and space. This helps us transcend the traditional organizational boundaries of engineering, sciences and medicine. Our independence allows us to pursue growth and collaborations in various disciplines. Our small size gives us agility to reconfigure and reorganize in response to emerging opportunities. The University Strategic Plan recognizes our School of Biomedical Engineering, Science and Health Systems as “Drexel’s prototype of academic integration. ”

Metropolitan Philadelphia has one of the nation’s highest concentrations of medical institutions and pharmaceutical, biotechnology, medical device and systems industry. The School has forged strategic partnerships with select universities, research institutes, health care institutions and industries in the region. We enjoy a close working relationship with our Drexel College of Medicine as well as alliances with prominent medical institutions in the region to develop joint research and educational programs. These include University of Pennsylvania, Thomas Jefferson University, the Fox Chase Cancer Center and the Wistar Institute. These collaborative initiatives provide students with ample opportunities in basic and clinical research as well as innovative academic programs.

Applicants to the graduate program must meet the requirements for admission to graduate studies at Drexel University. Candidates for degrees in the School of Biomedical Engineering, Science and Health Systems are required to maintain academics standards applicable to all graduate students at Drexel University.



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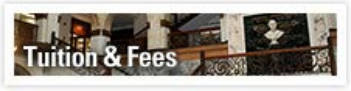
The School of Biomedical Engineering, Science and Health Systems

Co-operative Education

Co-op 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.



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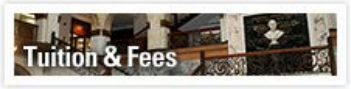
The School of Biomedical Engineering, Science and Health Systems

Accelerated Bachelor's/Master's Dual Degree Program
The Accelerated BS/MS degree program provides opportunities for strongly motivated students with high ability to progress toward their educational goals at an accelerated pace. The program makes it possible for top engineering students to obtain both degrees in the same time period that it takes most students to obtain a bachelor's degree.

Preprofessional Programs
Students who want to prepare for admission to schools of medicine, dentistry, or veterinary medicine, including the BA/BS /MD and early assurance programs at the Drexel College of Medicine, may obtain professional counseling and assistance from the Office of Preprofessional Programs, .

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.



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Biomedical Engineering

Bachelor of Science Degree

About the Major

Biomedical engineering is an innovative Bachelor of Science degree program developed and delivered in collaboration with the College of Engineering, the College of Arts and Sciences and the College of Information Science and Technology. 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. 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.

Outcomes

Graduates of the Biomedical Engineering program will attain the following skills:

- an understanding of advanced mathematics, physical science, biology and physiology;
- the ability to apply knowledge of mathematics, science and engineering to solve problems at the interface of engineering and biology;
- the ability to design and conduct experiments as well as to analyze and interpret data using statistical, computational or mathematical methods;
- the ability to make measurements on, and interpret data from, living systems addressing the problems associated with the interactions between living and non-living materials and systems;
- the ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, entrepreneurial, environmental, intellectual property rights, social, political, health and safety, manufacturability and sustainability;
- the ability to function on multi-disciplinary teams;
- the ability to identify, formulate, and solve engineering problems;
- an understanding of professional and ethical responsibilities;
- the ability to communicate effectively;
- the ability to understand the impact of engineering solutions in global, economic, environmental and societal contexts;
- a recognition of the need for, and ability to engage in, life-long learning;
- knowledge of contemporary issues;
- the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice; and
- knowledge of interdisciplinary concepts within a biomedical perspective.

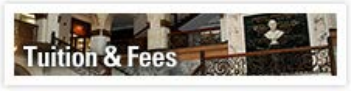
Areas of Specialization

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 Devices and Imaging
- Neuroengineering

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 Science and 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.



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Biomaterials and Tissue Engineering

Bachelor of Science Degree in Biomedical Engineering: 200.0 credits

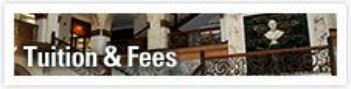
About the concentration
The concentration in Biomaterials and Tissue Engineering includes courses from the Departments of Bioscience & Biotechnology, Chemistry, and Mechanical Engineering & Mechanics. The program builds on the fundamental knowledge of natural and synthetic biomaterials and cellular biology 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.

Upon graduation, students will be able to:

- select and evaluate biomaterials for use in biomedical applications *in vivo*;
- develop *in vitro* models for drug delivery, drug toxicity and drug discovery choosing the appropriate biomaterials;
- create high-fidelity tissue models *in vitro*;
- develop and evaluate tissue engineering approaches to initiate and promote regenerative processes *in vivo*.

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



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Biomedical Engineering Biomaterials and Tissue Engineering Concentration

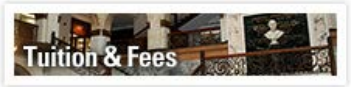
Bachelor of Science Degree: 200.0 quarter credits

Degree Requirements

Incoming students, 2011/2012

General education requirements		**29.0 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 and General studies electives (5)	15.0	

Engineering core courses		**68.5 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
PHYS 201	Fundamentals of Physics III	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 122	Cells and Genetics	4.5
ENGR 100	Beginning CAD for Design	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
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
ENGR 232	Dynamic Engineering Systems	3.0



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MEM 202	Engineering Mechanics: Statics	3.0

Required Biomedical Engineering courses		**49.0 Credits**
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 124	Freshman Seminar I	1.0
BMES 126	Freshman Seminar II	1.0
BMES 130	Problem-Solving in BME	2.0
BMES 201	Programming and Modeling for BME I	3.0
BMES 202	Programming and Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 303	Lab III: Biomedical Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 325	Engineering Principles of Living Systems I	3.0
BMES 326	Engineering Principles of Living Systems II	3.0
BMES 338	Biomedical Ethics and Law	4.0
BMES 372	Biosimulation	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 382	Junior Design Seminar II	2.0
BMES 491 WI	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

Biomaterials and Tissue Engineering concentration courses		**53.5 Credits**
BIO 218	Principles of Molecular Biology	3.0
BIO 219 WI	Techniques of Molecular Biology	2.5
BMES 301	Lab I: Experimental Biomechanics	2.0
BMES 345	Introduction to Mechanics of Biological Systems	3.0
BMES 375	Computational Bioengineering	4.0
BMES 451	Transport Phenomena in Living Systems I	4.0
BMES 460	Biomaterials I	4.0
BMES 461	Biomaterials II	4.0

BMES 471	Foundations of Tissue Engineering I	4.0
BMES 472	Foundations of Tissue Engineering II	4.0
BMES 475	Biomaterials and 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

***General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject areas of science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses. A certain number of General Studies credits are required for graduation with this major.**

Writing-Intensive Course Requirements
In order to graduate, all students 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 may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List on the Drexel University Writing Center page. Students scheduling their courses in Banner/DrexelOne can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

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Recommended Plan Of Study

BS Biomedical Engineering, Biomaterials & Tissue Engineering

5 YR UG Co-op Concentration /Biomaterials & Tissue Engineer

Term 1		Credits
BMES 124	BME Freshman Seminar I	1.0
CHEM 101	General Chemistry I	3.5
ENGL 101	Expository Writing and Reading	3.0
ENGR 100	Beginning CAD for Design	1.0
ENGR 101	Engineering Design Laboratory I	2.0
MATH 121	Calculus I	4.0
UNIV 101	The Drexel Experience	1.0
	Term Credits	*15.5*

Term 2		Credits
BMES 126	BME Freshman Seminar II	1.0
CHEM 102	General Chemistry II	4.5
ENGL 102	Persuasive Writing and Reading	3.0
ENGR 102	Engineering Design Laboratory II	2.0
MATH 122	Calculus II	4.0
PHYS 101	Fundamentals of Physics I	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*19.0*

Term 3		Credits
BIO 122	Cells and Genetics	4.5
BMES 130	Problem Solving in Biomedical Engineering	2.0
ENGL 103	Analytical Writing and Reading	3.0
ENGR 103	Engineering Design Laboratory III	2.0
MATH 200	Multivariate Calculus	4.0
PHYS 102	Fundamentals of Physics II	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*20.0*

Term 4		Credits
BIO 201	Human Physiology I	4.0
BMES 201	Programming & Modeling for BME I	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
PHYS 201	Fundamentals of Physics III	4.0
	Term Credits	*18.0*

Term 5		Credits
BMES 202	Programming & Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 235	Living Systems Engineering	4.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0

	Term Credits	*19.0*

Term 6		Credits
BMES 301	Biomedical Engineering Lab I: Experimental Biomechanics	2.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 325	Principles of Biomedical Engineering I	3.0
BMES 372	Biosimulation	3.0
ECE 201	Electric Circuits	3.0
HIST 285	Technology in Historical Perspective	3.0
	Term Credits	*16.0*

Term 7		Credits
BMES 303	Lab III: Biomed Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 326	Principles of Biomedical Engineering II	3.0
BMES 345	Mechanics of Biological Systems	3.0
	Liberal studies elective	3.0
	Term Credits	*15.0*

Term 8		Credits
BIO 218	Principles of Molecular Biology	3.0
BIO 219	Techniques in Molecular Biology	2.5
BMES 338	Biomedical Ethics and Law	3.0
BMES 381	Junior Design Seminar I	2.0
CHEM 241	Organic Chemistry I	4.0
	Term Credits	*14.5*

Term 9		Credits
BMES 375	Computational Bioengineering	4.0
BMES 382	Junior Design Seminar II	2.0
BMES 451	Transport Phenomena in Living Systems I	4.0
CHEM 242	Organic Chemistry II	4.0
CHEM 244	Organic Chemistry Laboratory I	3.0
	Term Credits	*17.0*

Term 10		Credits
BMES 460	Biomaterials I	4.0
BMES 471	Tissue Engineering I	4.0
BMES 491	Senior Design Project I	2.0
CHEM 245	Organic Chemistry Laboratory II	3.0
	Liberal studies elective	3.0
	Term Credits	*16.0*

Term 11		Credits
BMES 461	Biomaterials II	4.0
BMES 472	Tissue Engineering II	4.0
BMES 492	Senior Design Project II	2.0
	General studies elective	3.0
	Term Credits	*13.0*

Term 12		Credits
BMES 475	Biomaterials and Tissue Engineering III	4.0
BMES 493	Senior Design Project III	4.0
	Liberal studies electives	3.0
	General studies elective	3.0
	Term Credits	*14.0*

	Total Credits (minimum)	197.0

Biomechanics and Human Performance Engineering

Bachelor of Science Degree in Biomedical Engineering: 201.5 credits

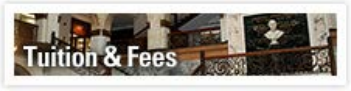
About the concentration

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.

Upon graduation, students will be able to:

- model the effects of external forces on the human body and its tissues;
- design implanted prosthetic devices through an understanding of the interaction between biological tissues and engineering material;
- understand neural control of posture and locomotion;
- apply system approaches to the interaction of humans with their environment in order to optimize performance;
- design devices to aid people with disabilities by capitalizing on their engineering skills and human performance criteria.

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



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Biomedical Engineering Biomechanics and Human Performance Engineering Concentration

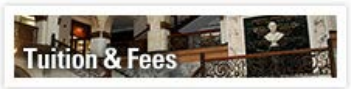
Bachelor of Science Degree: 201.5 quarter credits

Degree Requirements

Incoming students, 2011/2012

General education requirements			29.0 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 and General studies electives (5)		15.0	
Free elective		2.0	

Engineering core courses		68.5 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
PHYS 201	Fundamentals of Physics III	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 122	Cells and Genetics	4.5
ENGR 100	Beginning CAD for Design	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
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0



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ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics: Statics	3.0

Required Biomedical Engineering courses		**49.0 Credits**
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 124	Freshman Seminar I	1.0
BMES 126	Freshman Seminar II	1.0
BMES 130	Problem-Solving in BME	2.0
BMES 201	Programming and Modeling for BME I	3.0
BMES 202	Programming and Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 303	Lab III: Biomedical Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 325	Engineering Principles of Living Systems I	3.0
BMES 326	Engineering Principles of Living Systems II	3.0
BMES 338	Biomedical Ethics and Law	4.0
BMES 372	Biosimulation	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 382	Junior Design Seminar II	2.0
BMES 491 WI	Senior Design I	2.0
BMES 492	Senior Design II	2.0
BMES 493	Senior Design III	4.0
ECE 201	Foundations of Electric Circuits	3.0

Biomechanics and Human Performance Engineering concentration courses		**59.0 Credits**
BMES 301	Lab I: Experimental Biomechanics	2.0
BMES 305	Lab V: Musculoskeletal Anatomy for Biomedical Engineering	2.0
BMES 345	Introduction to Mechanics of Biological Systems	3.0
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 430	Neural Aspects of Posture and Locomotion	3.0
BMES 440	Biodynamics	3.0
BMES 441	Biomechanics I	4.0
BMES 442	Biomechanics II	4.0
BMES 444	Biofluid Mechanics	3.0
BMES 451	Transport Phenomena in Living Systems I	4.0
MEM 201	Foundations of CAD	4.0
MEM 238	Engineering Mechanics: Dynamics	4.0
PSY 101	General Psychology	3.0
	Biomechanics and Human Performance electives (3)	9.0

Suggested Biomechanics and Human Performance concentration electives

PSY 213	Sensation and Perception	3.0
PSY 332	Human Factors and Cognitive Engineering	3.0
PSY 410	Neuropsychology	3.0

***General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject areas of science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses. A certain number of General Studies credits are required for graduation with this major.**

Writing-Intensive Course Requirements
In order to graduate, all students 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.

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Recommended Plan Of Study

BS Biomedical Engineering, Biomechanics and Human Performance Engineering

5 YR UG Co-op Concentration /Biomechanics & Human Perf Eng

Term 1		Credits
BMES 124	BME Freshman Seminar I	1.0
CHEM 101	General Chemistry I	3.5
ENGL 101	Expository Writing and Reading	3.0
ENGR 100	Beginning CAD for Design	1.0
ENGR 101	Engineering Design Laboratory I	2.0
MATH 121	Calculus I	4.0
UNIV 101	The Drexel Experience	1.0
	Term Credits	*15.5*

Term 2		Credits
BMES 126	BME Freshman Seminar II	1.0
CHEM 102	General Chemistry II	4.5
ENGL 102	Persuasive Writing and Reading	3.0
ENGR 102	Engineering Design Laboratory II	2.0
MATH 122	Calculus II	4.0
PHYS 101	Fundamentals of Physics I	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*19.0*

Term 3		Credits
BIO 122	Cells and Genetics	4.5
BMES 130	Problem Solving in Biomedical Engineering	2.0
ENGL 103	Analytical Writing and Reading	3.0
ENGR 103	Engineering Design Laboratory III	2.0
MATH 200	Multivariate Calculus	4.0
PHYS 102	Fundamentals of Physics II	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*20.0*

Term 4		Credits
BIO 201	Human Physiology I	4.0
BMES 201	Programming & Modeling for BME I	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
PHYS 201	Fundamentals of Physics III	4.0
	Term Credits	*18.0*

Term 5		Credits
BMES 202	Programming & Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 235	Living Systems Engineering	4.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0

	Term Credits	***19.0***

Term 6		Credits
BMES 301	Biomedical Engineering Lab I: Experimental Biomechanics	2.0
BMES 302	Biomedical Engineering Lab II: Biomeasurements	2.0
BMES 325	Principles of Biomedical Engineering I	3.0
BMES 345	Mechanics of Biological Systems	3.0
BMES 372	Biosimulation	3.0
ECE 201	Electric Circuits	3.0
	Term Credits	***16.0***

Term 7		Credits
BMES 303	Biomedical Engineering Lab III: Biomedical Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 326	Principles of Biomedical Engineering II	3.0
MEM 230	Mechanics of Materials I	4.0
PSY 101	General Psychology I	3.0
	Term Credits	***16.0***

Term 8		Credits
BMES 305	Lab V: Musculoskeletal Anatomy for BME	2.0
BMES 338	Biomedical Ethics and Law	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 411	Chronoengineering I: Biorhythms	3.0
BMES 430	Neural Aspects of Posture and Locomotion	3.0
	Biomechanics & Human Performance Concentration elective (See degree requirements)	3.0
	Term Credits	***16.0***

Term 9		Credits
BMES 382	Junior Design Seminar II	2.0
BMES 412	Chronoengineering II: Sleep Functions	3.0
MEM 238	Dynamics	4.0
BMES 401	Biosensors I	4.0
or		
BMES 375	Computational Bioengineering	4.0
	Liberal studies elective	3.0
	Term Credits	***16.0***

Term 10		Credits
BMES 440	Introduction to Biodynamics	3.0
BMES 441	Biomechanics I:	4.0
BMES 451	Transport Phenomena in Living Systems I	4.0
BMES 491	Senior Design Project I	2.0
	Liberal studies elective	3.0
	Term Credits	***16.0***

Term 11		Credits
HIST 285	Technology in Historical Perspective	3.0
BMES 442	Biomechanics II	4.0
BMES 492	Senior Design Project II	2.0
	Biomechanics & Human Performance Concentration elective (See degree requirements)	3.0
	General studies elective	3.0
	Term Credits	***15.0***

Term 12		Credits
BMES 444	Biofluid Mechanics	3.0

BMES 493	Senior Design Project III	4.0
	General studies elective	3.0
	Biomechanics & Human Performance Concentration elective (See degree requirements)	3.0
	Term Credits	*13.0*
	Total Credits (minimum)	199.5

Biomedical Informatics

Bachelor of Science Degree in Biomedical Engineering: 200.0 credits

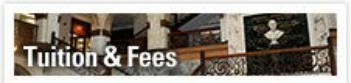
About the concentration

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 Biomedical Informatics 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.
Upon graduation, students will be able to:

- select, access and integrate bioinformatics related databases for applications in genomics and proteomics;
- apply biostatistical techniques to analyze high-throughput data for genotyping, gene expression and proteomics data;
- develop and evaluate computational models to describe and simulate gene regulatory, protein and metabolic networks.

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



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Biomedical Engineering
Biomedical Informatics Concentration

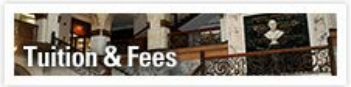
Bachelor of Science Degree: 200.0 quarter credits

Degree Requirements

Incoming students, 2011/2012

General education requirements			29.0 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 and General studies electives (5)		15.0	

Engineering core courses		68.5 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
PHYS 201	Fundamentals of Physics III	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 122	Cells and Genetics	4.5
ENGR 100	Beginning CAD for Design	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
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics: Statics	3.0



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Required Biomedical Engineering courses		49.0 Credits
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 124	Freshman Seminar I	1.0
BMES 126	Freshman Seminar II	1.0
BMES 130	Problem-Solving in BME	2.0
BMES 201	Programming and Modeling for BME I	3.0
BMES 202	Programming and Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 303	Lab III: Biomedical Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 325	Engineering Principles of Living Systems I	3.0
BMES 326	Engineering Principles of Living Systems II	3.0
BMES 338	Biomedical Ethics and Law	4.0
BMES 372	Biosimulation	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 382	Junior Design Seminar II	2.0
BMES 491 WI	Senior Design I	2.0
BMES 492	Senior Design II	2.0
BMES 493	Senior Design III	4.0
ECE 201	Foundations of Electric Circuits	3.0

Biomedical Informatics concentration courses		53.5 Credits
BIO 218	Principles of Molecular Biology	3.0
BIO 219 WI	Techniques of Molecular Biology	2.5
BMES 315	Experimental Design in Biomed Research	4.0
BMES 375	Computational Bioengineering	4.0
BMES 401	Biosensors I	4.0
BMES 483	Quantitative Systems Biology	4.5
BMES 484	Genome Information Engineering	4.5
CS 171	Computer Programming I	3.0
CS 172	Computer Programming II	3.0
CS 260	Data Structures	3.0

CS 265	Advanced Programming Tools and Techniques	3.0
INFO 110	Human-Computer Interaction I	3.0
INFO 200	Systems Analysis I	3.0
INFO 210	Database Management Systems	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. A certain number of General Studies credits are required for graduation with this major.**

Writing-Intensive Course Requirements
In order to graduate, all students 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 may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List on the Drexel University Writing Center page. Students scheduling their courses in Banner/DrexelOne can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

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Recommended Plan Of Study

BS Biomedical Engineering, Biomedical Informatics

5 YR UG Co-op Concentration /Biomedical Informatics

Term 1		Credits
BMES 124	BME Freshman Seminar I	1.0
CHEM 101	General Chemistry I	3.5
ENGL 101	Expository Writing and Reading	3.0
ENGR 100	Beginning CAD for Design	1.0
ENGR 101	Engineering Design Laboratory I	2.0
MATH 121	Calculus I	4.0
UNIV 101	The Drexel Experience	1.0
	Term Credits	*15.5*

Term 2		Credits
BMES 126	BME Freshman Seminar II	1.0
CHEM 102	General Chemistry II	4.5
ENGL 102	Persuasive Writing and Reading	3.0
ENGR 102	Engineering Design Laboratory II	2.0
MATH 122	Calculus II	4.0
PHYS 101	Fundamentals of Physics I	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*19.0*

Term 3		Credits
BIO 122	Cells and Genetics	4.5
BMES 130	Problem Solving in Biomedical Engineering	2.0
ENGL 103	Analytical Writing and Reading	3.0
ENGR 103	Engineering Design Laboratory III	2.0
MATH 200	Multivariate Calculus	4.0
PHYS 102	Fundamentals of Physics II	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*20.0*

Term 4		Credits
BIO 201	Human Physiology I	4.0
BMES 201	Programming & Modeling for BME I	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
PHYS 201	Fundamentals of Physics III	4.0
	Term Credits	*18.0*

Term 5		Credits
BMES 202	Programming & Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 235	Living Systems Engineering	4.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0

	Term Credits	*19.0*

Term 6		Credits
BIO 218	Principles of Molecular Biology	3.0
BIO 219	Techniques in Molecular Biology	2.5
BMES 325	Principles of Biomedical Engineering I	3.0
BMES 372	Biosimulation	3.0
CS 171	Computer Programming I	3.0
ECE 201	Electric Circuits	3.0
	Term Credits	*17.5*

Term 7		Credits
BMES 303	Lab III: Biomed Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 326	Principles of Biomedical Engineering II	3.0
CS 172	Computer Programming II	3.0
INFO 110	Human-Computer Interaction I	3.0
	Term Credits	*15.0*

Term 8		Credits
BMES 302	Lab II: Biomeasurements	2.0
BMES 315	Experimental Design in Biomed Research	4.0
BMES 338	Biomedical Ethics and Law	3.0
BMES 381	Junior Design Seminar I	2.0
CS 265	Advanced Programming Tools and Techniques	3.0
INFO 200	Systems Analysis I	3.0
	Term Credits	*17.0*

Term 9		Credits
BMES 375	Computational Bioengineering	4.0
BMES 382	Junior Design Seminar II	2.0
CS 260	Data Structures	3.0
INFO 210	Database Management Systems	3.0
	General studies elective	3.0
	Term Credits	*15.0*

Term 10		Credits
BMES 401	Biosensors I	4.0
BMES 491	Senior Design Project I	2.0
HIST 285	Technology in Historical Perspective	3.0
	General studies elective	3.0
	Biomedical Informatics concentration elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 11		Credits
BMES 483	Quantitative Systems Biology	4.5
BMES 492	Senior Design Project II	2.0
	Biomedical Informatics concentration elective (See degree requirements)	3.0
	General studies elective	3.0
	Term Credits	*12.5*

Term 12		Credits
BMES 484	Genome Information Engineering	4.5
BMES 493	Senior Design Project III	4.0
	General studies electives	6.0
	Term Credits	*14.5*

Total Credits (minimum)	**198.0**

Biomedical Devices and Imaging

Bachelor of Science Degree in Biomedical Engineering: 200.5 credits

About the concentration

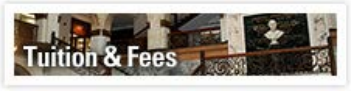
Biomedical imaging focuses on the theoretical and practical issues related to machine vision, image processing and analysis, and signal processing associated with such medical applications as ultrasound, optics, magnetic resonance, and autoradiographic imaging.

The concentration in Biomedical Devices and Imaging is for those individuals interested in careers in medical imaging, medical device development, and clinical engineering. 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).

Upon graduation, students will be able to:

- understand the multi-disciplinary background and limitations of current and emerging instrumentation, imaging and internet technologies used in clinical, pharmaceutical and research environments;
- select and evaluate sensors and imaging modalities for specific biomedical research, diagnostic and theragnostic applications;
- analyze the performance of different systems including microscopical and medical imaging methodologies in terms of safety, resolution and the trade-offs important for a given application;
- optimize digital acquisition, enhancement, visualization and analysis of signals from biomedical instruments in multidimensions;
- understand the impact of compliance with the standards and guidelines of regulatory agencies such as FDA on the design and application of devices in clinical practice and knowledge of basic quality assurance tools.

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



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Biomedical Engineering
Biomedical Devices and Imaging Concentration

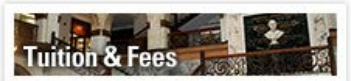
Bachelor of Science Degree: 200.5 quarter credits

Degree Requirements

Incoming students, 2011/2012

General education requirements		29.0 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 and General studies electives (5)	15.0	

Engineering core courses		68.5 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
PHYS 201	Fundamentals of Physics III	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 122	Cells and Genetics	4.5
ENGR 100	Beginning CAD for Design	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
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics: Statics	3.0



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Required Biomedical Engineering courses		49.0 Credits
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 124	Freshman Seminar I	1.0
BMES 126	Freshman Seminar II	1.0
BMES 130	Problem-Solving in BME	2.0
BMES 201	Programming and Modeling for BME I	3.0
BMES 202	Programming and Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 303	Lab III: Biomedical Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 325	Engineering Principles of Living Systems I	3.0
BMES 326	Engineering Principles of Living Systems II	3.0
BMES 338	Biomedical Ethics and Law	4.0
BMES 372	Biosimulation	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 382	Junior Design Seminar II	2.0
BMES 491 WI	Senior Design I	2.0
BMES 492	Senior Design II	2.0
BMES 493	Senior Design III	4.0
ECE 201	Foundations of Electric Circuits	3.0

Biomedical Devices and Imaging concentration courses		54.0 Credits
BIO 202	Human Physiology Laboratory	2.0
BMES 301	Lab I: Experimental Biomechanics	2.0
BMES 304	Lab IV:Ultrasound Images	2.0
BMES 315	Experimental Design in Biomedical Research	4.0
BMES 391	Biomedical Instrumentation I	3.0
BMES 392	Biomedical Instrumentation II	3.0
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 352	Digital Signals	4.0
Biomedical Systems and Imaging elective		3.0

Suggested Biomedical Systems and Imaging electives

BMES 488	Medical Device Development	3.0
BMES 494	Clinical Practicum I	3.0
BMES 495	Clinical Practicum II	3.0
BMES 496	Clinical Practicum III	3.0

***General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject areas of science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses. A certain number of General Studies credits are required for graduation with this major.**

Writing-Intensive Course Requirements
In order to graduate, all students 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.

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Recommended Plan Of Study

BS Biomedical Engineering, Biomedical Devices and Imaging

5 YR UG Co-op Concentration /Biomedical Devices & Imaging

Term 1		Credits
BMES 124	BME Freshman Seminar I	1.0
CHEM 101	General Chemistry I	3.5
ENGL 101	Expository Writing and Reading	3.0
ENGR 100	Beginning CAD for Design	1.0
ENGR 101	Engineering Design Laboratory I	2.0
MATH 121	Calculus I	4.0
UNIV 101	The Drexel Experience	1.0
	Term Credits	*15.5*

Term 2		Credits
BMES 126	BME Freshman Seminar II	1.0
CHEM 102	General Chemistry II	4.5
ENGL 102	Persuasive Writing and Reading	3.0
ENGR 102	Engineering Design Laboratory II	2.0
MATH 122	Calculus II	4.0
PHYS 101	Fundamentals of Physics I	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*19.0*

Term 3		Credits
BIO 122	Cells and Genetics	4.5
BMES 130	Problem Solving in Biomedical Engineering	2.0
ENGL 103	Analytical Writing and Reading	3.0
ENGR 103	Engineering Design Laboratory III	2.0
MATH 200	Multivariate Calculus	4.0
PHYS 102	Fundamentals of Physics II	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*20.0*

Term 4		Credits
BIO 201	Human Physiology I	4.0
BMES 201	Programming & Modeling for BME I	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
PHYS 201	Fundamentals of Physics III	4.0
	Term Credits	*18.0*

Term 5		Credits
BMES 202	Evaluation & Presentation of Experimental Data II	3.0
BMES 212	The Body Synthetic	3.0
BMES 235	Living Systems Engineering	4.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0

	Term Credits	*19.0*

Term 6		Credits
BMES 301	Biomedical Engineering Lab I: Experimental Biomechanics	2.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 325	Principles of Biomedical Engineering I	3.0
BMES 372	Biosimulation	3.0
ECE 201	Electric Circuits	3.0
HIST 285	Technology in Historical Perspective	3.0
	Term Credits	*16.0*

Term 7		Credits
BMES 303	Lab III: Biomed Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 326	Principles of Biomedical Engineering II	3.0
ECES 302	Transform Methods & Filtering	4.0
	Liberal studies elective	3.0
	Term Credits	*16.0*

Term 8		Credits
BIO 202	Human Physiology Laboratory	2.0
BMES 304	Lab IV: Ultrasound Images	2.0
BMES 315	Experimental Design in Biomed Research	4.0
BMES 338	Biomedical Ethics and Law	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 401	Biosensors I	4.0
	Term Credits	*17.0*

Term 9		Credits
BMES 375	Computational Bioengineering	4.0
BMES 382	Junior Design Seminar II	2.0
ECES 304	Dynamic Systems and Stability	4.0
ECES 352	Introduction to Digital Signal Processing	4.0
	Term Credits	*14.0*

Term 10		Credits
BMES 391	Biomedical Instrumentation I	3.0
BMES 421	Biomedical Imaging Systems I	4.0
BMES 432	Biomed Systems and Signals	3.0
BMES 491	Senior Design Project I	2.0
	Liberal studies elective	3.0
	Term Credits	*15.0*

Term 11		Credits
BMES 392	Biomedical Instrumentation II	3.0
BMES 422	Biomedical Imaging Systems II	4.0
BMES 492	Senior Design Project II	2.0
	General studies electives	6.0
	Term Credits	*15.0*

Term 12		Credits
BMES 423	Biomedical Imaging Systems III	4.0
BMES 493	Senior Design Project III	4.0
	Biomedical Devices and Imaging concentration elective (See degree requirements)	3.0
	Liberal studies elective	3.0
	Term Credits	*14.0*

Total Credits (minimum)	**198.5**

Neuroengineering

Bachelor of Science Degree in Biomedical Engineering: 197.5 credits

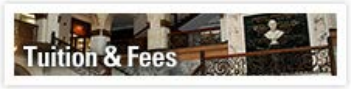
About the concentration

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.

Upon graduation, students will be able to:

- model specific aspects of neural systems;
- understand control system theory as applied to neural systems;
- understand how neuroengineering can be applied in clinical situations.

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



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Biomedical Engineering

Bachelor of Science Degree: 197.5 credits

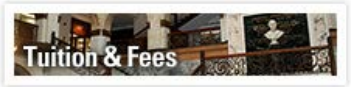
Neuroengineering Concentration

Degree Requirements

Incoming students, 2011/2012

General education requirements		29.0 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 and General studies electives (5)	15.0	

Engineering core courses		68.5 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
PHYS 201	Fundamentals of Physics III	4.0
CHEM 101	General Chemistry I	3.5
CHEM 102	General Chemistry II	4.5
BIO 122	Cells and Genetics	4.5
ENGR 100	Beginning CAD for Design	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
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
ENGR 232	Dynamic Engineering Systems	3.0



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MEM 202	Engineering Mechanics: Statics	3.0

Required Biomedical Engineering courses		**49.0 Credits**
BIO 201	Human Physiology I	4.0
BIO 203	Human Physiology II	4.0
BMES 124	Freshman Seminar I	1.0
BMES 126	Freshman Seminar II	1.0
BMES 130	Problem-Solving in BME	2.0
BMES 201	Programming and Modeling for BME I	3.0
BMES 202	Programming and Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 303	Lab III: Biomedical Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 325	Engineering Principles of Living Systems I	3.0
BMES 326	Engineering Principles of Living Systems II	3.0
BMES 338	Biomedical Ethics and Law	4.0
BMES 372	Biosimulation	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 382	Junior Design Seminar II	2.0
BMES 491 WI	Senior Design I	2.0
BMES 492	Senior Design II	2.0
BMES 493	Senior Design III	4.0
ECE 201	Foundations of Electric Circuits	3.0

Neuroengineering concentration courses		**55.0 Credits**
BIO 462	Biology of Neuron Function	3.0
BMES 301	Lab I: Experimental Biomechanics	2.0
BMES 304	Lab IV: Ultrasound Images	2.0
BMES 305	Lab V: Musculoskeletal Anatomy for Biomedical Engineering	2.0
BMES 375	Computational Bioengineering	4.0
BMES 401	Biosensors I	4.0
BMES 405	Physiological Control Systems	4.0
BMES 411	Chronoengineering I	3.0
BMES 430	Neural Aspects of Posture and	3.0

	Locomotion	
BMES 451	Transport Phenomena in Living Systems I	4.0
BMES 477	Neuroengineering I	3.0
BMES 478	Neuroengineering II	3.0
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

***General studies electives include all liberal arts electives plus additional subjects, such as business, which do not fall under the subject area of science, math or engineering. See the Biomedical Engineering General and Liberal Studies List for approved courses. A certain number of General Studies credits are required for graduation with this major.**

Writing-Intensive Course Requirements

In order to graduate, all students 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.

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catalog@drexel.edu •

Recommended Plan Of Study

BS Biomedical Engineering, Neuroengineering

5 YR UG Co-op Concentration /Neuroengineering

Term 1		Credits
BMES 124	BME Freshman Seminar I	1.0
CHEM 101	General Chemistry I	3.5
ENGL 101	Expository Writing and Reading	3.0
ENGR 100	Beginning CAD for Design	1.0
ENGR 101	Engineering Design Laboratory I	2.0
MATH 121	Calculus I	4.0
UNIV 101	The Drexel Experience	1.0
	Term Credits	*15.5*

Term 2		Credits
BMES 126	BME Freshman Seminar II	1.0
CHEM 102	General Chemistry II	4.5
ENGL 102	Persuasive Writing and Reading	3.0
ENGR 102	Engineering Design Laboratory II	2.0
MATH 122	Calculus II	4.0
PHYS 101	Fundamentals of Physics I	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*19.0*

Term 3		Credits
BIO 122	Cells and Genetics	4.5
BMES 130	Problem Solving in Biomedical Engineering	2.0
ENGL 103	Analytical Writing and Reading	3.0
ENGR 103	Engineering Design Laboratory III	2.0
MATH 200	Multivariate Calculus	4.0
PHYS 102	Fundamentals of Physics II	4.0
UNIV 101	The Drexel Experience	0.5
	Term Credits	*20.0*

Term 4		Credits
BIO 201	Human Physiology I	4.0
BMES 201	Programming & Modeling for BME I	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
PHYS 201	Fundamentals of Physics III	4.0
	Term Credits	*18.0*

Term 5		Credits
BMES 202	Programming & Modeling for BME II	3.0
BMES 212	The Body Synthetic	3.0
BMES 235	Living Systems Engineering	4.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0

	Term Credits	*19.0*

Term 6		Credits
BMES 301	Biomedical Engineering Lab I: Experimental Biomechanics	2.0
BMES 302	Lab II: Biomeasurements	2.0
BMES 325	Principles of Biomedical Engineering I	3.0
BMES 372	Biosimulation	3.0
ECE 201	Electric Circuits	3.0
HIST 285	Technology in Historical Perspective	3.0
	Term Credits	*16.0*

Term 7		Credits
BMES 303	Lab III: Biomed Electronics	2.0
BMES 310	Biomedical Statistics	4.0
BMES 326	Principles of Biomedical Engineering II	3.0
ECES 302	Transform Methods & Filtering	4.0
	Term Credits	*13.0*

Term 8		Credits
BMES 304	Lab IV: Ultrasound Images	2.0
BMES 338	Biomedical Ethics and Law	3.0
BMES 381	Junior Design Seminar I	2.0
BMES 411	Chronoengineering I: Biorhythms	3.0
ECES 356	Theory of Control	4.0
PSY 101	General Psychology I	3.0
	Term Credits	*17.0*

Term 9		Credits
BMES 375	Computational Bioengineering	4.0
BMES 382	Junior Design Seminar II	2.0
BMES 405	Physiological Control Systems	3.0
BMES 451	Transport Phenomena in Living Sys	4.0
ECES 304	Dynamic Systems and Stability	4.0
	Term Credits	*17.0*

Term 10		Credits
BIO 462	Biology of Neuron Function	3.0
BMES 401	Biosensors I	4.0
BMES 430	Neural Aspects of Posture and Locomotion	3.0
BMES 491	Senior Design Project I	2.0
PSY 213	Sensation and Perception	3.0
	Term Credits	*15.0*

Term 11		Credits
BMES 477	Neuroengineering I	3.0
BMES 492	Senior Design Project II	2.0
	General studies electives	9.0
	Term Credits	*14.0*

Term 12		Credits
BMES 305	Lab V: Musculoskeletal Anatomy for BME	2.0
BMES 478	Neuroengineering II	3.0
BMES 493	Senior Design Project III	4.0
	Liberal studies elective	3.0
	Term Credits	*12.0*

	Total Credits (minimum)	195.5