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The College of Engineering

Since its founding in the midst of the industrial revolution in 1891, Drexel University has emphasized its strengths in engineering, science and technology to train men and women to become leaders. In little over a century, Drexel University has transformed itself into a large, comprehensive institution committed to excellence in education, research and service to the engineering society and to the broader community. Although much has changed, the original mission of the university still rings true today.

The profession of engineering is concerned with turning the natural elements and energies to the service of mankind. The objectives of the undergraduate program in the College of Engineering are:

- *To offer an education that will give graduates the flexibility to adjust to future changes in technology*
- *To develop a sense of professionalism*
- *To provide a framework for concentrated study in a professional area*

To implement those objectives the curricula of the College of Engineering are designed to provide a firm grounding in basic science and liberal arts, along with broad-based engineering sciences and professional engineering subjects.

About the Co-operative Education
In five-year co-operative programs, engineering majors spend a total of 12 terms in school and six terms on co-op assignment. Freshmen attend classes for three terms. During their sophomore, pre-junior, and junior years, students generally attend class for two terms and are assigned a co-operative employment position for two terms each year.

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

The College of Engineering

Degree Requirements
The degree of Bachelor of Science in the engineering specialties requires a minimum of 192 credits of academic work and six terms of co-op or engineering experience. Transfer students must complete a minimum of four terms of industrial/engineering experience in order to earn a co-operative engineering degree accredited by ABET. All full-time students in the college of engineering are required to complete the minimum four terms of co-op experience.

Engineering students must maintain an overall grade point average of 2.0 in all required courses in their major.

Curricular Organization
With the exception of Computer Science majors, all students in the College of Engineering study the same subjects during the three terms in the first year. During the two terms of the sophomore year, students begin taking department specific coursework.

The first five terms are devoted to those subjects that form the foundation of the engineering curriculum. Courses in the core engineering curriculum are organized and taught to provide an integrated view of the basic sciences and an introduction to the art of engineering through group projects that deal with open-ended problems characteristic of the practice of engineering. Students also learn to use the modern tools of engineering both on the computer and in the laboratory.

The college considers it essential that students entering the Drexel Engineering Curriculum be placed in courses that take advantage of their abilities and prior training. Student preparation level is determined by a review committee that evaluates the student's high school record, standardized test scores, and placement tests administered during freshman orientation.

Students who demonstrate the preparation and skills to succeed in our integrated engineering calculus course immediately will be placed in MATH 121/MATH 122 starting in the fall term. Students who are not prepared for this sequence may participate in a special "pre-engineering" program before the fall term. These students may also have a modified fall schedule and may need summer school during the following summer.

In the second year, two professional subjects are introduced, and all the first-level professional courses are completed by the junior year. The senior year in all curricula contains at least one elective sequence so that students can study some aspect of engineering more deeply. In addition, all curricula provide a design experience in the senior year. Recognizing the importance of liberal studies in the education of an engineer, all curricula require that courses be taken in this area. These requirements are described under the Liberal Studies Program section.

Mission Statement
The mission of the Drexel Engineering Curriculum is to research, develop, implement, and share educational programs that integrate the foundations of engineering practice, humanities and communications, mathematics, and sciences.

Program Objectives

- *Provide students with a foundation for applying principles of science and mathematics to their disciplinary programs.*
- *Provide students with the skills and technical knowledge to perform engineering design.*
- *Provide students with skills to communicate technical ideas and present persuasive arguments.*
- *Provide students with teamwork skills.*
- *Provide students with understanding of what engineers do through personal experience.*

The Common First Year

University Requirements		**2.0 Credits**
UNIV 101	**The Drexel Experience (two semesters)**	2.0

Foundation requirements		
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 141	**Essential Biology**	4.5
CS 121	**Computational Laboratory I**	1.0
CS 122	**Computational Laboratory II**	1.0
CS 123	**Computational Laboratory II**	1.0
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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
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

General Education Requirements*

The General Education Program is designed to give engineering students an opportunity to take a set of courses that complement their technical studies and satisfy their intellectual and/or career interests. All engineering majors must take ten (10) courses. Three of the ten (10) courses are designated as follows and must be completed by all majors:

Designated liberal studies course requirements:		
ENGL 101	**Expository Writing and Reading**	3.0
ENGL 102	**Persuasive Writing and Reading**	3.0
ENGL 103	**Analytical Writing and Reading**	3.0

The remaining seven (7) General Education course requirements are not designated and can be chosen from the disciplines listed below. Any course of

three credits or more selected from the categories below meets this requirement, except as noted.

ACCT, AFAS, ANTH, ARBC, ARCH, ARTH, BLAW, BUSN, CHIN, COM, CJ, CULA, CUST, DANC, ECON, ENGL *(except 101, 102, 103 & 105)*, EAM, EDUC, FIN, FREN, GER, GREC, HIST, HRM, HRMT, HUM *(except 106, 107, & 108*), IAS, INTB, ITAL, JAPN, KOR, LANG, LEAD, MGMT, MKTG, MUSC, OPM, OPR, ORGB, PHIL, PHTO, PE, POM, PSCI, PSY *(except 330, 337, 364 & 365)*, RELG, RUSS, SCRP, SOC *(except 364 & 365*), SPAN, SMT, STAT, TAX, THTR, WMST, WRIT

The list is a sampling of courses; other courses may be accepted upon advisor approval.

Environmental Policy (ENVP) courses can be chosen by Architectural Engineering, Civil Engineering, and Environmental Engineering programs.

Architectural engineering students' liberal studies requirements are slightly different. The three-course ARCH 141–ARCH 143 (Architecture and Society) sequence, offered through the Antoinette Westphal College of Media Arts and Design, is required of all architectural engineering students.

Some engineering majors require a study in basic economic principles, the history of the engineering profession and its impact on modern society, and ethical standards required for the practice of the profession. Check curriculum guidelines for requirements. Any required economics, history or ethics courses will replace general education requirements on a course-for-course basis.
General Education electives must be non-technical. *All Computer, Math, Engineering & Science related courses will NOT count as* General Education *electives*

*This policy regarding General Education requirements applies to all College of Engineering programs with the exception of **Computer Science** and **Software Engineering.**

Electives
In addition to the electives in the Liberal Studies Program there are two types of elective sequences in the engineering curricula: technical electives and free electives.Technical electives are courses in engineering, science, or management that build on the required professional courses and lead to a specific technical specialization. Possible elective sequences should be discussed with and approved by advisors before the end of the junior year.Free electives are any courses for which students are eligible and that are not remedial in nature for engineering students.

Withdrawal from the College of Engineering
It is the policy of the College of Engineering that an engineering student who withdraws from the University cannot petition for readmission to the College of Engineering until at least one complete term has elapsed.

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.

The College of Engineering

Co-operative Education
In five-year co-operative programs, engineering majors spend a total of 12 terms in school and six terms on co-op assignment. Freshmen attend classes for three terms. During their sophomore, pre-junior, and junior years, students generally attend class for two terms and are assigned a co-operative employment position for two terms each year.

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

The College of Engineering

Accelerated Programs/ Bachelor's/Master's Dual Degree Program
The Accelerated Program of the College of Engineering provides opportunities for highly talented and strongly motivated students to progress toward their educational goals essentially 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. Students enrolled in this program may take advantage of the five-year Bachelor's/Master's Dual Degree Program described on the College of Engineering's Accelerated: BS /MS web page.

Lincoln University/Drexel 3-3 Plan
Drexel participates in a program with Lincoln University under which a student may attend Lincoln University for three years, taking liberal arts subjects and pre-engineering courses in mathematics, science, and related areas; transfer to Drexel; and receive a degree in engineering after three additional years at Drexel. This is similar to the conventional 3-2 program in which other colleges and universities participate; the extra year is necessitated by Drexel's co-operative education plan.

Indiana University of Pennsylvania/Drexel Plan
Indiana University of Pennsylvania and Drexel University have established a co-operative engineering program to increase the opportunities for young men and women from rural Pennsylvania to pursue careers in engineering. The program combines two years of study at the state-owned university with three years of study as part of the Drexel Plan of Co-operative Education.

Pre-Professional Programs
The College of Engineering offers Master of Science programs in engineering management and software engineering, and master's and PhD programs in chemical engineering, civil engineering, electrical engineering, materials engineering, and mechanical engineering. An Advanced Certificate in Engineering is also offered. For additional information, consult the graduate catalog or contact the graduate division of the College of Engineering.
Students wishing to prepare for admission to professional schools of law or medicine may obtain preprofessional counseling and assistance in making application from the Office of Preprofessional Programs, 215-895-2437.

Facilities

Facilities
From the start of their freshman year, students learn to use the equipment they are likely to need in their careers, such as oscilloscopes, signal generators, amplifiers, and power supplies. These skills make students more useful as co-op employees and give them a competitive advantage in their engineering careers. The new 15-station laboratories equipped with Hewlett-Packard computers, software, and test and measurement instruments now add to the value of a Drexel engineering degree.

Computer/Design Center
The Drexel Curriculum boasts two types of lab experience: Instrumentation and Computer Design. Instrumentation Labs introduce Engineering Majors to the sight, sound, and feel of equipment such as digital multimeters, power supplies, oscilloscopes, and waveform generators. The Computer Labs imbue these pre-engineers with knowledge of software which they will be vital in today's work environment. Visit the Computer/Design Center for more information.

Architectural Engineering

The architectural engineering major prepares graduates for professional work in the analysis, design, construction, and operation of residential, commercial, institutional, and industrial buildings. The program develops engineers familiar with all aspects of safe and economical construction. Students study the principles of structural support and external cladding, building environmental systems, and project management and develop depth in at least one area.
The program integrates building disciplines, including coordination with architects; construction managers; civil, mechanical, and electrical engineers; and others. Students use computer-aided design tools to understand system interactions; perform analysis, design, scheduling, and cost analysis; and present their work.

The first two years of the curriculum cover fundamentals necessary for all engineers. The pre-junior and junior years emphasize building systems and the principles governing their performance. In addition to the core engineering and science, students learn architectural approaches through studio design. Seniors focus on either structural or building environmental systems design, as well as a full-year realistic design project. The academic program is complemented by exposure to professional practice in the co-op experience.

Mission Statement
The civil and architectural engineering faculty are responsible for delivering an outstanding curriculum that equips our graduates with the broad technical knowledge, design proficiency, professionalism, and communications skills required for them to make substantial contributions to society and to enjoy rewarding careers.

Program Objectives
Architectural engineering graduates will become professionals who analyze, design, construct, manage, or operate residential, commercial, institutional and industrial buildings and systems, or advance knowledge of the field.

Senior Design Projects
A special feature of the major is senior design. A group of students works with a faculty advisor to develop a significant design project selected by the group. All architectural engineering students participate in a design project.

For more information about this major, contact the Department of Civil, Architectural and Environmental Engineering.

Architectural Engineering

Bachelor of Science Degree: 193.0 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies equirements		23.0 Credits
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
	General education requirements	12.0

Foundation requirements		65.5 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 141	**Essential Biology**	4.5
CS 121	**Computational Laboratory I**	1.0
CS 122	**Computational Laboratory II**	1.0
CS 123	**Computational Laboratory II**	1.0
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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
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

Major requirements		75.5 Credits
AE 220	**Introduction to HVAC**	3.5
AE 340	**Architectural Illumination and Electrical Systems**	3.0
AE 390	**Architectural Engineering Design I**	4.0
AE 391	**Architectural Engineering Design II**	4.0

AE 544	**Building Envelope**	4.0
ARCH 141	**Architecture and Society I**	3.0
ARCH 142 WI	**Architecture and Society II**	3.0
ARCH 143 WI	**Architecture and Society III**	3.0
ARCH 191	**Studio I**	3.0
ARCH 192	**Studio 2**	3.0
CAE 491 WI	**Senior Project Design I**	3.0
CAE 492 WI	**Senior Project Design II**	3.0
CAE 493 WI	**Senior Project Design III**	3.0
CAEE 201	**Introduction to Infrastructure Engineering**	3.0
CAEE 210	**Measurements in Civil, Architectural and Environmental Engineering I**	3.0
CAEE 211	**Measurements in Civil, Architectural and Environmental Engineering II**	3.0
CIVE 240 WI	**Engineering Economics**	3.0
CIVE 250	**Construction Materials**	4.0
CIVE 330	**Hydraulics**	4.0
CIVE 320	**Introduction to Fluid Flow**	3.0
MEM 202	**Engineering Mechanics: Statics**	3.0
MEM 230	**Mechanics of Materials I**	4.0
ENGR 361	**Statistical Analysis of Engineering Systems**	4.0

Students select one of the following concentrations:

Mechanical concentration requirements		**29.0 Credits**
AE 430	**Control Systems for HVAC**	3.0
CIVE 370	**Introduction to Structural Analysis**	3.0
CIVE 371	**Structural Design**	3.0
CIVE 372	**Structural Laboratory**	1.0
MEM 345	**Heat Transfer**	4.0
MEM 413	**Air Conditioning and Refrigeration I**	3.0
MEM 414	**Air Conditioning and Refrigeration II**	3.0
	Three professional electives	9.0

Structural concentration requirements		**29.0 Credits**
CIVE 300	**Theory of Structures I**	3.0
CIVE 301	**Theory of Structures II**	4.0
CIVE 310	**Soil Mechanics**	4.0
CIVE 400	**Structural Design I**	3.0
CIVE 401	**Structural Design II**	3.0
CIVE 402	**Structural Design III**	3.0
CIVE 410	**Foundational Engineering**	3.0
	Two professional electives	6.0

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.

Recommended Plan Of Study

BS Architectural Engineering
5 YR UG Co-op Concentration /Mechanical Engineering

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
CAEE 201	Introduction to Infrastructure Engineering	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
ARCH 191	Studio 1-1	3.0
CAEE 210	Measurements in Civil, Architectural and Environmental Engineering I	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0
	Term Credits	*18.0*

Term 6		Credits
AE 340	Architectural Illumination and Electrical Systems	3.0
ARCH 141	Architecture and Society I	3.0
ARCH 192	Studio 1-2	3.0
CIVE 320	Introduction to Fluid Flow	3.0
MEM 230	Mechanics of Materials I	4.0

	Term Credits	*16.0*

Term 7		Credits
AE 220	Introduction to HVAC	3.5
ARCH 142	Architecture and Society II	3.0
CAEE 211	Measurements in Civil, Architectural and Environmental Engineering II	4.0
CIVE 250	Construction Materials	4.0
CIVE 330	Hydraulics	4.0
	Term Credits	*18.5*

Term 8		Credits
AE 390	Architecture Engineering Design I	4.0
ARCH 143	Architecture and Society III	3.0
CIVE 240	Engineering Economic Analysis	3.0
CIVE 370	Introduction to Structural Analysis	3.0
MEM 345	Heat Transfer	4.0
	Term Credits	*17.0*

Term 9		Credits
AE 391	Architecture Engineering Design II	4.0
CIVE 371	Introduction to Structural Design	3.0
CIVE 372	Structural Laboratory	1.0
	Professional elective (See degree requirements for list)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*14.0*

Term 10		Credits
AE 544	Building Envelope Systems	3.0
CAE 491	Senior Design Project I	3.0
ENGR 361	Statistical Analysis of Engineering Systems	3.0
MEM 413	HVAC Loads	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 11		Credits
CAE 492	Senior Design Project II	3.0
MEM 414	HVAC Equipment	3.0
	Professional elective (See degree requirements for list)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*12.0*

Term 12		Credits
AE 430	Control Systems for HVAC	3.0
CAE 493	Senior Design Project III	3.0
	Professional elective (See degree requirements for list)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*12.0*

	Total Credits (minimum)	193.0

Recommended Plan Of Study

BS Architectural Engineering
5 YR UG Co-op Concentration /Structural

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
CAEE 201	Introduction to Infrastructure Engineering	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
ARCH 191	Studio 1-1	3.0
CAEE 210	Measurements in Civil, Architectural and Environmental Engineering I	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0
	Term Credits	*18.0*

Term 6		Credits
AE 340	Architectural Illumination and Electrical Systems	3.0
ARCH 141	Architecture and Society I	3.0
ARCH 192	Studio 1-2	3.0
CIVE 320	Introduction to Fluid Flow	3.0
MEM 230	Mechanics of Materials I	4.0

	Term Credits	*16.0*

Term 7		Credits
AE 220	Introduction to HVAC	3.5
ARCH 142	Architecture and Society II	3.0
CAEE 211	Measurements in Civil, Architectural and Environmental Engineering II	4.0
CIVE 250	Construction Materials	4.0
CIVE 330	Hydraulics	4.0
	Term Credits	*18.5*

Term 8		Credits
AE 390	Architectural Engineering Design I	4.0
ARCH 143	Architecture and Society III	3.0
CIVE 240	Engineering Economic Analysis	3.0
CIVE 300	Theory of Structures I	3.0
CIVE 310	Soil Mechanics I	4.0
	Term Credits	*17.0*

Term 9		Credits
AE 391	Architectural Engineering Design II	4.0
CIVE 301	Theory of Structures II	4.0
	Professional elective (See degree requirements for list)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*14.0*

Term 10		Credits
AE 544	Building Envelope Systems	3.0
CAE 491	Senior Design Project I	3.0
CIVE 400	Structural Design I	3.0
ENGR 361	Statistical Analysis of Engineering Systems	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 11		Credits
CAE 492	Senior Design Project II	3.0
CIVE 401	Structural Design II	3.0
CIVE 410	Foundation Engineering	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*12.0*

Term 12		Credits
CAE 493	Senior Design Project III	3.0
CIVE 402	Structural Design III	3.0
	Professional elective (See degree requirements for list)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*12.0*

Total Credits (minimum)	193.0

Architectural Engineering

Accelerated Program
The Accelerated Program of the College of Engineering provides opportunities for highly talented and strongly motivated students to progress toward their educational goals essentially 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.

Dual Degree Bachelor's Programs
A student completing the Bachelor of Science degree program in architectural engineering may complete additional courses (specified by the department) to earn the Bachelor of Science degree in civil engineering. (The reverse is difficult because of prerequisites in the sequence of architectural studio design courses, which begins in the sophomore year.)

Required courses for Dual Degree in Civil Engineering		Credits
CIVE 430	**Hydrology**	3.0
CIVE 477 WI	**Seminar in Civil Engineering**	2.0
CIVE 478 WI	**Seminar in Civil Engineering**	1.0
ENVE 300	**Introduction to Environmental Engineering**	3.0
	Technical elective (200-level or above) *	3.0

*Check with the Department for Technical elective options.

Required courses for Mechanical concentration		
CIVE 310	**Soil Mechanics**	3.0
CIVE 410	**Foundational Engineering**	3.0

Required courses for Structural concentration		
CIVE 375	**Structural Material Behavior**	3.0

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Architectural Engineering students can also complete a Bachelor of Science in Appropriate Technology, a select program to support work in international and disadvantaged communities. Another possible dual degree is a combination with a Bachelor of Science in Environmental Engineering.

Bachelor's/Master's Dual Degree Program
Exceptional students can also pursue a master of science degree in the same period as the bachelor of science. Exceptional students can also pursue a master of science degree in the same period as the bachelor of science. For more information about this program, visit the Department's BS /MS Dual Degree Program page.

Minor in Architectural Engineering

The minor in architectural engineering, designed to broaden the professional capabilities of students, offers the building systems portion of the architectural engineering curriculum with enough attention to structural components for completeness. Pursuing a minor in architectural engineering can be of interest to mechanical engineering students who wish to learn the application of HVAC systems within the building context; to civil engineering students who require knowledge of large-scale infrastructure systems; and to chemical engineering students who wish to understand the energy and distribution aspects of process plant design.

While this minor is primarily designed to provide technical knowledge and skills to other engineers, with the appropriate prerequisites students from other disciplines—such as architecture—can also complete this minor.
The minor consists of a minimum of 24 credits total, with five required core courses. Students take a minimum of eight additional credits taken from a list of optional courses.

Prerequisites
The common engineering core curriculum prerequisites are required of all students in the College of Engineering. Students from other colleges will need the appropriate background prerequisite courses in physics, mathematics and thermodynamics.

Required courses		
CAEE 201	**Introduction to Infrastructure Engineering**	3.0
AE 220	**Introduction to HVAC**	3.5
AE 340	**Architectural Illumination and Electrical Systems**	3.0
or		
ARCH 263	**Environmental Systems III**	3.0
AE 390	**Architectural Engineering Design I**	4.0
CIVE 370	**Introduction to Structural Analysis**	3.0

Students select a minimum of eight additional credits from the following:		
CIVE 250	**Construction Materials**	4.0
CIVE 371	**Introduction to Structural Design**	3.0
MEM 413	**Refrigeration and Air Conditioning I**	3.0
MEM 310	**Thermodynamic Analysis I**	4.0
ARCH 14I	**Architecture and Society I**	3.0
ARCH 191	**Studio 1-1**	3.0
or		
ARCH 101	**Studio 1-A**	4.5
AE 391	**Architectural Engineering Design II**	4.0
CIVE 240 WI	**Engineering Economics**	3.0

Chemical Engineering

Chemical engineers are concerned primarily with process engineering, the conversion of raw materials into valuable products. The products can include pharmaceuticals, specialized plastics, petrochemicals, materials for biomedical applications, and energy. The processes, which usually start out at a small laboratory scale, must be developed for production at a large chemical plant scale. The large change in scale requires careful engineering to minimize environmental contamination and to insure public safety.

The Department of Chemical and Biological Engineering is responsible for equipping our graduates with the broad technical knowledge and teamwork skills required for them to make substantial contributions to society.

Program Objectives:
The Chemical Engineering major has four goals for its students:

- Provide students with a strong foundation of scientific principles, teamwork methods, and communication skills for the identification and solution of chemical engineering problems.
- Instill in our students the capacity for self and group-study and experience self-assessment so that they possess the attributes necessary to continue life-long learning.
- Apply elements of public health and safety, concern for the environment, and ethics in the course of studies.
- Familiarize our students with research methodologies.

To help students reach these goals, the curriculum is structured so that they progress through sequences in the fundamental physical sciences, humanities, engineering sciences, and design.

Since chemical engineers have the responsibility for translating the results of chemical research into products for the marketplace, and for preventing the wastes generated by industry from contaminating the environment, the physical sciences sequence includes a strong emphasis on chemistry, with courses in analytical, inorganic, organic, and physical chemistry. All the courses emphasize modern theories of chemistry and are designed to help students gain a clearer understanding of their eventual assignments in engineering science and design.

As students progress to courses in engineering science and design, problems of a textbook nature give way to real-world examples. By senior year, students are involved in comprehensive design projects.

Senior Design Projects
A special feature of the major is senior design. A student — or group of students — works with a faculty advisor to develop a significant design project. Some recent examples include:

- Design of a process to make petrochemical intermediates
- Plastics recycling design
- Process design for antibiotic products

Chemical Engineering

Bachelor of Science Degree: 192.5 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies equirements		
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
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	General education requirements	15.0
	Free electives	3.0

Foundation requirements		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 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 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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
ENGR 220	**Fundamentals of Materials**	4.0
ENGR 231	**Linear Engineering Systems**	3.0
ENGR 232	**Dynamic Engineering Systems**	3.0

Sophomore engineering elective options (Students select one)		
BIO 214	**Principles of Cell Biology**	3.0
CHEM 230	**Quantitative Analysis**	3.0
ENVS 260	**Environmental Science and Society I**	3.0
MATH 221	**Discrete Mathematics**	3.0
PHYS 202	**Fundamentals of Physics IV**	4.0

Professional requirements		Credits
CHE 201	**Process Material Balances**	3.0
CHE 202	**Process Energy Balances**	3.0
CHE 206	**Basic Chemical Engineering Thermodynamics**	3.0
CHE 301	**Process Thermodynamics**	3.0
CHE 302	**Process Fluid Mechanics**	4.0
CHE 303	**Process Heat Transfer**	3.0
CHE 304	**Process Mass Transfer**	4.0
CHE 305	**Process Separations**	4.0
CHE 307	**Process Modeling I**	4.0
CHE 308	**Process Modeling II**	4.0
CHE 332 WI	**Chemical Engineering Laboratory I**	2.0
CHE 333 WI	**Chemical Engineering Laboratory II**	2.0
CHE 334 WI	**Chemical Engineering Laboratory III**	2.0
CHE 335	**Statistics and Design of Experiments**	3.0
CHE 420	**Process Systems Engineering**	3.0
CHE 424	**Chemical Kinetics and Reactor Design**	4.0
CHE 481	**Process Design I**	3.0
CHE 482 WI	**Process Design II**	3.0
CHE 483 WI	**Process Design III**	3.0
CHEC 352	**Physical Chemistry and Applications II**	4.0
CHEC 353	**Physical Chemistry and Applications III**	4.0
CHEM 241	**Organic Chemistry I**	4.0
CHEM 242	**Organic Chemistry II**	4.0
CHEM 356	**Physical Chemistry Laboratory I**	2.0
	Concentration electives	14.0

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.

Graduate-Level Electives

		Credits
CHE 502	**Mathematical Methods in Chemical Engineering**	3.0
CHE 513	**Chemical Engineering Thermodynamics**	3.0
CHE 525	**Transport Phenomena I**	3.0
CHE 543	**Kinetics and Catalysis I**	3.0
CHE 554	**Process Systems Engineering**	3.0
CHE 562	**Bioreactor Engineering**	3.0
CHE 564	**Unit Operations in Bioprocess Systems**	3.0

Recommended Plan Of Study

BS Chemical Engineering
5 YR UG Co-op Concentration

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
CHE 201	Process Material Balances	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
CHE 202	Process Energy Balances	3.0
CHE 206	Basic Chemical Engineering Thermodynamics	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 232	Dynamic Engineering Systems	3.0
	Sophomore engineering elective (See degree requirements for list of options)	3.0
	Term Credits	*15.0*

Term 6		Credits
CHE 301	Process Thermodynamics	3.0
CHE 307	Process Modeling I	4.0
CHEM 241	Organic Chemistry I	4.0
CHEM 356	Physical Chemistry Lab	2.0
HIST 285	Technology in Historical Perspective	3.0
	Term Credits	*16.0*

Term 7		Credits
CHE 302	Process Fluid Mechanics	4.0
CHE 332	Chemical Engineering Laboratory	2.0
CHE 335	Statistics and Design of Experiments	3.0
CHEM 242	Organic Chemistry II	4.0
PHIL 315	Engineering Ethics	3.0
	Term Credits	*16.0*

Term 8		Credits
CHE 303	Process Heat Transfer	3.0
CHE 305	Process Separations	4.0
CHE 333	Chemical Engineering Laboratory II	2.0
CHEC 352	Physical Chemistry and Applications II	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 9		Credits
CHE 304	Process Mass Transfer	4.0
CHE 308	Process Modeling II	4.0
CHE 334	Chemical Engineering Laboratory III	2.0
CHEC 353	Physical Chemistry and Applications III	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*17.0*

Term 10		Credits
CHE 420	Process Systems Engineering	3.0
CHE 424	Chemical Kinetics and Reactor Design	4.0
CHE 481	Process Design I	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*13.0*

Term 11		Credits
CHE 482	Process Design II	3.0
	Free elective	3.0
	CHE concentration electives	7.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 12		Credits
CHE 483	Process Design III	3.0
	CHE concentration electives	7.0
	General education elective (See degree requirements)	3.0
	Term Credits	*13.0*
	Total Credits (minimum)	**192.5**

Chemical Engineering

Accelerated Program
The Accelerated Program of the College of Engineering provides opportunities for highly-talented and strongly-motivated students to progress toward their educational goals essentially at their own pace. 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 Bachelor's degree.

In Chemical Engineering, the course sequence for MS/BS students involves additional graduate courses and electives.

Civil Engineering

Civil engineers are active in the planning, design, construction, research and development, operation, maintenance, and rehabilitation of large engineering systems. A particular focus is the reconstruction of the nation's infrastructure through solutions that minimize the disruption of social and natural environments.

Civil engineering graduates are grounded in the fundamental principles necessary for the practice of this profession in any of its modern branches, including construction management, water resources engineering, structural engineering, geotechnical engineering, transportation engineering, and environmental engineering.

Seven of the required courses in the discipline include integral laboratories or field projects for both educational illustration and professional practice exposure.

Careful selection of the electives specified in the curriculum can lead to a wide variety of career objectives. For instance, students with an interest in water resources engineering may elect advanced courses in hydrology, ecology, and chemistry; select senior professional electives in the geotechnical and water resources areas; and choose appropriate topics for senior design and senior seminar. Seniors, with the approval of the department head, can elect certain graduate courses.

Mission Statement
The civil and architectural engineering faculty are responsible for delivering an outstanding curriculum that equips our graduates with the broad technical knowledge, design proficiency, professionalism, and communications skills required for them to make substantial contributions to society and to enjoy rewarding careers.

Program Objectives
Civil engineering graduates will become professionals who analyze, design, construct, manage or operate physical infrastructure and systems, or advance knowledge of the field.

Senior Design Projects
A special feature of the major is senior design. A group of students works with a faculty advisor to develop a significant design project selected by the group. All civil engineering students participate in a design project.

For more information about this major, contact the Department of Civil, Architectural and Environmental Engineering.

Civil Engineering

Bachelor of Science Degree: 190.5 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies equirements		
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
	General education requirements	21.0
	Free electives	6.0

Foundation requirements		
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 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 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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
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
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0

Major requirements		
CAE 491 WI	**Senior Project Design I**	3.0
CAE 492 WI	**Senior Project Design II**	3.0
CAE 493 WI	**Senior Project Design III**	3.0
CAEE 201	**Introduction to Infrastructure Engineering**	3.0

CAEE 210	**Measurements in Civil, Architectural and Environmental Engineering I**	3.0
CAEE 211	**Measurements in Civil, Architectural and Environmental Engineering II**	4.0
CIVE 240 WI	**Engineering Economics**	3.0
CIVE 250	**Construction Materials**	4.0
CIVE 310	**Soil Mechanics I**	4.0
CIVE 320	**Introduction to Fluid Flow**	3.0
CIVE 330	**Hydraulics**	4.0
CIVE 375	**In Situ Material Behavior**	3.0
CIVE 410	**Foundation Engineering**	3.0
CIVE 430	**Hydrology**	3.0
CIVE 477 WI	**Seminar I**	2.0
CIVE 478 WI	**Seminar II**	1.0
ENVE 300	**Introduction to Environmental Engineering**	3.0
MEM 202	**Engineering Mechanics: Statics**	3.0
MEM 230	**Mechanics of Materials I**	4.0
	Senior professional electives*	18.0

*A sequence of three courses in a major area of study is required, with a total of six 3-credit professional electives.

Students select one of the following:

CIVE 370	**Introduction to Structural Analysis**	3.0
or		
CIVE 300	**Theory of Structures I**	3.0

Based on whether or not students are pursuing a structural or non-structural concentration, students select either:

CIVE 301	**Introduction to Structural Analysis II**	4.0
or		
CIVE 371	**Introduction to Structural Design**	3.0
and		
CIVE 372	**Structural Laboratory**	1.0

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.

Recommended Plan Of Study

BS Civil Engineering
5 YR UG Co-op Concentration

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
CAEE 201	Introduction to Infrastructure Engineering	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
CAEE 210	Measurements in Civil, Architectural and Environmental Engineering I	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 202	Engineering Mechanics-Statics	3.0
	Term Credits	*15.0*

Term 6		Credits
CIVE 240	Engineering Economic Analysis	3.0
CIVE 320	Introduction to Fluid Flow	3.0
ENVE 300	Introduction to Environmental Engineering	3.0
MEM 230	Mechanics of Materials I	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 7		Credits
CAEE 211	Measurements in Civil, Architectural and Environmental Engineering II	4.0
CIVE 250	Construction Materials	4.0
CIVE 330	Hydraulics	4.0
ENGR 361	Statistical Analysis of Engineering Systems	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*18.0*

Term 8		Credits
CIVE 310	Soil Mechanics I	4.0
CIVE 430	Hydrology	3.0
CIVE 370	Introduction to Structural Analysis	3.0
or		
CIVE 300	Theory of Structures I	3.0
	General education elective (See degree requirements)	3.0
	Free elective	3.0
	Term Credits	*16.0*

Term 9		Credits
CIVE 375	Structural Material Behavior	3.0
CIVE 410	Foundation Engineering	3.0
	General education electives (See degree requirements)	3.0
	CIVE 301 Theory of Structures II (Non-structural concentration takes CIVE 371 & 372)	4.0
	Term Credits	*13.0*

Term 10		Credits
CAE 491	Senior Design Project I	3.0
CIVE 477	Seminar	2.0
	Professional electives (See degree requirements for list)	6.0
	General education elective (See degree requirements)	3.0
	Term Credits	*14.0*

Term 11		Credits
CAE 492	Senior Design Project II	3.0
CIVE 478	Seminar	1.0
	Professional electives (See degree requirements for list)	6.0
	General education elective (See degree requirements)	3.0
	Term Credits	*13.0*

Term 12		Credits
CAE 493	Senior Design Project III	3.0
	Free elective	3.0
	Professional electives (See degree requirements for list)	6.0
	General education elective (See degree requirements)	3.0
	Term Credits	*15.0*
	Total Credits (minimum)	190.5

Civil, Architectural and Environmental Engineering Department

Accelerated Program
The Accelerated Program of the College of Engineering provides opportunities for highly talented and strongly motivated students to progress toward their educational goals essentially 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.

Dual Degree Bachelor's Programs
A student completing the Bachelor of Science degree program in architectural engineering may complete additional courses (specified by the department) to earn the Bachelor of Science degree in civil engineering. (The reverse is difficult because of prerequisites in the sequence of architectural studio design courses, which begins in the sophomore year.)

Civil Engineering students can also complete a dual degree with the Bachelor of Science in Environmental Engineering.

Bachelor's/Master's Dual Degree Program
Exceptional students can also pursue a master of science degree in the same period as the bachelor of science. For more information about this program, visit the Department's BS /MS Dual Degree Program page.

Computer Engineering

Computer engineers design smaller, faster, and more reliable computers and digital systems; embed microprocessors in larger systems (e.g. anti-lock brake systems); work in theoretical issues in computing; use object-oriented programming languages; and design large-scale software systems and computer networks. Computer engineers may work in positions that apply computers in control systems, digital signal processing, telecommunications, and power systems, and may design very large-scale integration (VLSI) integrated circuits and systems.

The computer engineering degree program is designed to provide our students with breadth in engineering, the sciences, mathematics, and the humanities, as well as depth in both software and hardware disciplines appropriate for a computer engineer. It embodies the philosophy and style of the Drexel Engineering Curriculum, and will develop the student's design and analytical skills. In combination with the co-op experience, it opens to the student opportunities in engineering practice, advanced training in engineering or in other professions, and an entry to business and administration.

The computer engineering program's courses in ECE are supplemented with five courses from the departments of Mathematics and Computer Science: Programming I and II, Discrete Mathematics, Data Structures, and Software Engineering. Students gain the depth of knowledge of computer hardware and software essential for the computer engineer.

Mission Statement
The ECE Department prepares men and women to become leaders working in a highly dynamic and global environment at the forefront of engineering and pursues research to advance the state-of-the-art in electrical and computer engineering and engineering education.
Program Objectives

Our alumni will:

- *Continue as valued, dependable, and competent employees in a wide variety of fields and industries, in particular as computer engineers,*
- *Succeed in graduate and professional studies, such as engineering, science, law, medicine, and business, if pursued,*
- *Understand the need for life-long learning and continued professional development for a successful and rewarding career,*
- *Accept responsibility for leadership roles, in their profession, in their communities, and in the global society, and*
- *Function as responsible members of society with an awareness of the social and ethical ramifications of their work.*

Computer Engineering

Bachelor of Science Degree: 192.0 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies requirements		
ENGL 101	**Expository Writing and Reading**	3.0
ENGL 102	**Persuasive Writing and Reading**	3.0
ENGL 103	**Analytical Writing and Reading**	3.0
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	General education requirements	18.0

Foundation requirements		
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 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
ECE 200	**Digital Logic Design**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
ECE 203	**Programming for Engineers**	3.0
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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
ENGR 220	**Fundamentals of Materials**	4.0
ENGR 231	**Linear Engineering Systems**	3.0
ENGR 232	**Dynamic Engineering Systems**	3.0

Professional requirements		
CS 260	**Data Structures**	3.0
CS 265	**Advanced Programming Tools and Techniques**	3.0
ECE 491 WI	**Senior Project Design I**	2.0

ECE 492 WI	**Senior Project Design II**	2.0
ECE 493	**Senior Project Design III**	4.0
ECEC 301	**Advanced Programming for Engineers**	3.0
ECEC 302	**Digital System Projects**	4.0
ECEC 304	**Design with Microcontrollers**	4.0
ECEC 352	**Secure Computing**	4.0
ECEC 353	**Systems Programming**	4.0
ECEC 355	**Computer Organization and Architecture**	4.0
ECEC 356	**Embedded Systems**	3.0
ECEC 357	**Introduction to Computer Networks**	4.0
ECEL 301 WI	**ECE Laboratory I**	2.0
ECEL 302	**ECE Laboratory II**	2.0
ECEL303	**ECE Laboratory III**	2.0
ECEL 304	**ECE Laboratory IV**	2.0
ECES 302	**Transform Methods and Filtering**	4.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
MATH 221	**Discrete Mathematics**	3.0
	Six Computer Engineering courses	18.0
	Free electives	5.0-11.0

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.

Recommended Plan Of Study

BS Computer Engineering
5 YR UG Co-op Concentration

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
ECE 200	Digital Logic Design	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
ECE 201	Foundations of Electric Circuits	3.0
ECE 203	Programming for Engineers	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MATH 221	Discrete Mathematics	3.0
	Term Credits	*15.0*

Term 6		Credits
ECEC 301	Advanced Programming for Engineers	3.0
ECEC 302	Digital System Projects	4.0
ECEL 301	ECE Laboratory I	2.0
ECES 302	Transform Methods and Filtering	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 7		Credits
ECEC 304	Design with Microcontrollers	4.0
ECEC 355	Computer Organization and Architecture	4.0
ECEL 302	ECE Laboratory II	2.0
PHIL 315	Engineering Ethics	3.0
	Free elective	3.0
	Term Credits	*16.0*

Term 8		Credits
CS 265	Advanced Programming Tools and Techniques	3.0
ECEC 357	Introduction to Computer Networks	4.0
ECEL 303	ECE Laboratory III	2.0
ENGR 361	Statistical Analysis of Engineering Systems	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 9		Credits
CS 260	Data Structures	3.0
ECEC 353	Systems Programming	3.0
ECEC 356	Embedded Systems	4.0
ECEL 304	ECE Laboratory IV	2.0
	General education elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 10		Credits
ECE 491	Senior Design Project I	2.0
	Free elective	3.0
	General education elective (See degree requirements)	3.0
	Two Computer Engineering electives	6.0
	Term Credits	*14.0*

Term 11		Credits
ECE 492	Senior Design Project II	2.0
	Free elective	3.5
	Two Computer Engineering electives	6.0
	General education elective (See degree requirements)	3.0
	Term Credits	*14.5*

Term 12		Credits
ECE 493	Senior Design Project III	4.0
	General education elective (See degree requirements)	3.0
	Free elective	3.0
	Two Computer Engineering electives	6.0
	Term Credits	*16.0*
	Total Credits (minimum)	**192.0**

Electrical and Computer Engineering

Accelerated Program
The Accelerated Program of the College of Engineering provides opportunities for highly talented and strongly motivated students to progress toward their educational goals essentially at their own pace. These options include opportunities for accelerated studies, dual degrees, and combined bachelor's/master's programs.

Primarily through advanced placement, credit by examination, flexibility of scheduling, and independent study, the "fast track" makes it possible to complete the undergraduate curriculum and initiate graduate study in less than the five years required by the standard curriculum.

Dual Degree Bachelor's Programs
With careful planning, students can complete two full degrees in the time usually required to complete one. The double major option works best in closely related areas. For detailed information the student should contact his or her advisor.

Bachelor's/Master's Dual Degree Program
Exceptional students can also pursue a master of science degree in the same period as the bachelor of science.

For more information on these and other options, visit the Department of Electrical and Computer Engineering BS/MS page.

Minor in Computer Engineering

The Computer Engineering minor is designed to provide students from other computer-intensive majors—such as computer science or other engineering majors—with a foundation of knowledge in the hardware portion of computer systems. The minor consists of a minimum of seven ECE courses resulting in 25 credits. There are four required courses and an additional 12 credits of elective courses.

Prerequisites
The minor assumes that students will have a background in mathematics, physics, and computer programming equivalent to that covered in the first two years of engineering. Programming experience must include CS 171 at the minimum. CS 172 and CS 260 are also recommended, and are required for some upper level Computer Engineering (ECEC) courses. Courses taken to meet these requirements will not count toward the minor.

Required courses		
ECE 200	**Digital Logic Design**	3.0
ECEC 302	**Digital System Projects**	4.0
ECEC 355	**Computer Structures**	4.0
ECEL 304	**ECE Laboratory IV (prerequisite waived for minor)**	2.0

Electives **12.0**
Students should choose an additional 12 credits from 300- and/or 400-level Computer Engineering (ECEC) courses. All prerequisites must be satisfied.

The Computer Engineering Minor for Electrical Engineering Students
The University limit on the overlap between major and minor programs is 9 credits. Since 5 of the 13 required credits in the Computer Engineering minor are also in the Electrical Engineering degree program, electrical engineering students can overlap one additional 4-credit ECEC course in their major plan of study. ECEC courses that are used to satisfy core or technical electives in the EE degree program, beyond this one additional course, cannot be used toward the Computer Engineering minor due to the credit overlap limit.

Computer Science

The programs of study in computer science are designed with the flexibility to prepare students for careers in a rapidly changing profession and to allow strong preparation for graduate education in the field. In addition to the courses in the major, the Bachelor of Science program emphasizes foundation courses in the sciences and in applied mathematics, leading to careers involving applications in science and engineering. The Bachelor of Arts degree emphasizes foundation courses in the humanities and the social sciences, leading to careers involving applications in those areas.

Core courses in all programs include programming and data structures, programming language concepts, computer systems architecture, and a track of courses in software methodology and engineering. Students also choose two other tracks from the following: artificial intelligence, computer graphics, computer and network security, data structures and algorithms, game development and design, human-computer interaction, numeric and symbolic computation, operating systems and programming languages. Please contact the department for a current list of computer science elective and track courses.
The BS and BA programs are accredited by the Computing Accreditation Commission (CAC) of ABET.

Mission Statement
To educate students for computer science careers in industry and research with an emphasis on analysis of problems, understanding of fundamental concepts, and interest in lifelong learning. To integrate real-world experiences, e.g. , as obtained through the cooperative education program, into the academic curriculum.

Computer Science Program Outcomes:
The Bachelor of Science in Computer Science program prepares its graduates:

- to understand and be able to apply the underlying principles of Computer Science to a variety of problem domains;
- to develop good communication skills so that they can solve problems and communicate their solution;
- to develop strong analytical skills so that they can quickly assess how to solve problems;
- to be able to work in groups and appreciate the dynamic and collaborative nature of problem solving;
- to be equipped with a thorough understanding of the development process of software including design, implementation, documentation, and testing;
- to appreciate the role that computers play in society and to be able to direct the use of technology in a beneficial way and to solve new problems.
- to understand and be able to apply mathematics and science.

The Bachelor of Arts in Computer Science program prepares its graduates:

- to understand and be able to apply the underlying principles of Computer Science to a variety of problem domains;
- to develop good communication skills so that they can solve problems and communicate their solution;
- to develop strong analytical skills so that they can quickly assess how to

solve problems;

- to be able to work in groups and appreciate the dynamic and collaborative nature of problem solving;
- to be equipped with a thorough understanding of the development process of software including design, implementation, documentation, and testing;
- to appreciate the role that computers play in society and to be able to direct the use of technology in a beneficial way and to solve new problems.
- to have a broad education in the liberal arts balanced with technical study in computer science.

Computer Science Program Educational Objectives
Drexel Computer Science alumni will:

- be valued employees in a wide variety of occupations in industry, government and academia, in particular as computer scientists and software engineers;
- succeed in graduate and professional studies, such as engineering, science, law, medicine and business;
- pursue life-long learning and professional development to remain current in an ever changing technological world;
- provide leadership in their profession, in their communities, and society;
- function as responsible members of society with an awareness of the social and ethical ramifications of their work.

For more information about this major, contact the Department of Computer Science.

Computer Science

Bachelor of Arts Degree: 186.5 credits
Degree requirements (incoming students, 2010/2011)

General education requirements		**55.0 Credits**
COM 230	**Techniques of Speaking**	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
PHIL 311	**Computer Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	Humanities/fine arts electives	6.0
	International area studies	6.0
	Foreign language courses	8.0
	Social studies electives	12.0
	Diversity studies electives	6.0

Science requirements*		**18.0 Credits**
***Students must take one full year of a laboratory science and take courses in more than one science field. (Other options for the laboratory sequence are available; see the Computer Science department for list.)**		
BIO 122	**Cells and Genetics**	4.5
BIO 124	**Evolution and Organismal Diversity**	4.5
BIO 126	**Physiology and Ecology**	4.5
or		
CHEM 101	**General Chemistry I**	3.5
CHEM 102	**General Chemistry II**	4.5
CHEM 103	**General Chemistry III**	5.0
or		
PHYS 101	**Fundamentals of Physics I**	4.0
PHYS 102	**Fundamentals of Physics II**	4.0
PHYS 201	**Fundamentals of Physics III**	4.0
	Additional science electives (adding to 18.0 credits total with the chosen laboratory science track)	4.5-6.0

Mathematics requirements		**26.0 Credits**
MATH 101	**Introduction to Analysis I**	4.0
or		
MATH 121	**Calculus I**	4.0
MATH 102	**Introduction to Analysis II**	4.0
or		
MATH 122	**Calculus II**	4.0
MATH 239	**Mathematics for the Life Sciences**	4.0

or		
MATH 123	**Calculus III**	4.0
MATH 221	**Discrete Mathematics**	3.0
STAT 201	**Statistics I**	4.0
or		
MATH 410	**Scientific Data Analysis I**	3.0
STAT 202	**Statistics II**	4.0
	Mathematics/science elective	3.0

Computer science requirements		**64.0 Credits**
CS 164	**Introduction to Computer Science**	3.0
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
CS 270	**Mathematical Foundations of Computer Science**	3.0
CS 281	**Systems Architecture I**	4.0
CS 350 WI	**Software Design**	3.0
CS 360	**Programming Language Concepts**	3.0
CS 451	**Software Engineering**	3.0
CS 491 WI	**Software Engineering Workshop I**	3.0
CS 492 WI	**Software Engineering Workshop II**	3.0
CS 493 WI	**Software Engineering Workshop III**	3.0
	Computer science track* courses	18.0
	Computer science electives	6.0

Other courses		**23.5 Credits**
	Free electives	23.5

Computer Science Tracks

* Students must complete two of the following Computer Science tracks for a total of 18.0 credits. The tracks may overlap by one course. Students should check with the Department for any additional Special Topics courses being offered that may be appropriate for one of the tracks.

Algorithms and Data Structures		
CS 440	**Theory of Computation**	3.0
CS 457	**Data Structures & Algorithms I**	3.0
CS 458	**Data Structures & Algorithms II**	3.0
Artificial Intelligence		
CS 380	**Artificial Intelligence**	3.0
CS 481	**Advanced Artificial Intelligence**	3.0
CS 485	**Special Topics in Artificial Intelligence**	3.0
Computer and Network Security		
CS 472	**Computer Networks**	3.0
CS 475	**Computer and Network Security**	3.0
CS 303	**Algorithmic Number Theory and Cryptography**	3.0
Computer Graphics and Vision		
CS 430	**Computer Graphics**	3.0
CS 435	**Computational Photography**	3.0

CS 338	**Graphical User Interfaces**	3.0
or		
CS 431	**Advanced Rendering Techniques**	
or		
CS 432	**Interactive Graphics**	
Game Development and Design		
CS 345	**Computer Game Design and Development**	3.0
or		
DIGM 345	**Game Development: Foundations**	3.0
CS 445	**Topics in Computer Gaming**	3.0
CS 445	**Topics in Computer Gaming**	3.0
or		
DIGM 361	**Computer Gaming Workshop I**	3.0
DIGM 362	**Computer Gaming Workshop II**	3.0
Human-Computer Interactions		
CS 337	**Human-Computer Interaction**	3.0
CS 338	**Graphical User Interfaces**	3.0
CS 430	**Computer Graphics**	3.0
or		
CS 345	**Game Development: Foundations**	
or		
CS 435	**Computational Photography**	
or		
PSY 330	**Cognitive Psychology**	
Numeric and Symbolic Computation		
CS 300	**Applied Symbolic Computation**	3.0
MATH 300	**Numerical Analysis**	4.0
MATH 305	**Introduction to Optimization Theory**	4.0
or		
MATH 301	**Numerical Analysis II**	3.0
or		
CS 303	**Algorithmic Number Theory and Cryptography**	3.0
Programming Languages		
CS 440	**Theory of Computation**	3.0
CS 441	**Compiler Workshop I**	3.0
CS 442	**Compiler Workshop II**	3.0
Systems		
CS 361	**Concurrent Programming**	3.0
CS 370	**Operating Systems**	3.0
CS 461	**Database Systems**	3.0
or		
CS 472	**Computer Networks**	3.0
or		
CS 365	**Systems Administration**	3.0

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.

Recommended Plan Of Study

BA Computer Science
5 YR UG Co-op Concentration

Term 1		Credits
CS 164	Introduction to Computer Science	3.0
ENGL 101	Expository Writing and Reading	3.0
UNIV 101	The Drexel Experience	1.0
BIO 122	Cells and Genetics	4.5
or		
CHEM 101	General Chemistry I	3.5
or		
PHYS 101	Fundamentals of Physics I	4.0
MATH 101	Introduction to Analysis I	4.0
or		
MATH 121	Calculus I	4.0
	Term Credits	*15.5*

Term 2		Credits
CS 171	Computer Programming I	3.0
ENGL 102	Persuasive Writing and Reading	3.0
UNIV 101	The Drexel Experience	0.5
BIO 124	Evolution & Organismal Diversity	4.5
or		
CHEM 102	General Chemistry II	4.5
or		
PHYS 102	Fundamentals of Physics II	4.0
MATH 102	Introduction to Analysis II	4.0
or		
MATH 122	Calculus II	4.0
	Term Credits	*15.0*

Term 3		Credits
CS 172	Computer Programming II	3.0
ENGL 103	Analytical Writing and Reading	3.0
UNIV 101	The Drexel Experience	0.5
BIO 126	Physiology and Ecology	4.5
or		
CHEM 103	General Chemistry III	5.0
or		
PHYS 201	Fundamentals of Physics III	4.0
MATH 123	Calculus III	4.0
or		
MATH 239	Mathematics for the Life Sciences	4.0
	Free elective	3.0
	Term Credits	*18.0*

Term 4		Credits
CS 265	Advanced Programming Tools and Techniques	3.0
CS 270	Mathematical Foundations of Computer Science	3.0
	Science elective (See degree requirements)	3.0
	Diversity studies elective	3.0
	Arts and Humanities elective	3.0
	Term Credits	*15.0*

Term 5		Credits
CS 260	Data Structures	3.0
MATH 221	Discrete Mathematics	3.0
	Social studies elective	3.0

	Free elective	3.0
	Science elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 6		Credits
CS 281	Systems Architecture I	4.0
CS 350	Software Design	3.0
STAT 201	Statistics I	4.0
	Social studies elective	3.0
	Arts and Humanities elective	3.0
	Term Credits	*17.0*

Term 7		Credits
COM 230	Techniques of Speaking	3.0
CS 360	Programming Language Concepts	3.0
STAT 202	Business Statistics II	4.0
	Social studies elective	3.0
	Computer Science elective (See degree requirements for list)	3.0
	Term Credits	*16.0*

Term 8		Credits
PHIL 311	Computer Ethics	3.0
	Foreign language course	4.0
	Computer Science elective (See degree requirements for list)	6.0
	Math/science elective	3.0
	Term Credits	*16.0*

Term 9		Credits
CS 451	Software Engineering	3.0
	Free elective	3.0
	Computer science electives (See degree requirements)	3.0
	Foreign language course	4.0
	Diversity studies elective	3.0
	Term Credits	*16.0*

Term 10		Credits
CS 491	Software Engineering Workshop	3.0
	Computer Science elective (See degree requirements for list)	3.0
	International studies elective	3.0
	Free electives	6.0
	Term Credits	*15.0*

Term 11		Credits
CS 492	Software Engineering Workshop II	3.0
	Computer science electives (See degree requirements)	6.0
	International studies elective	3.0
	Free elective	3.5
	Term Credits	*15.5*

Term 12		Credits
CS 493	Software Engineering Workshop III	3.0
	Social studies elective	3.0
	Free electives	3.5
	Computer Science elective (See degree requirements for list)	3.0
	Term Credits	*12.5*

	Total Credits (minimum)	186.5

Computer Science

Bachelor of Science Degree: 186.5 credits
Degree requirements (incoming students, 2010/2011)

General education requirements		**47.0 Credits**
COM 230	**Techniques of Speaking**	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
PHIL 311	**Computer Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	Business elective	4.0
	Social Studies elective	3.0
	Writing and communication electives*	6.0
	General education electives	17.0

***See the Computer Science Department's web site for a list of approved options for the writing and communication electives.**

Freshman Design requirements		**6.0 Credits**
ENGR 101	**Engineering Design Laboratory I**	2.0
ENGR 102	**Engineering Design Laboratory II**	2.0
ENGR 103	**Engineering Design Laboratory III**	2.0

Mathematics requirements		**26.0 - 27.0 Credits**
MATH 121	**Calculus I**	4.0
MATH 122	**Calculus II**	4.0
MATH 123	**Calculus III**	4.0
MATH 201	**Linear Algebra**	4.0
MATH 221	**Discrete Mathematics**	3.0
MATH 311	**Probability and Statistics I**	4.0
or		
MATH 410	**Scientific Data Analysis**	
	Mathematics elective*	3.0 - 4.0

***Mathematics elective options**: MATH 200 Multivariate Calculus; MATH 210 Differential Equations; MATH 262 Differential Equations; ENGR 232 Dynamic Engineering Systems; or any 300-400 level MATH course.

Science requirements	**25.0 Credits**

Twenty-five science credits are required. These must include a three-term sequence from one of the laboratory sciences. (Other options for the laboratory sequence are available; see the Computer Science department for a complete list of acceptable science courses.)

BIO 122	**Cells and Genetics**	4.5
BIO 124	**Evolution and Organismal Diversity**	4.5
BIO 126	**Physiology and Ecology**	4.5
or		
CHEM 101	**General Chemistry I**	3.5
CHEM 102	**General Chemistry II**	4.5
CHEM 103	**General Chemistry III**	5.0
or		
PHYS 101	**Fundamentals of Physics I**	4.0
PHYS 102	**Fundamentals of Physics II**	4.0
PHYS 201	**Fundamentals of Physics III**	4.0

Computation requirements		**3.0 Credits**
CS 121 WI	**Computational Laboratory I**	1.0
CS 122 WI	**Computational Laboratory II**	1.0
CS 123 WI	**Computational Laboratory III**	1.0

Computer science requirements		**71.0 Credits**
CS 164	**Introduction to Computer Science**	3.0
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
CS 270	**Mathematical Foundations of Computer Science**	3.0
CS 281	**Systems Architecture I**	4.0
CS 282	**Systems Architecture II**	4.0
CS 350 WI	**Software Design**	3.0
CS 360	**Programming Language Concepts**	3.0
CS 451	**Software Engineering**	3.0
CS 491	**Software Engineering Workshop I**	3.0
CS 492	**Software Engineering Workshop II**	3.0
CS 493	**Software Engineering Workshop III**	3.0
ECE 200	**Digital Logic Design**	3.0
	Computer science track* courses	18.0
	Computer science electives	6.0

Other courses		**7.5 - 8.5 Credits**
	Free electives	7.5

Computer Science Tracks

* Students must complete two of the following Computer Science tracks for a total of 18.0 credits. The tracks may overlap by one course. Students should check with the Department for any additional Special Topics courses being offered that may be appropriate for one of the tracks.

Algorithms and Data Structures

CS 440	**Theory of Computation**	3.0
CS 457	**Data Structures & Algorithms I**	3.0
CS 458	**Data Structures & Algorithms II**	3.0
Artificial Intelligence		
CS 380	**Artificial Intelligence**	3.0
CS 481	**Advanced Artificial Intelligence**	3.0
CS 485	**Special Topics in Artificial Intelligence**	3.0
Computer and Network Security		
CS 472	**Computer Networks**	3.0
CS 475	**Computer and Network Security**	3.0
CS 303	**Algorithmic Number Theory and Cryptography**	3.0
Computer Graphics and Vision		
CS 430	**Computer Graphics**	3.0
CS 435	**Computational Photography**	3.0
CS 338	**Graphical User Interfaces**	3.0
or		
CS 431	**Advanced Rendering Techniques**	
or		
CS 432	**Interactive Graphics**	
Human-Computer Interactions		
CS 337	**Human-Computer Interaction**	3.0
CS 338	**Graphical User Interfaces**	3.0
CS 430	**Computer Graphics**	3.0
or		
CS 345	**Computer Game Design**	
or		
CS 435	**Computational Photography**	
or		
PSY 330	**Cognitive Psychology**	
Game Development and Design		
CS 345	**Computer Game Design and Development**	3.0
or		
DIGM 345	**Game Development: Foundations**	3.0
CS 445	**Topics in Computer Gaming**	3.0
CS 445	**Topics in Computer Gaming**	3.0
or		
DIGM 361	**Computer Gaming Workshop I**	3.0
DIGM 362	**Computer Gaming Workshop II**	3.0
Numeric and Symbolic Computation		
CS 300	**Applied Symbolic Computation**	3.0
MATH 300	**Numerical Analysis**	4.0
MATH 305	**Introduction to Optimization Theory**	4.0
or		
MATH 301	**Numerical Analysis II**	3.0
or		
CS 303	**Algorithmic Number Theory and Cryptography**	3.0
Programming Languages		
CS 440	**Theory of Computation**	3.0
CS 441	**Compiler Workshop I**	3.0
CS 442	**Compiler Workshop II**	3.0
Systems		
CS 361	**Concurrent Programming**	3.0
CS 370	**Operating Systems**	3.0
CS 461	**Database Systems**	3.0
or		
CS 472	**Computer Networks**	3.0

or

CS 365	**System Administration**	3.0

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.

Recommended Plan Of Study

BS Computer Science
5 YR UG Co-op Concentration

Term 1		Credits
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
CS 164	Introduction to Computer Science	3.0
ENGL 101	Expository Writing and Reading	3.0
ENGR 101	Engineering Design Laboratory I	2.0
MATH 121	Calculus I	4.0
UNIV 101	The Drexel Experience	1.0
BIO 122	Cells and Genetics	4.5
or		
PHYS 101	Fundamentals of Physics I	4.0
or		
CHEM 101	General Chemistry I	3.5
	Term Credits	*18.5*

Term 2		Credits
CS 122	Computation Lab II	1.0
CS 171	Computer Programming I	3.0
ENGL 102	Persuasive Writing and Reading	3.0
ENGR 102	Engineering Design Laboratory II	2.0
MATH 122	Calculus II	4.0
UNIV 101	The Drexel Experience	0.5
BIO 124	Evolution & Organismal Diversity	4.5
or		
PHYS 102	Fundamentals of Physics II	4.0
or		
CHEM 102	General Chemistry II	4.5
	Term Credits	*18.0*

Term 3		Credits
CS 123	Computation Lab III	1.0
CS 172	Computer Programming II	3.0
ENGL 103	Analytical Writing and Reading	3.0
ENGR 103	Engineering Design Laboratory III	2.0
MATH 123	Calculus III	4.0
UNIV 101	The Drexel Experience	0.5
BIO 126	Physiology and Ecology	4.5
or		
PHYS 201	Fundamentals of Physics III	4.0
or		
CHEM 103	General Chemistry III	5.0
	Term Credits	*18.0*

Term 4		Credits
CS 265	Advanced Programming Tools and Techniques	3.0
CS 270	Mathematical Foundations of Computer Science	3.0
MATH 201	Linear Algebra	4.0
	Social studies elective	3.0
	Science elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 5		Credits
CS 260	Data Structures	3.0
ECE 200	Digital Logic Design	3.0
MATH 221	Discrete Mathematics	3.0

	Science elective (See degree requirements)	3.0
	Business elective	4.0
	Term Credits	*16.0*

Term 6		Credits
COM 230	Techniques of Speaking	3.0
CS 281	Systems Architecture I	4.0
CS 350	Software Design	3.0
	General education elective	3.0
	Science elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 7		Credits
CS 282	Systems Architecture II	4.0
CS 360	Programming Language Concepts	3.0
	Science elective (See degree requirements)	3.0-4.0
	Writing/Communication elective (See approved course list)	3.0
	General education elective	3.0
	Term Credits	*16.0-17.0*

Term 8		Credits
PHIL 311	Computer Ethics	3.0
MATH 410	Scientific Data Analysis I	3.0
or		
MATH 311	Probability and Statistics I	4.0
	Computer science electives (See degree requirements)	6.0
	General education elective	3.0
	Term Credits	*15.0*

Term 9		Credits
CS 451	Software Engineering	3.0
	General education elective	3.0
	Mathematics elective (See degree requirements for list of options)	3.0-4.0
	Free elective	3.0
	Computer Science elective (See degree requirements for list)	3.0
	Term Credits	*15.0-16.0*

Term 10		Credits
CS 491	Software Engineering Workshop	3.0
	Computer science electives (See degree requirements)	6.0
	General education elective	3.0
	Free elective	3.0
	Term Credits	*15.0*

Term 11		Credits
CS 492	Software Engineering Workshop II	3.0
	Computer science electives (See degree requirements)	6.0
	General education elective	3.0
	Term Credits	*12.0*

Term 12		Credits
CS 493	Software Engineering Workshop III	3.0
	Free elective	3.5
	Writing/Communication elective (See approved course list)	3.0
	Computer Science elective (See degree requirements for list)	3.0
	Term Credits	*12.5*
	Total Credits (minimum)	**188.0-190.0**

Computer Science

Bachelor's/Master's Accelerated Degree in Computer Science

The guidelines for the application to the Computer Science Bachelor's/Master's Accelerated Degree Program are as follows:

University regulations require application after the completion of 90 credits but before the completion of 120 credits.

Applicants must have completed the following core Computer Science courses with a minimum GPA of 3.50:

- CS 171 (Programming I)
- CS 172 (Programming II)
- CS 260 (Data Structures)
- CS 265 (Advanced Programming Tools and Techniques - Formerly CS 390 UNIX and Advanced Programming)
- CS 270 (Mathematical Foundations of Computer Science)
- MATH 221 (Discrete Mathematics)
- ECE 200 (Digital Logic Design)
- CS 281 (Systems Architecture I)
- CS 350 (Software Design - Formerly Oriented Programming)
- CS 360 (Programming Language Concepts)
- A CS Track Elective from: CS 300 (Applied Symbolic Computation), CS 338 (Graphical User Interfaces), CS 361 (Concurrent Programming), CS 380 (Artificial Intelligence), CS457 (Data Structures and Algorithms I), or CS 440 (Theory of Computation).

Applicants must have an overall cumulative Grade Point Average of 3.25 or higher. Letters of recommendation from two Computer Science faculty are required. Students must submit a plan of study. Consult the Graduate Advisor and course schedules for guidance.

Acceptance to the program will be decided by the graduate admissions committee with consultation from the undergraduate curriculum committee, and will be based on a combination of the student's GPA and letters of recommendation. Acceptance may be denied if the plan of study is not feasible. For more information, contact the Department of Computer Science.

Minor in Computer Science

The computer science minor provides students with a breadth of knowledge in areas which form the foundation of computer science. The student adds some depth by selecting courses from a list of advanced computer science courses.

Mathematics prerequisites:		
One of the following two-term mathematics sequences must be completed before entering the program:		
MATH 101	**Introduction to Analysis I**	4.0
MATH 102	**Introduction to Analysis II**	4.0
or		
MATH 121	**Calculus I**	4.0
MATH 122	**Calculus II**	4.0

Required Courses*:*

Students must complete at least 25 credits from courses listed below, subject to the following restrictions:

- The requirements of each category (*Computer Programming*, *Theoretical Foundations*, *Computer Systems*, and *Advanced Electives*) must be fulfilled
- Not more than 9 credit hours may overlap with those required for the student's academic major.
- All courses listed as required must be completed
- Programming courses bypassed through advanced placement do not count toward the 25 credit requirement.
- Remaining credits are to be earned from the list of elective courses.

Computer Programming		**6.0 - 15.0**
Students complete one of the following introductory course sequences:*:*		
CS 171	**Computer Programming I**	3.0
CS 172	**Computer Programming II**	3.0
or		
CS 131	**Computer Programming A**	3.0
CS 132	**Computer Programming B**	3.0
CS 133	**Computer Programming C (prior to Fall 08-09)**	3.0
CS 172	**Computer Programming II**	3.0
or		
SE 101	**Fundamentals of Software Engineering I**	3.0
SE 102	**Fundamentals of Software Engineering II**	3.0
SE 103	**Fundamentals of Software Engineering III**	3.0
or		
ECE 203	**Programming for Engineers**	3.0
ECEC 301	**Advanced Programming for Engineers**	3.0

Students complete the following advanced course:*:*		
CS 265	**Advanced Programming Tools and Techniques**	3.0

Theoretical Foundations		**6.0**
CS 260	**Data Structures**	3.0
CS 270	**Mathematical Foundations of Computer Science**	3.0

Computer Systems		**4.0**
CS 281	**Systems Architecture I**	4.0

Advanced Electives*		**6.0-10.0**
Students select two or more courses from the following list. Courses are grouped according to subject area, to assist students in making selections.		
Computing Systems and Security		
CS 282	**Systems Architecture II**	4.0
CS 361	**Concurrent Programming**	3.0
CS 365	**System Administration**	3.0
CS 370	**Operating Systems**	3.0
CS 461	**Database Systems**	3.0
CS 472	**Computer Networks**	3.0
CS 475	**Computer and Network Security**	3.0
Programming Languages and Compilers		
CS 360	**Programming Language Concepts**	3.0
CS 440	**Theory of Computation**	3.0
CS 441	**Compiler Workshop I**	3.0
CS 442	**Compiler Workshop II**	3.0
Human-Computer Interaction		
CS 338	**Graphical User Interfaces**	3.0
CS 430	**Computer Graphics**	3.0
Artificial Intelligence		
CS 380	**Artificial Intelligence**	3.0
CS 481	**Advanced Artificial Intelligence**	3.0
CS 485	**Special Topics in Artificial Intelligence**	3.0
Numeric and Symbolic Computation		
CS 300	**Applied Symbolic Computation**	3.0
MATH 300	**Numerical Analysis**	4.0
CS 303	**Algorithmic Number Theory and Cryptography**	3.0
Algorithms Theory		
CS 440	**Theory of Computation**	3.0
CS 457	**Data Structures & Algorithms I**	3.0
CS 458	**Data Structures & Algorithms II**	3.0
Software Methodology (not available to Software Engineering Students)		
CS 350 WI	**Software Design**	3.0
CS 451	**Software Engineering I**	3.0

***Other courses may be approved by the Department for this purpose; contact the Computer Science Undergraduate Advisor (advisor@cs.drexel.edu).**

Electrical Engineering

The Department of Electrical and Computer Engineering curriculum emphasizes computer-aided design and hands-on laboratory experience, and flexibility is a major hallmark of the new program. State-of-the-art interdisciplinary courses have been developed to prepare the Drexel engineer for the technical challenges and the business atmosphere of the 21st century. Strong emphasis is given to the role of the engineer in the global competitive economy, and to the need to work closely with experts and practitioners in many fields.
The Electrical Engineering curriculum balances technical depth and breadth: depth through the selection of a track and breadth through courses selected in other tracks and the laboratories.

The curriculum offers three different tracks, or areas of study: telecommunications/digital signal processing, electronics, and electrical engineering. The majority of the core courses will be in their track, while others will be chosen from other tracks or from the computer engineering program. Descriptions and course requirements for each track follow the basic degree requirements.

Mission Statement
The ECE Department prepares men and women to become leaders working in a highly dynamic and global environment at the forefront of engineering and pursues research to advance the state-of-the-art in electrical and computer engineering and engineering education.
Program Objectives

Our alumni will:

- *Continue as valued, dependable, and competent employees in a wide variety of fields and industries, in particular as electrical engineers,*
- *Succeed in graduate and professional studies, such as engineering, science, law, medicine, and business, if pursued,*
- *Understand the need for life-long learning and continued professional development for a successful and rewarding career,*
- *Accept responsibility for leadership roles, in their profession, in their communities, and in the global society, and*
- *Function as responsible members of society with an awareness of the social and ethical ramifications of their work.*

Electrical Engineering Tracks

Telecommunications/DSP Track
Telecommunications and digital signal processing (DSP) are two of the fastest-growing fields of electrical engineering. The telecommunications/DSP track prepares students for mastery of fundamental and applied knowledge in the theory and the technology of the transmission and processing of information-bearing signals such as voice, audio, data, images, and video. The curriculum includes core courses in electromagnetic propagation, communication devices and media, signal processing, modulation, and coding. Complementary electives can be taken in

computers, electronics, control systems, and electric power systems.

Career opportunities include design and development of digital communications systems and telephony, speech recognition systems, fiber-optic networks, digital radio, medical diagnostic image processing, high-definition television, cellular and wireless communications, satellite communications, networked multimedia communications, and personal communication systems.

Track courses		Credits
ECEE 302	**Electronic Devices**	4.0
ECEE 304	**Electromagnetic Fields and Waves**	4.0
ECES 302	**Transform Methods and Filtering**	4.0
ECES 306	**Introduction to Modulation and Coding**	4.0
ECES 352	**Introduction to Digital Signal Processing**	4.0
ECES 354	**Wireless, Mobile, and Cellular Communications**	4.0
	Additional 300-level core courses	8.0

Electronics Track

The electronics track constitutes the study of electronic and optical semiconductor devices; analog and digital electronic circuits; and generation, transmission, and reception of information both in optical and microwave frequency ranges and guided or free-space conditions.

Career opportunities include jobs in telecommunications (optical, wireless, wired, satellite, and radar), VLSI (analog and digital), aerospace, remote sensing and instrumentation, computer circuitry interface, biomedical instrumentation, semiconductor device fabrication, and transportation.

Track courses		Credits
ECEE 302	**Electronic Devices**	4.0
ECEE 304	**Electromagnetic Fields and Waves**	4.0
ECEE 352	**Analog Electronics**	4.0
ECEE 354	**Introduction to Wireless and Optical Electronics**	4.0
ECES 302	**Transform Methods and Filtering**	4.0
	Additional 300-level core courses	12.0

Electrical Engineering Track

The electrical engineering track has at its core the areas of controls engineering and electric power engineering, the classic core of electrical engineering, and exploits the synergies between these two areas. The track explores subjects such as modeling, analysis and control of dynamic systems including power systems, planning and optimization, electromechanical energy conversion, motor operation and control, transformers, power electronics, sensors and actuators, and the electrical and economic structure of the power industry. The track offers access to two state-of-the-art laboratories. In the Interconnected Power System Laboratory, students can operate and control a small power system through the fusing of computer software and hardware technology with high-voltage, high-power technology. The Ortlip Systems Laboratory houses various experiments in sensing, feedback, and control. Both laboratories stress the use of modeling software, especially MATLAB, and the integrated use of computers and hardware.

Career opportunities include options ranging from manufacturing, the power industry (generation, transmission, distribution, marketing, and consumption), robotics, and transportation to Wall Street.

Track courses		Credits
ECEE 302	**Electronic Devices**	4.0
ECEP 352	**Electric Motor Control Principles**	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
	Additional 300-level core courses	12.0

Electrical Engineering

Bachelor of Science Degree: 192.0 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies requirements		32.0 Credits
ENGL 101	**Expository Writing and Reading**	3.0
ENGL 102	**Persuasive Writing and Reading**	3.0
ENGL 103	**Analytical Writing and Reading**	3.0
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	General education requirements	18.0

Foundation requirements		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 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
ECE 200	**Digital Logic Design**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
ECE 203	**Programming for Engineers**	3.0
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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
ENGR 220	**Fundamentals of Materials**	4.0
ENGR 231	**Linear Engineering Systems**	3.0
ENGR 232	**Dynamic Engineering Systems**	3.0

Sophomore engineering elective options (Students select one)		
ENGR 210	**Introduction to Thermodynamics**	3.0
MATH 221	**Discrete Mathematics**	3.0
PHYS 202	**Fundamentals of Physics IV**	4.0

Professional requirements		Credits
ECE 491 WI	**Senior Project Design I**	2.0
ECE 492 WI	**Senior Project Design II**	2.0
ECE 493	**Senior Project Design III**	4.0
ECEL 301 WI	**ECE Laboratory I**	2.0
ECEL 302	**ECE Laboratory II**	2.0
ECEL303	**ECE Laboratory III**	2.0
ECEL 304	**ECE Laboratory IV**	2.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
MATH 291	**Complex and Vector Analysis for Engineers**	4.0
	ECE track courses (8)**	32.0
	ECE technical electives***	9.0-12.0
	Free electives	0.0-12.0

**Track Courses:

Electrical Engineering Track
ECES 444 Systems and Controls I(4.0), ECES 445 Systems and Controls II (4.0), and ECES 446 Systems and Controls III (4.0);
or
ECEP 411 Power Systems (3.0), ECEP 412 Power Systems II (3.0) and ECEP 413 Power Systems III (3.0).

Electronics Track
ECEE 421 Advanced Electronics I (4.0), ECEE 422 Advanced Electronic Circuits I (3.0), and ECEE 434 Digital Electronics (4.0)
or
ECEE 471 High Frequency Passive Circuits (4.0), ECEE 472 RF Electronics (4.0), and ECEE 473 Antennas and Radiating Systems (4.0)

Telecommunications/DSP Track
ECES 434 Deterministic Signal Processing (4.0), ECES 435 Statistical Signal Processing (4.0), and ECES 436 Speech and Image Signal Interpretation (4.0);

***ECE Technical electives are 300 or 400-level courses from any Electrical Engineering track.

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.

Recommended Plan Of Study

BS Electrical Engineering
5 YR UG Co-op Concentration /Telecommunications/DSP

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
ECE 200	Digital Logic Design	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
ECE 201	Foundations of Electric Circuits	3.0
ECE 203	Programming for Engineers	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 232	Dynamic Engineering Systems	3.0
	Sophomore engineering elective (See degree requirements for list of options)	3.0
	Term Credits	*15.0*

Term 6		Credits
ECEE 302	Electronic Devices	4.0
ECEL 301	ECE Laboratory I	2.0
ECES 302	Transform Methods and Filtering	4.0
	Free elective	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 7		Credits
ECEL 302	Electrical Engineering Laboratory II	2.0
ECES 352	Digital Signal Processing	4.0
MATH 291	Complex and Vector Analysis for Engineering	4.0
PHIL 315	Engineering Ethics	3.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	Term Credits	*17.0*

Term 8		Credits
ECEE 304	Electromagnetic Fields and Waves	4.0
ECEL 303	Electrical Engineering Laboratory III	2.0
ECES 306	Modulation and Coding	4.0
ENGR 361	Statistical Analysis of Engineering	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 9		Credits
ECEE 354	Wireless and Optical Electronics	4.0
ECEL 304	Electrical Engineering Laboratory IV	2.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*13.0*

Term 10		Credits
ECE 491	Senior Design I	2.0
ECES 434	Deterministic Signal Processing	4.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	General education elective (See degree requirements)	3.0
	Free elective	3.0
	Term Credits	*15.0*

Term 11		Credits
ECE 492	Senior Design II	2.0
ECES 435	Statistical Signal Processing	4.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	General education elective (See degree requirements)	3.0
	Free elective	3.5
	Term Credits	*15.5*

Term 12		Credits
ECE 493	Senior Design III	4.0
ECES 436	Speech and Image Signal Interpret	4.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*14.0*
	Total Credits (minimum)	**192.0**

Recommended Plan Of Study

BS Electrical Engineering
5 YR UG Co-op Concentration /Electronics

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
ECE 200	Digital Logic Design	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
ECE 201	Foundations of Electric Circuits	3.0
ECE 203	Programming for Engineers	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 232	Dynamic Engineering Systems	3.0
	Sophomore engineering elective (See degree requirements for list of options)	3.0
	Term Credits	*15.0*

Term 6		Credits
ECEE 302	Electronic Devices	4.0
ECEL 301	ECE Laboratory I	2.0
ECES 302	Transform Methods and Filtering	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*13.0*

Term 7		Credits
ECEE 352	Analog Electronics	4.0
ECEL 302	ECE Laboratory II	2.0
MATH 291	Complex and Vector Analysis for Engineers	4.0
PHIL 315	Engineering Ethics	3.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	Term Credits	*17.0*

Term 8		Credits
ECEE 304	Electromagnetic Fields and Waves	4.0
ECEL 303	ECE Laboratory III	2.0
ENGR 361	Statistical Analysis of Engineering Systems	3.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 9		Credits
ECEE 354	Wireless and Optical Electronics	4.0
ECEL 304	Electrical Engineering Laboratory IV	2.0
	Free elective	3.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 10		Credits
ECE 491	Senior Design I	2.0
ECEE 471	RF Components and Techniques	4.0
or		
ECEE 421	Advanced Electronics I	4.0
	General education elective (See degree requirements)	3.0
	ECE Technical elective (300 or 400-level ECE course)	4.0
	Free elective	4.0
	Term Credits	*17.0*

Term 11		Credits
ECE 492	Senior Design II	2.0
ECEE 472	RF Electronics	4.0
or		
ECEE 422	Advanced Electronic Circuits I	3.0
	Free elective	1.5
	General education elective (See degree requirements)	3.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	Term Credits	*13.5*

Term 12		Credits
ECE 493	Senior Design III	4.0
ECEE 473	Antennas and Radiating Systems	4.0
or		
ECEE 434	Digital Electronics	4.0
	General education elective (See degree requirements)	3.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	Term Credits	*14.0*
	Total Credits (minimum)	**192.0**

Recommended Plan Of Study

BS Electrical Engineering
5 YR UG Co-op Concentration /Electrical Engineering

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
ECE 200	Digital Logic Design	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
ECE 201	Foundations of Electric Circuits	3.0
ECE 203	Programming for Engineers	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 232	Dynamic Engineering Systems	3.0
	Sophomore engineering elective (See degree requirements for list of options)	3.0
	Term Credits	*15.0*

Term 6		Credits
ECEE 302	Electronic Devices	4.0
ECEL 301	ECE Laboratory I	2.0
ECES 302	Transform Methods and Filtering	4.0
	General education elective (See degree requirements)	3.0
	Free elective	3.0
	Term Credits	*16.0*

Term 7		Credits
ECEL 302	ECE Laboratory II	2.0
ECES 304	Dynamic Systems and Stability	4.0
MATH 291	Complex and Vector Analysis for Engineers	4.0
PHIL 315	Engineering Ethics	3.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	Term Credits	*17.0*

Term 8		Credits
ECEL 303	ECE Laboratory III	2.0
ECES 356	Theory of Control	4.0
ENGR 361	Statistical Analysis of Engineering Systems	3.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 9		Credits
ECEL 304	Electrical Engineering Laboratory IV	2.0
ECEP 352	Electric Motor Control Principles	4.0
	General education elective (See degree requirements)	3.0
	Free elective	3.0
	ECE Core elective (300-level ECE courses from other EE tracks or computer engineering.)	4.0
	Term Credits	*16.0*

Term 10		Credits
ECE 491	Senior Design I	2.0
ECES 444	Systems and Control I	4.0
or		
ECEP 411	Power Systems I	3.0
	General education elective (See degree requirements)	3.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	Free elective	2.0
	Term Credits	*14.0*

Term 11		Credits
ECE 492	Senior Design II	2.0
ECES 445	Systems and Control II	4.0
or		
ECEP 412	Power Systems II	4.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	Free elective	1.5
	General education elective (See degree requirements)	3.0
	Term Credits	*13.5*

Term 12		Credits
ECE 493	Senior Design III	4.0
ECES 446	Systems and Control III	4.0
or		
ECEP 413	Power Systems III	3.0
	ECE Technical elective (300 or 400-level ECE course)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*14.0*
	Total Credits (minimum)	192.0

Minor in Electrical Engineering

The Electrical Engineering minor is designed to provide other engineering majors or students from other disciplines an introduction to the wide-ranging content of the electrical engineering major. The minor consists of a minimum of eight ECE courses resulting in 26 credits. There are five required courses and an additional 12 credits of elective courses.

Prerequisites
The minor assumes that students will have a background in mathematics and physics equivalent to that covered in the first two years of the engineering curriculum. In mathematics, this would cover calculus and differential equations. Knowledge of linear algebra is also recommended. Courses taken to meet these requirements will not count toward the minor.

Required courses		
ECE 200	**Digital Logic Design**	3.0
ECE 201	**Fundamentals of Electrical Circuits**	3.0
ECES 302	**Transform Methods & Filtering**	4.0
ECEL 301 WI	**ECE Laboratory I**	2.0
ECEL 302	**ECE Laboratory II**	2.0

Electives **12.0**

Students should choose 12 credits from 300- and/or 400-level ECE courses. These courses can come from the Computer (ECEC), Electrophysics (ECEE), Electric Power (ECEP), or Systems (ECES) groups. All prerequisites must be satisfied.

The Electrical Engineering Minor for Computer Engineering Students
The University limit on overlap between major and minor programs is 9 credits. Since all of the required courses in the EE minor are also in the CE degree program, computer engineering students will be required to add at least 5 additional EE credits to their minor plan of study in consultation with their academic advisor. Computer Engineering majors may only choose their elective courses from the ECEE, ECEP, and ECES course groups.

Engineering

Drexel's engineering program was developed to provide students with educational and professional challenges not available in the traditional engineering curriculum.

Program Objectives
The key objectives of the Bachelor of Science in Engineering are to provide the student with:

- a strong foundation in basic sciences and mathematics
- a foundation of the fundamentals of engineering as a discipline
- a strong grounding in a second cognate area (either technical, pre-professional, cultural, global, or another area worked out between the student and his/her advisor)
- an integrating experience that ties the technical and the cognate areas together. Examples of such experiences may be, but ar not limited to, research projects, capstone designs, a public service assignment, etc.

For additional information about the Bachelor of Science in Engineering, visit the College of Engineering's web site.

Engineering

Bachelor of Science Degree: 180.5 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies equirements		
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
	General education requirements	24.0
	Free electives	24.0

Math and Science requirements		**36.5 Credits**
BIO 141	**Essential Biology**	4.5
CHEM 101	**General Chemistry I**	3.5
CHEM 102	**General Chemistry II**	4.5
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

Core Curriculum requirements		**22.0 Credits**
CS 121	**Computation Lab I**	1.0
CS 122	**Computation Lab II**	1.0
CS 123	**Computation Lab III**	1.0
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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
ENGR 231	**Linear Engineering Systems**	3.0
ENGR 232	**Dynamic Engineering Systems**	3.0

Engineering requirements		**45.0 Credits**
	As part of the 45.0 credits of Engineering requirements, students must include a capstone experience (Senior design sequence, research project, etc.)	

Technical electives*		18.0 Credits
	Students select 18.0 credits of 200-level (or higher) courses in BMES, MATH, CHEM, PHYS, BIO or College of Engineering courses. Advisor approval is required for technical electives.	3.0

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.

Recommended Plan Of Study

BS Engineering
5 YR UG Co-op Concentration

Term 1		Credits
CHEM 101	General Chemistry I	3.5
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
ENGR 201	Evaluation & Presentation of Experimental Data I	3.0
ENGR 231	Linear Engineering Systems	3.0
PHYS 201	Fundamentals of Physics III	4.0
	Engineering course (see degree requirements)	3.0
	Term Credits	*13.0*

Term 5		Credits
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 232	Dynamic Engineering Systems	3.0
	Free elective	3.0
	Engineering course (see degree requirements)	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 6		Credits
	Free elective	3.0
	General education elective (See degree requirements)	3.0
	Two engineering courses (see degree requirements)	6.0
	Term Credits	*12.0*

Term 7		Credits
	Two engineering courses (see degree requirements)	6.0
	Technical elective	3.0
	Free elective	3.0

	General education elective (See degree requirements)	3.0
	Term Credits	*15.0*

Term 8		Credits
	Free elective	3.0
	General education elective (See degree requirements)	3.0
	Technical elective	3.0
	Two engineering courses (see degree requirements)	6.0
	Term Credits	*15.0*

Term 9		Credits
	General education elective (See degree requirements)	3.0
	Two engineering courses (see degree requirements)	6.0
	Technical elective	3.0
	Free elective	3.0
	Term Credits	*15.0*

Term 10		Credits
	Technical elective	3.0
	Free elective	3.0
	Engineering course (see degree requirements)	3.0
	General education elective (See degree requirements)	3.0
	Senior Design Project I or Capstone course (See degree requirements)	3.0
	Term Credits	*15.0*

Term 11		Credits
	Engineering course (see degree requirements)	3.0
	General education elective (See degree requirements)	3.0
	Free elective	3.0
	Technical elective	3.0
	Senior Design Project II or Capstone course (See degree requirements)	3.0
	Term Credits	*15.0*

Term 12		Credits
	Senior Design Project III or Capstone course (See degree requirements)	3.0
	Technical elective	3.0
	Free elective	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*12.0*
	Total Credits (minimum)	**180.5**

Environmental Engineering

Environmental engineering is concerned with protecting human, animal, and plant populations from the effects of adverse environmental factors, including toxic chemicals and wastes, pathogenic bacteria, and global warming.

Environmental engineers also try to minimize the effect of human activities on the physical and living environment so that we can all live more healthy and sustainable lives.This field builds on other branches of engineering, especially civil, chemical, and mechanical engineering. It also builds on information from many of the sciences, such as chemistry, physics, hydrology, geology, atmospheric science, and several specializations of biology (ecology, microbiology, and biochemistry). Students who elect to study environmental engineering will become familiar with many of these areas because maintaining and improving the environment requires that problems be evaluated and solutions found using a multidisciplinary approach.

Mission
The mission of the undergraduate environmental engineering program at Drexel University is to graduate outstanding engineers who can identify, evaluate and solve complex environmental problems, and who desire to continue their education on a lifelong basis.

Program Objectives
Environmental engineering graduates will become professionals who analyze, design, construct, manage or operate facilities or systems to protect or enhance the environment of people and other living things, or advance knowledge of the field.

For more information about this major, visit the Civil, Architectural and Environmental Engineering Department and the BS in Environmental Engineering page.

Environmental Engineering

Bachelor of Science Degree: 193.5 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies equirements		
ENGL 101	**Expository Writing and Reading**	3.0
ENGL 102	**Persuasive Writing and Reading**	3.0
ENGL 103	**Analytical Writing and Reading**	3.0
ENGR 361	**Statistical Analysis of Engineering Systems**	4.0
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	General education requirements	15.0

Engineering core courses		
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 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 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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
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

Environmental engineering requirements		
CAEE 201	**Introduction to Infrastructure Engineering**	3.0
CAEE 210	**Measurements in Civil, Architectural and Environmental Engineering I**	3.0
CAEE 211	**Measurements in Civil, Architectural and Environmental Engineering II**	3.0

CHE 201	**Process Material Balances**	3.0
CHEM 230	**Quantitative Analysis**	3.0
CHEM 231 WI	**Quantitative Analysis Laboratory**	2.0
CHEM 241	**Organic Chemistry I**	4.0
CHEM 242	**Organic Chemistry II**	4.0
CIVE 240 WI	**Engineering Economic Analysis**	3.0
CIVE 320	**Introduction tof Fluid Flow**	3.0
CIVE 330	**Hydraulics I**	4.0
CIVE 430	**Hydrology**	3.0
CIVE 431	**Ground Water Hydrology**	3.0
ENVE 300	**Introduction to Environmental Engineering**	3.0
ENVE 302	**Environmental Transport and Kinetics**	3.0
ENVE 410	**Solid and Hazardous Waste**	3.0
ENVE 421	**Water and Waste Treatment II**	3.0
ENVE 422	**Water and Waste Treatment Design**	3.0
ENVE 435	**Groundwater Remediation**	3.0
ENVE 460	**Fundamentals of Air Pollution Control**	3.0
or		
ENVE 465	**Indoor Air Quality**	3.0
ENVE 485	**Professional Environmental Engineering Practice**	1.0
ENVE 486	**Environmental Engineering Processing Lab I**	2.0
ENVE 487	**Environmental Engineering Processing Lab II**	2.0
ENVE 491 WI	**Senior Project Design I**	3.0
ENVE 492 WI	**Senior Project Design II**	3.0
ENVE 493 WI	**Senior Project Design III**	3.0
ENVS 284 WI	**Physiological and Population Ecology**	3.0
or		
BIO 221	**Microbiology**	3.0
ENVS 401	**Chemistry of the Environment**	3.0
	Technical electives	12.0

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.

Recommended Plan Of Study

BS Environmental Engineering
5 YR UG Co-op Concentration

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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
ENGL 103	Analytical Writing and Reading	3.0
	Term Credits	*19.0*

Term 4		Credits
CAEE 201	Introduction to Infrastructure Engineering	3.0
ENGR 201	Evaluation & Presentation of Experimental Data 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	*17.0*

Term 5		Credits
CAEE 210	Measurements in Civil, Architectural and Environmental Engineering I	3.0
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
ENVS 284	Physiological and Population Ecology	3.0
or		
BIO 221	Microbiology	3.0
	Term Credits	*15.0*

Term 6		Credits
CHE 201	Process Material Balances	3.0
CHEM 230	Quantitative Analysis	3.0
CHEM 231	Quantitative Analysis Laboratory	2.0
CIVE 320	Introduction to Fluid Flow	3.0

ENGR 361	Statistical Analysis of Engineering Systems	3.0
ENVE 300	Introduction to Environmental Engineering	3.0
	Term Credits	*17.0*

Term 7		Credits
CAEE 211	Measurements in Civil, Architectural and Environmental Engineering II	4.0
CIVE 330	Hydraulics	4.0
ENVE 302	Environmental Transport and Kinetics	3.0
PHIL 315	Engineering Ethics	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*17.0*

Term 8		Credits
CHEM 241	Organic Chemistry I	4.0
CIVE 240	Engineering Economic Analysis	3.0
CIVE 430	Hydrology	3.0
	Technical elective	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*16.0*

Term 9		Credits
CHEM 242	Organic Chemistry II	4.0
	Technical elective	3.0
	Free elective	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*13.0*

Term 10		Credits
ENVE 485	Professional Environmental Engineering Practice	1.0
ENVE 491	Senior Project Design I	3.0
ENVS 401	Chemistry of the Environment	3.0
ENVE 465	Indoor Air Quality	3.0
or		
ENVE 460	Fundamentals of Air Pollution Control	3.0
	General education elective (See degree requirements)	3.0
	Technical elective	3.0
	Term Credits	*16.0*

Term 11		Credits
CIVE 431	Hydrology-Ground Water	3.0
ENVE 410	Solid and Hazardous Waste	3.0
ENVE 421	Water and Waste Treatment II	3.0
ENVE 486	Environmental Engineering Processes Laboratory I	2.0
ENVE 492	Senior Design Project II	3.0
	Technical elective	3.0
	Term Credits	*17.0*

Term 12		Credits
ENVE 422	Water and Waste Treatment Design	3.0
ENVE 435	Groundwater Remediation	3.0
ENVE 487	Environmental Engineering Processes Laboratory II	2.0
ENVE 493	Senior Design Project III	4.0
	Term Credits	*12.0*
	Total Credits (minimum)	**193.5**

Environmental Engineering

Accelerated Program
The Accelerated Program of the College of Engineering provides opportunities for highly-talented and strongly-motivated students to progress toward their educational goals essentially at their own pace. 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.

For more information on this program visit the Department's BS /MS Dual Degree Program page.

Minor in Environmental Engineering

The Environmental Engineering minor focuses on pollution control and is primarily designed to broaden the professional capabilities of engineering students. For example, chemical and mechanical engineers working in process and manufacturing plants will be provided with a better understanding of the natural context of their facilities, better equipped to perform fate and risk analyses, and better able to apply the appropriate technology to control air and water discharges.

While this minor is designed to provide technical knowledge and skills to other engineers, with the appropriate prerequisites students from disciplines other than engineering can also complete this minor.

The minor consists of 24 credits, with five core required courses and nine additional credits taken from a list of options.

Prerequisites
The common engineering core curriculum prerequisites are required of all students in the College of Engineering. Students from other colleges will need the appropriate background in physics, mathematics and thermodynamics.

Required courses			**16.0**
CAEE 210	**Measurements in Civil, Architectural and Environmental Engineering I**	3.0	
ENVE 300	**Introduction to Environmental Engineering**	3.0	
ENVE 302	**Environmental Transport and Kinetics**	3.0	
CIVE 330	**Hydraulics**	4.0	
ENVS 401	**Chemistry of the Environment**	3.0	

			8.0
Students select a minimum of eight additional credits from the following:			
ENVE 410	**Solid and Hazardous Waste**	3.0	
ENVE 460	**Fundamentals of Air Pollution Control**	3.0	
ENVE 486	**Environmental Engineering Processing Lab I**	2.0	
ENVE 487	**Environmental Engineering Processing Lab II**	2.0	
CIVE 430	**Hydrology**	3.0	

Materials Science and Engineering

Materials science and engineering is concerned with the production, properties and utilization of metals, ceramics, polymers, composites, electronic, optical, nano- and bio-compatible materials. Materials engineers play a key role in our increasingly complex technological society by extending the limited supply of materials, improving existing materials, and developing and designing new and superior materials and processes with an awareness of their cost, reliability, safety, and societal/environmental implications.

Students majoring in Materials Science and Engineering (MSE) receive a thorough grounding in the basic sciences and engineering of all materials. All students are required to take course sequences that include materials processing, thermodynamics and kinetics of materials, and their physical and mechanical behavior, plus laboratories designed to familiarize them with the instruments and advanced techniques used to characterize materials and evaluate their performance. A number of custom tracks allow upper level students to concentrate their technical electives in areas of specialization, including nanoscale materials and nanotechnology, biomaterials, electronic and photonic materials, soft materials and polymers, advanced materials design and processing, and a design your own track. In addition, several required senior level courses emphasize the role of materials selection and specification in design.

A required senior design capstone project, a wide variety of technical elective courses, and co-op experiences allow students in-depth exploration of selected areas. A Minor in Materials Science and Engineering is also available.

Mission Statement
The Department of Materials Science and Engineering will provide our BS, MS and PhD graduates with the technical and theoretical knowledge, design capabilities, professionalism, and communications skills necessary for them to excel in leadership positions in academia, industry, and government at the national and international levels.

Vision
Materials science and engineering is a multi-disciplinary field that is at the forefront of all emerging technologies. Advances in the understanding of the process-structure-property-performance relationships of materials is critical for future developments in energy storage and power generation, biomaterials and nanomaterials. The Department of Materials Science and Engineering at Drexel University is recognized as a leader in these areas through teaching and scholarly research.

Program Educational Objectives (PEO)
The educational objectives of the Materials Science and Engineering BS degree program are:

1. Materials Science and Engineering program graduates will possess the core technical competencies in their field necessary to successfully interface with other engineering disciplines in the workplace.
2. At least 30% of Materials Science and Engineering program graduates will progress towards graduate education.

3. Materials Science and Engineering program graduates will become leaders in their chosen fields.
4. Materials Science and Engineering program graduates will have the ability to engage in lifelong learning.
5. Materials Science and Engineering program graduates will have written and verbal communication skills appropriate for professional materials engineers.

Program Outcomes
The department's Program Outcomes reflect the skills and abilities that the curriculum is designed to provide to students by the time they graduate. These are:

a. An ability to apply a knowledge of mathematics, science, and engineering. b. An ability to design and conduct an experimental investigation, as well as analyze and interpret data using statistical, computational and mathematical methods. c. An ability to design and/or select a material, system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. d. Ability to function on multi-disciplinary teams. e. An ability to identify, formulate, and solve materials engineering problems. f. A knowledge and understanding of professional and ethical responsibility. g.1 An ability to communicate effectively – oral. g.2 An ability to communicate effectively – written. h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. i. A recognition of the need for, and an ability to engage in, lifelong learning. j. A knowledge of contemporary issues. k. An ability to use the techniques, skills, and modern engineering tools necessary for materials engineering practice.

Senior Design Projects
Throughout the senior year, students majoring in materials science and engineering work on a capstone senior design project over the course of three terms, with guidance from a faculty advisor and graduate student mentor. Students, working individually or in small groups, synthesize information from their courses to arrive at solutions to real-world engineering problems.
Some recent senior design projects include:

1. Fracture Behavior of Pharmaceutical Excipients
2. Understanding the Swelling of Common Pharmaceutical Excipients and its Effect on Interface Strength Stability of Bilayer Tablets
3. Improvements to the Design and Fabrication of Carbon Nanotube Tipped Pipettes
4. Correlation of Microstructure and Mechanical Properties in Nuclear Reactor Stainless Steels
5. Freeze-Casting of a Multi-Functional Material
6. Design and Synthesis of ITO-Free Flexible Organic Solar Cells.

Materials Science and Engineering

Bachelor of Science Degree: 192.0 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies equirements		
ECON 201	**Principles of Microeconomics**	4.0
ECON 202	**Principles of Macroeconomics**	4.0
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
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	Technical electives/Track courses*	12.0
	General education requirements	9.0
	Free elective	6.0

* A “Track” is a sequence of 4-5 technical electives (12-18 credits) with an underlying connection to a specific area of materials science and engineering. With the rapid expansion of the technical and scientific knowledge in the field of materials science and engineering, organizing technical electives into thematic tracks benefits students. Combined with relevant Co-op experiences and senior design, the tracks can provide strong evidence of specialization, which will benefit students in future job searches.

Technical electives can be taken during the junior and (mostly during) the senior year. For planning reasons, better coordination with senior design, and to accommodate students with an out-of-cycle schedule (e.g. , transfer students), tracks need to be declared by the beginning of the pre-junior year. Students may change their track selection after consulting with their MSE department advisor.

Foundation requirements		
CHE 335	**Statistics and Design of Experiments**	3.0
CHEC 353	**Physical Chemistry and Applications III**	4.0
CHEM 241	**Organic Chemistry I**	4.0
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 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 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 201	**Evaluation/Presentation of Experimental Data I**	3.0
ENGR 202	**Evaluation/Presentation of Experimental Data II**	3.0
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

Professional requirements

MATE 214	**Introduction to Polymers**	4.0
MATE 221	**Introduction to Mechanical Behavior of Materials**	3.0
MATE 240	**Thermodynamics of Materials**	4.0
MATE 245	**Kinetics of Materials**	4.0
MATE 280	**Advanced Materials Laboratory**	4.0
MATE 315	**Processing of Polymers**	4.5
MATE 341	**Defects in Solids**	3.0
MATE 345	**Processing of Ceramics**	4.5
MATE 355	**Structure and Characterization of Crystalline Materials**	3.0
MATE 366 WI	**Processing of Metallic Materials**	4.5
MATE 370	**Mechanical Behavior of Solids**	3.0
MATE 410	**Case Studies in Materials**	3.0
MATE 455	**Biomedical Materials**	3.0
MATE 460	**Engineering Computational Laboratory**	4.0
MATE 491 WI	**Senior Project Design I**	2.0
MATE 492	**Senior Project Design II**	2.0
MATE 493 WI	**Senior Project Design III**	4.0
MATE 495	**Special Topics in Materials: Electronic and Photonic Properties of Materials**	4.0

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/DrexelOne 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.

Recommended Plan Of Study

BS Materials Science and Engineering
5 YR UG Co-op Concentration

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
CHEM 241	Organic Chemistry I	4.0
ENGR 201	Evaluation & Presentation of Experimental Data 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
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MATE 221	Introduction to Mechanical Behavior of Materials	3.0
	Free elective	3.0
	Term Credits	*15.0*

Term 6		Credits
ECON 201	Principles of Microeconomics	4.0
MATE 214	Introduction to Polymers	4.0
MATE 240	Thermodynamics of Materials	4.0
MATE 355	Structure and Characterization of Crystalline Materials	3.0
	Term Credits	*15.0*

Term 7	Credits

ECON 202	Principles of Macroeconomics	4.0
MATE 245	Kinetics of Materials	4.0
MATE 315	Processing Polymers	4.5
MATE 341	Defects in Solids	3.0
	Term Credits	*15.5*

Term 8		Credits
HIST 285	Technology in Historical Perspective	3.0
MATE 280	Advanced Materials Laboratory	4.0
MATE 366	Processing of Metallic Materials	4.5
MATE 370	Mechanical Behavior of Solids	3.0
	Technical elective/Track course	3.0
	Term Credits	*17.5*

Term 9		Credits
CHEC 353	Physical Chemistry and Applications III	4.0
MATE 345	Processing of Ceramics	4.5
MATE 495	Special Topics in Materials:Electronic and Photonic Properties of Materials	4.0
PHIL 315	Engineering Ethics	3.0
	Term Credits	*15.5*

Term 10		Credits
MATE 455	Biomedical Materials	3.0
MATE 460	Engineering Computational Laboratory	4.0
MATE 491	Senior Project Design I	2.0
	General education elective (See degree requirements)	3.0
	Technical elective/Track course	3.0
	Term Credits	*15.0*

Term 11		Credits
CHE 335	Statistics and Design of Experiments	3.0
MATE 492	Senior Project Design II	2.0
	Free elective	3.0
	Technical elective/Track course	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*14.0*

Term 12		Credits
MATE 410	Case Studies in Materials	3.0
MATE 493	Senior Project Design III	4.0
	Technical elective/Track course	3.0
	General education elective (See degree requirements)	3.0
	Term Credits	*13.0*

	Total Credits (minimum)	**192.0**

Materials Science and Engineering

Accelerated Program
The Accelerated Program of the College of Engineering provides opportunities for highly talented and strongly motivated students to progress toward their educational goals essentially at their own pace. These options include opportunities for accelerated studies, dual degrees, as well as a combined bachelor's/master's (BS/MS) program. Primarily through advanced placement, credit by examination, flexibility of scheduling, and independent study, this "fast-track" makes it possible to complete the undergraduate curriculum and initiate graduate studies in less than the five years required by the standard curriculum.

Dual Degree Bachelor's Programs
With careful planning, students can complete two full degrees in the time usually required to complete one. For detailed information, students should contact their advisors.

Bachelor's/Master's Dual Degree Program
Exceptional students can also pursue a master of science (MS) degree in the same period as the bachelor of science (BS). The combined BS/MS degree in Materials Science and Engineering differs from the standard BS degree in that there are two Co-op periods instead of three and in the last two years, specific graduate courses are taken instead of technical electives. For more information about this program, please visit the Department's BS/MS Dual Degree Program page.

Minor in Materials Science and Engineering

24.0 credits

In addition to the core engineering curriculum and the courses required for majors in chemical, civil, electrical, or mechanical engineering, students can obtain a minor in Materials Science and Engineering by taking 24.0 credits from the courses listed below.

Required Courses

MATE 221	**Introduction to Mechanical Behavior of Materials**	3.0

Students select at least 21.0 credits from the following courses

MATE 214	**Introduction to Polymers***	4.0
MATE 240	**Thermodynamics of Materials**	4.0
MATE 245	**Kinetics of Materials**	4.0
MATE 341	**Defects in Solids**	3.0
MATE 355	**Structure and Characterization of Crystalline Materials**	3.0
MATE 370	**Mechanical Behavior of Solids****	3.0
MATE 455	**Biomedical Materials**	3.0
MATE 495	**Special Topics in Materials: Electronic and Photonic Properties of Materials**	4.0
PHYS 451	**Quantum Structure of Materials**	4.0

*MATE 214 requires CHEM 241 as a pre-requisite. If MATE 214 is elected, the credits for CHEM 241 can count toward the 21 credits.
**MATE 370 requires MATH 201 as a pre-requisite. If MATE 370 is elected, the credits for MATH 201 can count toward the 21 credits.

Note: Only one of the prerequisites (either CHEM 241 or MATH 201) can count toward the required 24.0 credits. In other words, both MATE 214 and MATE 370 can be used to fulfill the requirements for the minor, but only the pre-requisite for one of those courses will be calculated into the 24.0 credits. Similarly, MATH 201 or CHEM 241 cannot be counted alone as fulfilling the requirements for this minor. The credits for MATH 201 or CHEM 241 will only count toward the minor when the course(s) is/are taken as a prerequisite for MATE 214 or MATE 370.
Substitution for these courses of equivalent courses offered by other departments and/or institutions may be made with the approval of the Department of Materials Science and Engineering on a case-by-case basis. At least two-thirds of the content of a substitute course must be the same as that of the course in the list above. It is imperative that students check each course carefully with respect to prerequisites since some may be included in the list above and some may be from other departments. Courses taken outside the department as prerequisites do not count towards the 24.0 credits required for the minor. They may, however, be used as technical or free electives in students' home department. Students pursuing the minor in Materials Science and Engineering are also encouraged to select a senior design topic that relates to the field of materials.

Mechanical Engineering and Mechanics

The role of the mechanical engineer in today's society is rapidly changing. Advances in manufacturing, transportation, infrastructure systems, materials, communications, and high-performance computing have introduced new demands, opportunities, and challenges for mechanical engineers. What was once an individual endeavor has now become a team activity. Today's industries require that mechanical engineers possess diverse interdisciplinary skills, a global viewpoint, entrepreneurial and managerial abilities, and an understanding of the forces governing the marketplace.

Traditionally, mechanical engineers have been associated with industries like automotive, transportation, and power generation, and with activities involving the design, analysis, and manufacturing of products useful to society. While today such activities are still dominated by mechanical engineers, the spectrum of opportunities for these professionals has expanded tremendously. For example, mechanical engineers are involved in the design and analysis of biomedical instrumentation, electronic components, smart structures, and advanced materials; they are involved in sophisticated studies of human motion, control of satellites, and the development of more efficient energy-transfer techniques.

Drexel's Department of Mechanical Engineering and Mechanics prides itself on providing its students with a comprehensive program of courses, laboratories, design projects, and co-op experiences. The MEM curriculum is designed to balance technical breadth (provided by a set of fundamental required core courses) with technical depth (provided by optional concentrations that emphasize particular fields within the profession). Thus, the MEM program not only prepares its graduates to become successful mechanical engineers needed in industry and government, but also provides an excellent springboard to pursue graduate studies in medical sciences, law, business, information technology, and any other disciplines where technological and analytical skills play an important role.

A minor in mechanical engineering is available to students majoring in other disciplines. The minor consists of 16 credits in the core curriculum and at least 8 credits of elective courses.

Mission Statement
The mission of the Department of Mechanical Engineering and Mechanics of Drexel University is to transfer and acquire knowledge through: (a) the education of engineers for leadership in industry, business, academia, and government; and (b) the establishment of internationally recognized research programs. This mission is accomplished by the delivery of an outstanding curriculum, by the participation of our students in one of the nation's most prestigious co-operative educational programs, and by the scholarly activities of the faculty.

Program Objectives

- Our graduates will be successful in careers that deal with the design, simulation and analysis of engineering systems, experimentation and testing, manufacturing, technical services, and research.
- Our graduates will enter and complete academic and professional programs in engineering, business, management, law and medicine.

- Our graduates will communicate effectively with peers and be successful working with and leading multi-disciplinary and multi-cultural teams.
- Our graduates will recognize the global, legal, societal, and ethical contexts of their work.
- Our graduates will advance in their careers; for example, assuming increasing levels of responsibility and acquiring professional licensure.

Mechanical Engineering and Mechanics

Bachelor of Science Degree: 195.0 credits
Degree requirements (incoming students, 2010/2011)

General education/liberal studies equirements		
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
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	General education requirements	12.0

Mathematics requirements		Credits
MATH 121	**Calculus I**	4.0
MATH 122	**Calculus II**	4.0
MATH 200	**Multivariate Calculus**	4.0

Physics requirements		
PHYS 101	**Fundamentals of Physics I**	4.0
PHYS 102	**Fundamentals of Physics II**	4.0
PHYS 201	**Fundamentals of Physics III**	4.0

Chemistry/biology requirements		
CHEM 101	**General Chemistry I**	3.5
CHEM 102	**General Chemistry II**	4.5
BIO 141	**Essential Biology**	4.5

Design/laboratory requirements		
CS 121	**Computational Laboratory I**	1.0
CS 122	**Computational Laboratory II**	1.0
CS 123	**Computational Laboratory III**	1.0
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

Engineering requirements		
ENGR 201	**Evaluation and Presentation of Experimental Data I**	3.0

ENGR 202	**Evaluation and Presentation of Experimental Data II**	3.0
ENGR 210	**Introduction to Thermodynamics**	3.0
ENGR 231	**Linear Engineering Systems**	3.0
ENGR 232	**Dynamic Engineering Systems**	3.0

Engineering economics requirements		
CIVE 240 WI	**Project Economics and Decisions**	3.0
Materials requirements		
ENGR 220	**Fundamentals of Materials**	4.0

Mechanical requirements		
MEM 201	**Fundamentals of Computer Aided Design**	3.0
MEM 202	**Engineering Mechanics: Statics**	3.0
MEM 220	**Basic Fluid Mechanics**	4.0
MEM 230	**Mechanics of Materials I**	4.0
MEM 238	**Engineering Mechanics: Dynamics**	4.0
MEM 255	**Introduction to Controls**	4.0
MEM 310	**Thermodynamic Analysis I**	4.0
MEM 311	**Thermal Fluid Science Laboratory**	2.0
MEM 331	**Experimental Mechanics Laboratory**	2.0
MEM 351	**Dynamic Systems Laboratory**	2.0
MEM 345	**Heat Transfer**	4.0
MEM 355	**Performance Enhancement of Dynamic Systems**	4.0
MEM 361	**Engineering Reliability**	3.0
MEM 435	**Introduction to CAD/CAM**	4.0
MEM 491	**Senior Design I**	3.0
MEM 492	**Senior Design II**	3.0
MEM 493	**Senior Design III**	3.0

Elective courses		**Credits**
	MEM advanced fundamental courses*	12.0
	MEM electives**	6.0-8.0
	COE electives***	6.0-8.0
	Math/science electives******	6.0-8.0
	Free electives	6.0-8.0

* All MEM students must complete a minimum of four of the advanced MEM fundamentals courses

** Any two MEM courses 300 level or higher.

***Any two College of Engineering (including MEM) courses 300 level or higher.

***300+ level courses from MATH, PHYS, BIO, CHEM, CHEC, and ENVS.

Advanced MEM Fundamental Courses		**Credits**
MEM 320	**Fluid Dynamics I**	3.0
MEM 330	**Mechanics of Materials II**	4.0
MEM 410	**Thermodynamics Analysis II**	3.0
MEM 417	**Introduction to Microfabrication**	3.0
MEM 423	**Mechanics of Vibration**	4.0
MEM 431	**Machine Design I**	3.0

MEM 437	**Manufacturing Processes**	3.0
MEM 440	**Thermal Systems Design**	3.0
MEM 458	**Microcomputer-Based Control Systems I**	3.0
MEM 459	**Microcomputer-Based Control Systems II**	3.0

Mechanical Engineering

Recommended Plan of Study:

BS in Mechanical Engineering

Areas of Concentration
Because of the diversity of mechanical engineering, students are offered the option to concentrate in one of the following areas:

Aerospace
Biomechanical Engineering
Design and Manufacturing
Mechanics and Structures
Systems and Control
Thermal and Fluid Sciences

This option is typically available starting Term 8 (Fall or Spring term in the Junior year). Although not required, students who have opted to take such concentrations will find it extremely beneficial to pursue their Senior Design projects within the corresponding concentration.

The department suggests that students take at least six courses within their concentration.

Students should consult the undergraduate advisor and the coordinating faculty of the respective concentration area to select their electives and to complete the Plan of Study based on the courses listed in the concentration pages.

For more detailed information regarding these areas of concentration, visit the Areas of Concentration page at the Department of Mechanical Engineering and Mechanics site.

Recommended Plan Of Study

BS Mechanical Engineering and Mechanics
5 YR UG Co-op Concentration

Term 1		Credits
CHEM 101	General Chemistry I	3.5
COOP 101	Career Management/Professional Development	0.0
CS 121	Computation Lab I	1.0
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
CHEM 102	General Chemistry II	4.5
CS 122	Computation Lab II	1.0
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 141	Essential Biology	4.5
CS 123	Computation Lab III	1.0
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	*19.0*

Term 4		Credits
ENGR 201	Evaluation & Presentation of Experimental Data I	3.0
ENGR 220	Fundamentals of Materials	4.0
ENGR 231	Linear Engineering Systems	3.0
MEM 202	Engineering Mechanics: Statics	3.0
PHYS 201	Fundamentals of Physics III	4.0
	Term Credits	*17.0*

Term 5		Credits
ENGR 202	Evaluation & Presentation of Experimental Data II	3.0
ENGR 210	Introduction to Thermodynamics	3.0
ENGR 232	Dynamic Engineering Systems	3.0
MEM 201	Fundamentals of Computer-Aided Design	3.0
MEM 238	Engineering Mechanics: Dynamic	4.0
	Term Credits	*16.0*

Term 6		Credits
CIVE 240	Engineering Economics Analysis	3.0
HIST 285	Technology in Historical Perspective	3.0
MEM 230	Mechanics of Materials I	4.0
MEM 310	Thermal Analysis	4.0
	Term Credits	*14.0*

Term 7		Credits

MEM 380	Special Topics in Mechanical Engineering	3.0
MEM 220	Basic Fluid Mechanics	4.0
MEM 255	Introduction to Controls	4.0
MEM 331	Experimental Mechanics Laboratory	2.0
PHIL 315	Engineering Ethics	3.0
	Term Credits	*16.0*

Term 8		Credits
MEM 311	Thermal Fluid Science Laborato	2.0
MEM 355	Performance Enhancement of Dynamic Systems	4.0
MEM 435	Introduction to CAD/CAM	4.0
MEM 345	Heat Transfer	4.0
	Advanced MEM Fundamentals course (see degree requirements list)	3.0-4.0
	Term Credits	*17.0-18.0*

Term 9		Credits
MEM 351	Dynamic Systems Laboratory	2.0
MEM 361	Engineering Reliability	3.0
	General education elective (See degree requirements)	3.0-4.0
	Two MEM or MEM/COE or MEM/SCI/BUS electives (see degree requirements)	6.0-8.0
	Advanced MEM Fundamentals course (see degree requirements list)	3.0-4.0
	Term Credits	*17.0-21.0*

Term 10		Credits
MEM 491	Senior Design I	3.0
	Advanced MEM Fundamentals course (see degree requirements list)	3.0-4.0
	Two MEM or MEM/COE or MEM/SCI/BUS electives (see degree requirements)	6.0-8.0
	General education elective (See degree requirements)	3.0-4.0
	Term Credits	*15.0-19.0*

Term 11		Credits
MEM 492	Senior Design II	3.0
	General education elective (See degree requirements)	3.0-4.0
	Advanced MEM Fundamentals course (see degree requirements list)	3.0-4.0
	Two MEM or MEM/COE or MEM/SCI/BUS electives (see degree requirements)	6.0-8.0
	Term Credits	*15.0-19.0*

Term 12		Credits
MEM 493	Senior Project Design III	3.0
	MEM elective or MEM/COE elective or MEM/SCI/BUS elective (see degree requirements)	3.0-4.0
	Free electives	6.0-8.0
	Term Credits	*12.0-15.0*
	Total Credits (minimum)	192.5-208.5

Aerospace

The concentration in Aerospace provides students with the opportunity of learning and integrating multiple engineering disciplines. Emphasis is placed on structural, aerodynamic, guidance and control and propulsion problems related to air and space vehicles. Career opportunities can be found in the fields of design of air vehicles, auto-pilot design, design of structural components and propulsion systems.

Recommended courses		Credits
MEM 320	**Fluid Dynamics I**	3.0
MEM 330	**Mechanics of Materials II**	4.0
MEM 403	**Gas Turbines/Jet Propulsion**	3.0
MEM 420	**Aerodynamics**	3.0
MEM 423	**Mechanics of Vibrations**	4.0
MEM 425	**Aircraft Design/Performance**	3.0
MEM 427	**Finite Element Methods**	3.0
MEM 453	**Aircraft Flight Dynamics & Control I**	3.0

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Biomechanical Engineering

Biomechanical engineering is a large and expanding area related to the application of mechanical engineering principles in the medical field. It includes diverse areas such as orthopedics, cardiovascular engineering, medical robotics, rehabilitation, sports, forensic engineering, injury protection and tissue engineering. Career opportunities may be found in the medical, rehabilitation and sports industries; in medical research at hospital laboratories and institutes of higher education and in working as consultants and expert advisors to the industrial, legal and medical communities.

Recommended courses		Credits
ANAT 101	**Anatomy and Physiology I**	5.0
ANAT 102	**Anatomy and Physiology II**	5.0
BMES 680	**Special Topics: CAD/CAM in Biomedical and Tissue Engineering**	2.0
MATE 661	**Biomedical Materials I**	3.0
MATE 662	**Biomedical Materials II**	3.0
MEM 444	**Biofluid Mechanics**	3.0
MEM 478	**Computer-Aided Tissue Engineering**	4.0
MEM 684	**Mechanics of Biological Tissues**	3.0
MEM 685	**Mechanics of Human Joints**	4.0
MEM 686	**Mechanics of Human Motion**	3.0

For more detailed information regarding the requirements for the Biomechanical Engineering area of concentration, visit the Biomechanical Engineering Concentration at the Department of Mechanical Engineering and Mechanics site.

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Design and Manufacturing

The concentration in Design and Manufacturing provides students with the basic concepts related to manufacturing processes, product design, management of computer-integrated systems and the application of modern numerical tools for the design and analysis of complex devices. Industries ranging from automotive to electronics provide excellent career opportunities to students following this concentration.

Recommended courses		Credits
MEM 417	**Introduction to Microfabrication I**	3.0
MEM 419	**Microfluidics and Lab-on-a-Chip**	3.0
MEM 427	**Introduction to Finite Element Methods**	3.0
MEM 431	**Machine Design**	3.0
MEM 437	**Manufacturing Process I**	3.0
MEM 438	**Manufacturing Process II**	3.0
MEM 455	**Introduction to Robotics**	3.0
MEM 456	**Robotics II**	3.0
MEM 458	**Microcomputer-Based Control Systems I**	3.0
MEM 459	**Microcomputer-Based Control Systems II**	3.0

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Mechanics and Structures

Students following this concentration are exposed to the foundations of the static and dynamic analysis of structures and machines from a theoretical and computational point of view. Emphasis is placed on the mechanical behavior of structures and machine parts, failure mechanisms, advanced materials, and use of finite elements for stress analysis of complex structures. Career opportunities are found virtually in any technological field where issues such as reliability and failure of materials and structures are of utmost importance, including buildings, aircraft, machine components, electronic parts, and biomechanical systems.

Recommended courses		Credits
CIVE 301	**Structural Analysis II**	3.0
MEM 330	**Mechanics of Materials II**	4.0
MEM 423	**Mechanics of Vibrations**	4.0
MEM 430	**Advanced Stress Analysis**	4.0
MEM 431	**Machine Design I**	3.0
MEM 427	**Introduction to Finite Element Methods**	3.0

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Systems and Control

This concentration is designed for students with an interest in the analysis, control, and design of dynamic systems. Topics in this track include various aspects of robotic motion and robotic-based automated manufacturing and hands-on experience in real-time control and manipulation of hardware dynamic systems. Career opportunities include those of aircraft guidance and control systems in automotive, chemical, and power plants.

Recommended courses		Credits
MEM 425	**Aircraft Design/Performance**	4.0
MEM 453	**Aircraft Flight Dynamics & Control I**	3.0
MEM 454	**Aircraft Flight Dynamics & Control II**	3.0
MEM 455	**Introduction to Robotics**	3.0
MEM 456	**Robotics II**	3.0
MEM 458	**Microcomputer-based Control Systems I**	3.0
MEM 459	**Microcomputer-based Control Systems II**	4.0

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Thermal and Fluid Sciences

This concentration provides students with a background in fluid motion, heat transfer, combustion, HVAC (heating, ventilation, and air conditioning), and applied thermo dynamics. These courses prepare students for careers in a multitude of large and small companies where the transfer of liquids, gases, and/or energy from one location to another is required. Potential employers include companies in the aerospace, automotive, chemical processing, power generation, and HVAC industries.

For more detailed information regarding recommended courses for this concentration, visit the Thermal and Fluid Sciences Concentration at the Department of Mechanical Engineering and Mechanics site.

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Mechanical Engineering and Mechanics

Accelerated Program
The Accelerated Program of the College of Engineering provides opportunities for highly talented and strongly motivated students to progress toward their educational goals essentially at their own pace. These options include opportunities for accelerated studies, dual degrees, a combined bachelor's/master's program as well as participation in the University Honors Program.
Primarily through advanced placement, credit by examination, flexibility of scheduling, and independent study, the "fast track" makes it possible to complete the undergraduate curriculum and initiate graduate study in less than the five years required by the standard curriculum.

Dual Degree Bachelor's Programs
With careful planning, you can complete two full degrees in the time usually required to complete one. The double major option works best in closely related areas. For detailed information please contact your advisor.

Bachelor's/Master's Dual Degree Program
Exceptional students can also pursue a master of science degree in the same period as the bachelor of science. For MEM undergraduate students, the following are the possible graduate programs for the Master's degree in the BS/MS dual degree program:

- Electrical and Computer Engineering
- Engineering Management
- Material Engineering
- Mechanical Engineering and Mechanics
- Biomedical Engineering

For more information about this program, visit the Department's BS /MS Dual Degree Program page.

Minor in Mechanical Engineering

Any undergraduate student in good standing who has completed more than 30 credits at Drexel may apply for the minor in mechanical engineering.

The minor must contain a minimum of 24 credits according to the following distribution: (a) 16 credits from any four of the 4-credit required course options; (b) at least eight credits from additional required courses or from the laboratory components and recommended electives.

Required course options: (Students must select at least 4 courses)		
MEM 220	**Basic Fluid Mechanics**	4.0
MEM 230	**Mechanics of Materials I**	4.0
MEM 238	**Engineering Mechanics: Dynamics**	4.0
MEM 255	**Introduction to Controls**	4.0
MEM 310	**Thermodynamic Analysis I**	4.0
MEM 345	**Heat Transfer**	4.0
MEM 355	**Performance Enhancement of Dynamic Systems**	4.0
MEM 361	**Engineering Reliability**	3.0
MEM 435	**Introduction to CAD/CAM**	4.0

Laboratories		
MEM 311	**Thermal Fluid Science Laboratory**	2.0
MEM 331	**Experimental Mechanics Laoratory**	2.0
MEM 351	**Dynamic Systems Laboratory**	2.0

Recommended electives		
MEM 320	**Fluid Dynamics I**	3.0
MEM 330	**Mechanics of Materials II**	4.0
MEM 410	**Thermodynamics Analysis II**	3.0
MEM 420	**Aerodynamics**	3.0
MEM 423	**Mechanics of Vibration**	4.0
MEM 425	**Aircraft Design/Performance**	3.0
MEM 430	**Advanced Stress Analysis**	4.0
MEM 437	**Manufacturing Process I**	3.0
MEM 438	**Manufacturing Process II**	3.0
MEM 440	**Thermal Systems Design**	3.0
MEM 453	**Aircraft Flight Dynamics and Control I**	3.0
MEM 455	**Introduction to Robotics**	3.0
MEM 458	**Microcomputer-Based Control Systems I**	3.0
MEM 459	**Microcomputer-Based Control Systems II**	3.0
MEM 462 WI	**Introduction to Engineering Management**	3.0

Software Engineering

Advances in information technology have captured the public imagination and had tremendous economic and social impact over the last 50 years. These advances offer great benefit, but have also created a great need for highly dependable systems developed at predictable cost. Unfortunately, it has become increasingly clear that our ability to produce the software for these systems in a way that meets cost and quality requirements is quite limited.
For example:

- Studies conclude that cost and schedule overruns on commercial software projects commonly average at least 100%. Some studies report averages as high as 300 - 400%.
- Studies of large projects indicate that about 25% of them are abandoned and never completed.
- There is a growing list of incidents in which software failures have caused injury and death.

Software engineering is an attempt to solve this problem. The notion can be traced to a conference sponsored by NATO in 1967. The conference was organized to discuss the problems in creating software systems reliably. In the years since, there has been some progress, but the problems that motivated the original conference are still very much in evidence. There is good reason to believe that the creation of software will never be easy. But there is tremendous incentive to make the process as efficient and reliable as possible.

In summary, software engineering can be defined as the application of processes, methods, and tools to the problem of building and maintaining computer software with a defined level of quality, at a predictable cost, on a predictable schedule.

Software Engineering

Bachelor of Science in Software Engineering (BSSE): 188.0 credits
Required courses (incoming students, 2010/2011)

University and college requirements		2.0 Credits
COOP 101	**Career Management/Professional Development**	0.0
UNIV 101	**The Drexel Experience**	2.0
or		
INFO 120	**Seminar for Transfer Students**	2.0

Software engineering requirements		36.0 Credits
SE 101	**Foundations of Software Engineering I**	3.0
SE 102	**Foundations of Software Engineering II**	3.0
SE 103	**Foundations of Software Engineering III**	3.0
SE 210	**Software Specification and Design I**	3.0
SE 211	**Software Specification and Design II**	3.0
SE 310	**Software Architecture I**	3.0
SE 311	**Software Architecture II**	3.0
SE 320	**Software Verification and Validation**	3.0
SE 410	**Software Evolution**	3.0
SE 491	**Design Project I**	3.0
SE 492	**Design Project II**	3.0
SE 493	**Design Project III**	3.0

Computer science requirements		13.0 Credits
CS 260	**Data Structures**	3.0
CS 265	**Advanced Programming Techniques**	3.0
CS 281	**Systems Architecture I**	4.0
CS 283	**Systems Programming**	3.0

Networking elective		3.0 - 4.0 Credits
CS 472	**Computer Networks**	3.0
or		
INFO 330	**Computer Networking Technology I**	4.0

Information systems requirements		9.0 Credits
INFO 210	**Database Management Systems**	3.0

INFO 310	**Human Computer Interaction II**	3.0
INFO 420 WI	**Software Project Management**	3.0

Computing electives		**18.0 Credits**
	Any non-required INFO, CS or SE course at the 300+ level	18.0

Mathematics/statistics requirements		**26.0 Credits**
CS 270	**Mathematical Foundations of Computer Science**	3.0
MATH 121	**Calculus I**	4.0
MATH 122	**Calculus II**	4.0
MATH 123	**Calculus III**	4.0
MATH 221	**Discrete Mathematics**	3.0
STAT 201	**Statistics I**	4.0
STAT 202	**Statistics II**	4.0

Science sequence requirements		**21.0 Credits**
Students select one science sequence from the following:		
CHEM 101	**General Chemistry I**	3.5
CHEM 102	**General Chemistry II**	4.5
CHEM 103	**General Chemistry III**	5.0
or		
PHYS 101	**Fundamentals of Physics I**	4.0
PHYS 102	**Fundamentals of Physics II**	4.0
PHYS 201	**Fundamentals of Physics III**	4.0
or		
BIO 122	**Cells and Genetics**	4.5
BIO 124	**Evolution and Organismal Diversity**	4.5
BIO 126	**Physiology and Ecology**	4.5

Science Electives		
	Students select 8.0 - 9.0 additional credits from any natural science courses	7.5 - 9.0

Liberal Studies requirements		**33.0 Credits**
ENGL 101	**Expository Writing and Reading**	3.0
ENGL 102	**Persuasive Writing and Reading**	3.0
ENGL 103	**Analytical Writing and Reading**	3.0
PHIL 105	**Critical Reasoning**	3.0
PHIL 311	**Computer Ethics**	3.0
COM 230	**Techniques of Speaking**	3.0
COM 310 WI	**Technical Communication**	3.0
PSY 101	**General Psychology**	3.0
PSY 330	**Cognitive Psychology**	3.0
	Liberal studies electives*	6.0
* Any non-required course in ENGL, PHIL, COM, PSY, SOC, ANTH, WMST, AFAM, PSCI.		

Students select two of the following business courses:	**8.0 Credits**

ACCT 115	**Financial Accounting Foundations**	4.0
ECON 201	**Principles of Microeconomics**	4.0
ECON 202	**Principles of Macroeconomics**	4.0

Free electives		**18.0 - 19.0 Credits**
	Free electives	16.0-19.0

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.

Recommended Plan Of Study

BS Software Engineering
5 YR UG Co-op Concentration

Term 1		Credits
COOP 101	Career Management/Professional Development	0.0
ENGL 101	Expository Writing and Reading	3.0
MATH 121	Calculus I	4.0
SE 101	Foundations of Software Engineering I	3.0
UNIV 101	The Drexel Experience	1.0
	First course in a 3-part laboratory science sequence	4.0-4.5
	Term Credits	*15.0-15.5*

Term 2		Credits
ENGL 102	Persuasive Writing and Reading	3.0
MATH 122	Calculus II	4.0
SE 102	Foundations of Software Engineering II	3.0
UNIV 101	The Drexel Experience	0.5
	Second course in a 3-part laboratory science sequence	4.0-4.5
	Term Credits	*14.5-15.0*

Term 3		Credits
ENGL 103	Analytical Writing and Reading	3.0
MATH 123	Calculus III	4.0
SE 103	Foundations of Software Engineering III	3.0
UNIV 101	The Drexel Experience	0.5
	Third course in a 3-part laboratory science sequence	4.0-4.5
	Liberal studies elective	3.0
	Term Credits	*17.5-18.0*

Term 4		Credits
COM 230	Techniques of Speaking	3.0
SE 210	Software Specification and Design I	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
CS 270	Mathematical Foundations of Computer Science	3.0
	Natural science elective	3.0
	Term Credits	*15.0*

Term 5		Credits
CS 260	Data Structures	3.0
INFO 210	Database Management Systems	3.0
MATH 221	Discrete Mathematics	3.0
SE 211	Software Specification and Design II	3.0
	Natural science elective	3.0
	Term Credits	*15.0*

Term 6		Credits
COM 310	Technical Communication	3.0
CS 281	Systems Architecture I	4.0
PSY 101	General Psychology I	3.0
SE 310	Software Architecture I	3.0
STAT 201	Business Statistics I	4.0
	Term Credits	*17.0*

Term 7		Credits
SE 311	Software Architecture II	3.0
STAT 202	Business Statistics II	4.0
	Computing elective (300-level or higher INFO, SE, CS)	3.0
	Natural science elective	3.0

	Free elective	3.0
	Term Credits	*16.0*

Term 8		Credits
CS 283	Systems Programming	3.0
INFO 420	Software Project Management	3.0
PHIL 105	Critical Reasoning	3.0
SE 320	Software Verification and Validation	3.0
	Free elective	3.0
	Term Credits	*15.0*

Term 9		Credits
INFO 310	Human-Computer Interaction II	3.0
PHIL 311	Computer Ethics	3.0
SE 410	Software Evolution	3.0
	Free elective	3.0
	Computing electives (300-level or higher INFO, SE, CS)	3.0
	Term Credits	*15.0*

Term 10		Credits
SE 491	Design Project I	3.0
INFO 330	Computer Networking Technologies I	4.0
or		
CS 472	Computer Networks	3.0
ECON 201	Principles of Microeconomics	4.0
or		
ECON 202	Principles of Macroeconomics	4.0
or		
ACCT 115	Financial Accounting Foundations	4.0
	Computing elective (300-level or higher INFO, SE, CS)	3.0
	Free elective	3.0
	Term Credits	*17.0*

Term 11		Credits
PSY 330	Cognitive Psychology	3.0
SE 492	Design Project II	3.0
ACCT 115	Financial Accounting Foundations	4.0
or		
ECON 202	Principles of Macroeconomics	4.0
or		
ECON 201	Principles of Microeconomics	4.0
	Computing electives (300-level or higher INFO, SE, CS)	6.0
	Term Credits	*16.0*

Term 12		Credits
SE 493	Design Project III	3.0
	Liberal studies elective	3.0
	Computing elective (300-level or higher INFO, SE, CS)	3.0
	Free electives	6.0
	Term Credits	*15.0*
	Total Credits (minimum)	188.0-189.5

Minor in Software Engineering

The software engineering minor is available to all University students in good standing, with the exception of software engineering majors. A total of 24 credits is needed to complete the academic minor in software engineering.

Prerequisites

Computer programming competence may be established by completing one of the following course sequences:

- CS 171-2 (Computer Programming I-II)
- CS 131-2-3 (Computer Programming A-B-C)
- SE 101-2-3 (Fundamentals of Software Engineering I-II-III)
- CS/ECE203-ECEC480 (Programming for Engineers, Advanced Programming for Engineers)
- INFO 151-2-3-4 (IS Software I-II-III-IV)

Additional computer programming competence may be established by completing both CS 265 (Advanced Programming Techniques) and CS 260 (Data Structures).

Minor Requirements

SE 210	**Software Specification and Design I**	3.0
SE 211	**Software Specification and Design II**	3.0
SE 310	**Software Architecture I**	3.0
SE 311	**Software Architecture II**	3.0
SE 320	**Sofware Verification and Validation**	3.0
SE 410	**Software Evolution**	3.0
	Two Computing/Software Engineering electives	6.0

Minor in Global Engineering

24.0 credits

The Minor in Global Engineering is designed to train engineering students to become global citizens, skilled in meeting the challenges of a global work environment. Coursework in this minor aims at developing students' international historical, political, and cultural awareness as well as their knowledge of international business in order to succeed in the global economy. In addition to the required coursework, students must successfully complete an experience abroad prior to graduation. Experiences other than approved Study Abroad or Co-Op Abroad programs must receive prior approval from the College of Engineering's Associate Dean of Outreach and International Relations, or the College of Engineering Associate Dean for Undergraduate Affairs.

Restrictions

Currently, only students enrolled in either the the College of Engineering or the School of Biomedical Engineering, Science and Health Systems can enroll in this minor.

Foreign language

Foreign language is not required for the Minor in Global Engineering, but it may be required as a prerequisite to a student' experience abroad. In addition, a student can choose to apply as many as eight (8) credits of 200-level or higher foreign language toward the credit requirements for the minor.

Required courses		Credits
ENGR 280	**Introduction to Global Engineering**	2.0

Students select a minimum of one course from each of the three categories:

International Business		
INTB 200	**International Business (recommended)**	4.0
BLAW 340	**International Business Law**	4.0
ECON 342	**Economic Development***	4.0
INTB 332 WI	**Multinational Corporations***	4.0
INTB 334	**International Trade***	4.0
INTB 336	**International Money and Finance***	4.0

*Require ECON 201 and ECON 202 as pre-requisites.

Political Science/History		
PSCI 140	**Introduction to Comparative Political Analysis**	4.0
PSCI 150	**International Politics**	4.0
PSCI 351	**International Political Economics**	4.0
PSCI 352	**Ethics and International Relations**	3.0
PSCI 353	**International Human Rights**	3.0
PSCI 354	**US and the Third World**	3.0
PSCI 357	**The European Union**	3.0
HIST 220	**History of American Business**	3.0

HIST 259	**History of Europe, 20th Century**	3.0

Culture and Communications

IAS 359	**Culture and Values (recommended)**	3.0
COM 360	**International Communication**	3.0
PHIL 335	**Global Ethical Issues***	3.0
SOC 330	**Developing Nations and the International Division of Labor**	3.0
WMST 240	**Women and Society in a Global Context**	3.0

*Requires PHIL 105 as a prerequisite.

Note: Students may petition the College of Engineering Associate Dean of Outreach and International Relations or the College of Engineering Associate Dean for Undergraduate Affairs for permission to apply other courses they believe relevant to the Minor in Global Engineering toward their credit requirements. Such requests will be handled on a case-by-case basis.