Drexel University

Catalog 2005 / 2006

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The College of Engineering Undergraduate Programs

The College of Engineering

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.

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 the Accreditation Board for Engineering and Technology (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—the Drexel Engineering Curriculum (tDEC). During the two terms of the sophomore year, students continue in tDEC and 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 the sequences TDEC 110/112/114 and TDEC 111/113/115 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. The tDEC prepares students for professional practice and further education in their selected engineering disciplines. By emphasizing innovative and integrated teaching, the tDEC also trains the next generation of engineering educators.

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

Humanities and other courses		Credits
HUM 106	**Humanities and Communications I**	3.0
HUM 107	**Humanities and Communications II**	3.0
HUM 108	**Humanities and Communications III**	3.0
UNIV 101	**The Drexel Experience (two semesters)**	4.0

Foundation requirements		
TDEC 110	**Mathematical Foundations of Engineering I**	3.0
TDEC 111	**Physical Foundations of Engineering I**	3.0
TDEC 112	**Mathematical Foundations of Engineering II**	3.0
TDEC 113	**Physical Foundations of Engineering II**	3.0
TDEC 114	**Mathematical Foundations of Engineering III**	3.0
TDEC 115	**Physical Foundations of Engineering III**	3.0
TDEC 120	**Chemical and Biological Foundations of Engineering I**	3.0
TDEC 121	**Chemical and Biological Foundations of Engineering II**	3.0
TDEC 122	**Chemical and Biological Foundations of Engineering III**	3.0
TDEC 130	**Engineering Design and Laboratory I**	3.0
TDEC 131	**Engineering Design and Laboratory II**	3.0
TDEC 132	**Engineering Design and Laboratory III**	3.0
TDEC 150	**Freshman Engineering Design I**	1.0
TDEC 151	**Freshman Engineering Design II**	1.0
TDEC 152	**Freshman Engineering Design III**	1.0
TDEC 201	**Energy I**	3.0
TDEC 202	**Energy II**	3.0
TDEC 211	**Materials I**	3.0
TDEC 221	**Systems I**	3.0

TDEC 222	**Systems II**	3.0
TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0
TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0

Liberal Studies Program

The Liberal Studies Program is designed to give engineering students a foundation in the following areas: English, history of the engineering profession and its impact on modern society, ethical standards required for the practice of the profession, and an in-depth study in a specific discipline in liberal studies.

All engineering majors must take 10 courses. Five of the 10 courses are designated as follows and must be completed by all majors:

Designated liberal studies course requirements	
HIST 285	**Technology in Historical Perspective**
HUM 106	**Humanities and Communications I**
HUM 107	**Humanities and Communications II**
HUM 108	**Humanities and Communications III**
PHIL 315	**Engineering Ethics**

The five remaining liberal studies course requirements are undesignated and can be chosen from the disciplines listed below. Any course selected from the categories below meets this requirement, except language courses below 200 level and survey, performance, studio, or skills courses. Two of the five courses must comprise a sequence and therefore must be in the same discipline, but not necessarily sequentially numbered.

- Anthropology
- Architectural/Social History
- Art History
- Communications
- Dance
- Dramatic Writing
- Film and Video
- History
- Language (200 level and above)
- Literature
- Music
- Philosophy
- Political Science
- Psychology
- Sociology
- Theater

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, and fulfills the two-course sequence requirement.

Some engineering majors require a study in basic economic principles. Check curriculum guidelines for requirements. Any required economics courses will replace liberal studies requirements on a course-for-course basis. The acceptable

economics courses for engineering majors are ECON 211/212 (Principles of Economics I and II) and ECON 201/202 (Economics I and II).

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.

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

Appropriate Technology

As developed nations increase their aid to less developed countries, there is a growing recognition that high-tech solutions to problems of underdeveloped nations are not always satisfactory. Instead, a more appropriate, or less sophisticated, technological level is often the best solution for many problems of these developing nations.

To successfully transfer technological knowledge of this type to the Third World, a profound understanding of the mores, beliefs, and needs of the people of these nations is vital. However, it is equally important that the person involved in this transfer be highly educated in technical matters so that appropriate creative designs can be turned into practical devices.

Drexel's appropriate technology major offers a unique opportunity to combine an engineering degree with practical experience in helping improve the living conditions of people in rural areas of Africa, Asia, and Latin America, as well as in poorer regions of the United States.

Appropriate Technology

Bachelor of Science Degree: 192.0 credits

Freshman year

Students participate in the common freshman year for all engineering students:

First Term		**Credits**
HUM 106	**Humanities and Communications I**	3.0
TDEC 110	**Mathematical Foundations of Engineering I**	3.0
TDEC 111	**Physical Foundations of Engineering I**	3.0
TDEC 120	**Chemical and Biological Foundations of Engineering I**	3.0
TDEC 130	**Engineering Design and Laboratory I**	4.0
UNIV 101	**The Drexel Experience**	1.0
	Total credits	17.0

Second Term		
HUM 107	**Humanities and Communications II**	3.0
TDEC 112	**Mathematical Foundations of Engineering II**	3.0
TDEC 113	**Physical Foundations of Engineering II**	3.0
TDEC 121	**Chemical and Biological Foundations of Engineering II**	3.0
TDEC 131	**Engineering Design and Laboratory II**	4.0
UNIV 101	**The Drexel Experience**	1.0
	Total credits	17.0

Third Term		
HUM 108	**Humanities and Communications III**	3.0
TDEC 114	**Mathematical Foundations of Engineering III**	3.0
TDEC 115	**Physical Foundations of Engineering III**	3.0
TDEC 122	**Chemical and Biological Foundations of Engineering III**	3.0
TDEC 132	**Engineering Design and Laboratory III**	4.0
	Total credits	16.0

Sophomore year

Fourth Term

CIVE 251	**Engineering Surveying**	3.0

TDEC 201	**Energy I**	3.0
TDEC 211	**Materials I**	3.0
TDEC 221	**Systems I**	3.0
TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0
	Total credits	16.0

Fifth Term

CIVE 252	**Introduction to Transportation Infrastructure**	3.0
TDEC 202	**Energy II**	3.0
TDEC 212	**Materials II**	3.0
TDEC 222	**Systems II**	3.0
TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0
	Total credits	16.0

Pre-Junior Year

Sixth Term

CHE 311	**Transport Phenomena**	3.0
EGEO 220	**Engineering Geology**	4.0
ENGR 103	**Appropriate Technology and Engineering Design**	3.0
HIST 162	**Themes in World Civilization II**	3.0
MEM 202	**Statics**	3.0
	Total credits	16.0

Seventh Term

ANTH 210	**Worldview: Science, Religion, Magic**	3.0
CIVE 250	**Construction Materials**	4.0
CIVE 330	**Hydraulics I**	3.0
HIST 163	**Themes in World Civilization III**	3.0
MEM 230	**Mechanics of Materials I**	4.0
	Total credits	17.0

Junior Year

Eight Term

ANTH 489	**Approaches to Intercultural Behavior**	3.0
CIVE 310	**Soil Mechanics I**	4.0
CIVE 341	**Municipal Water Facilities**	3.0
CIVE 370	**Introduction to Structural Analysis**	3.0
PSCI 340	**Politics of Developing Nations**	3.0
	Total credits	16.0

Ninth Term

CIVE 360	**Water Quality Infrastructure**	3.0
CIVE 430	**Hydrology**	3.0
CIVE 371	**Introduction to Structural Design**	3.0
ECON 212	**Principles of Economics II (Macro)**	3.0
	Appropriate Technology Course	3.0
	Total credits	15.0

Senior Year

Tenth Term

CAE 491	**Senior Project Design I**	3.0
CIVE 477 WI	**Seminar I**	2.0
	Appropriate Technology Course	3.0
	Professional Electives	6.0
	Free Elective	3.0
	Total credits	17.0

Eleventh Term

CAE 492	**Senior Project Design II**	3.0
CIVE 478	**Seminar II**	1.0
ECON 342	**Economic Development**	4.0
	Professional electives	6.0
	Total credits	14.0

Twelfth Term

CAE 493	**Senior Project Design III**	3.0
	Seminar III*	1.0
	Professional electives	6.0
	Free electives	5.0
	Total credits	15.0

*See the Civil Engineering Department for course number.

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.

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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

- Provide students with a solid scientific and mathematical foundation, knowledge of engineering principles and their application to the solution of problems, and a sense of engineering judgment, which comprise the technical competencies necessary to plan, design, construct, operate, and maintain large-scale building systems and structures
- Develop an awareness of mitigating adverse impacts of projects on the social, economic, and natural environments locally, regionally, and globally
- Prepare students for professional practice through preparation for professional licensing, development of ethical judgment, and appreciation of lifelong learning and graduate and other advanced study
- Provide experience in and develop proficiency for working in multidisciplinary teams; working with the public; and acquiring necessary oral, writing, and graphical communication skills

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

Required courses

General education requirements		Credits
ECON 211	Principles of Economics I (Micro)	3.0
HUM 106	Humanities and Communications I	3.0
HUM 107	Humanities and Communications II	3.0
HUM 108	Humanities and Communications III	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives	9.0
	Free elective	3.0

Foundation requirements

TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 150	Freshman Engineering Design I	1.0
TDEC 151	Freshman Engineering Design II	1.0
TDEC 152	Freshman Engineering Design III	1.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0

Major requirements

AE 210	**Introduction to AE Building Systems**	3.0
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
CIVE 240 WI	**Engineering Economics**	3.0
CIVE 250	**Construction Materials**	4.0
CIVE 330	**Hydraulics**	3.0
CIVE 370	**Introduction to Structural Analysis**	3.0
CIVE 371	**Structural Design**	3.0
CIVE 320	**Fundamentals of Fluid Flow**	3.0
CIVE 372	**Structural Laboratory**	1.0
EGEO 220	**Engineering Geology**	4.0
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		**Credits**
MEM 310	**Thermal Analysis**	4.0
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		**Credits**
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 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.

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Recommended Plan of Study

BS Architectural Engineering

Mechanical Concentration

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	**Humanities and Communications I**	3.0
TDEC 110	**Mathematical Foundations of Engineering I**	3.0
TDEC 111	**Physical Foundations of Engineering I**	3.0
TDEC 120	**Chemical and Biological Foundations of Engineering I**	3.0
TDEC 130	**Engineering Design and Laboratory I**	3.0
TDEC 150	**Freshman Engineering Design I**	1.0
UNIV 101	**The Drexel Experience**	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	**Humanities and Communications II**	3.0
TDEC 112	**Mathematical Foundations of Engineering II**	3.0
TDEC 113	**Physical Foundations of Engineering II**	3.0
TDEC 121	**Chemical and Biological Foundations of Engineering II**	3.0
TDEC 131	**Engineering Design and Laboratory II**	3.0
TDEC 151	**Freshman Engineering Design II**	1.0
UNIV 101	**The Drexel Experience**	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	**Humanities and Communications III**	3.0
TDEC 114	**Mathematical Foundations of Engineering III**	3.0
TDEC 115	**Physical Foundations of Engineering III**	3.0
TDEC 122	**Chemical and Biological Foundations of Engineering III**	3.0
TDEC 132	**Engineering Design and Laboratory III**	3.0
TDEC 152	**Freshman Engineering Design III**	1.0
	Term credits	*16.0*
Term 4		**Credits**
AE 210	**Introduction to AE Building Systems** [1]	3.0
TDEC 201	**Energy I**	3.0
TDEC 211	**Materials I**	3.0
TDEC 221	**Systems I**	3.0
TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0
	Term credits	*16.0*

1 Mechanical concentration students may take MEM 345 in place of AE 210 and then take an additional professional elective in term 12. Students selecting to do this are advised to take a liberal studies elective in Term 7.

Term 5		Credits
ARCH 191	**Studio I**	3.0
MEM 202	**Engineering Mechanics: Statics**	3.0
TDEC 202	**Energy II**	3.0
TDEC 222	**Systems II**	3.0
TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0
	Term credits	*16.0*
Term 6		**Credits**
AE 340	**Architectural Illumination and Electrical Systems**	3.0

ARCH 192	**Studio 2**	3.0
CIVE 320	**Fundamentals of Fluid Flow**	4.0
ARCH 141	**Architecture and Society I**	3.0
CIVE 240 WI	**Engineering Economics Analysis**	3.0
	Term credits	*16.0*
Term 7		**Credits**
AE 220	**Introduction to HVAC**	3.5
ARCH 142 WI	**Architecture and Society II**	3.0
CIVE 250	**Construction Materials**	4.0
CIVE 330	**Hydraulics**	3.0
MEM 230	**Mechanics of Materials I**	4.0
	Term credits	*17.5*
Term 8		**Credits**
CIVE 370	**Introduction to Structural Analysis**	3.0
EGEO 220	**Engineering Geology**	4.0
MEM 345	**Heat Transfer**	4.0
AE 390	**Architectural Engineering Design I**	4.0
ARCH 143 WI	**Architecture and Society III**	3.0
	Term credits	*18.0*
Term 9		**Credits**
AE 391	**Architectural Engineering Design II**	4.0
CIVE 371	**Introduction to Structural Design**	3.0
MEM 310	**Thermal Analysis**	4.0
	Elective	3.0
	Term credits	*14.0*
Term 10		**Credits**
AE 544	**Building Envelope**	3.0
CAE 491	**Senior Project Design I**	3.0
ECON 211	**Principles of Economics I (Micro)**	3.0
MEM 413	**Air Conditioning and Refrigeration I**	3.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
	Term credits	*15.0*
Term 11		**Credits**
MEM 414	**Air Conditioning and Refrigeration IIs**	3.0
CAE 492	**Senior Project Design II**	3.0
	Elective	3.0
	Technical elective (1)	3.0
	Liberal Studies elective (1)	3.0
	Term credits	*15.0*
Term 12		**Credits**
CAE 493	**Senior Project Design III**	3.0
	Liberal Studies elective (3)	3.0
	Technical elective (2)	3.0
	Technical elective (3)	3.0
	Liberal Studies elective (2)	3.0
	Term credits	*15.0*
	Total credits (minimum)	**192.5**

Recommended Plan of Study

BS Architectural Engineering

Structural Concentration

Bachelor of Science Degree

4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
AE 210	Introduction to AE Building Systems	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
ARCH 191	Studio I	3.0
MEM 202	Engineering Mechanics: Statics	3.0
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
	Term credits	*16.0*
Term 6		**Credits**
AE 340	Architectural Illumination and Electrical Systems	3.0
ARCH 192	Studio 2	3.0
CIVE 320	Fundamentals of Fluid Flow	4.0

ARCH 141	**Architecture and Society I**	3.0
CIVE 240 WI	**Engineering Economics Analysis**	3.0
	Term credits	*16.0*
Term 7		**Credits**
AE 220	**Introduction to HVAC**	3.5
ARCH 142 WI	**Architecture and Society II**	3.0
CIVE 250	**Construction Materials**	4.0
CIVE 330	**Hydraulics**	3.0
MEM 230	**Mechanics of Materials I**	4.0
	Term credits	*17.5*
Term 8		**Credits**
CIVE 370	**Introduction to Structural Analysis**	3.0
ECON 211	**Principles of Economics I (Micro)**	3.0
EGEO 220	**Engineering Geology**	4.0
AE 390	**Architectural Engineering Design I**	4.0
ARCH 143 WI	**Architecture and Society III**	3.0
	Term credits	*17.0*
Term 9		**Credits**
AE 391	**Architectural Engineering Design II**	4.0
CIVE 371	**Introduction to Structural Design**	3.0
CIVE 372	**Structural Laboratory**	1.0
	Elective	3.0
	Liberal Studies elective (1)	3.0
	Term credits	*14.0*
Term 10		**Credits**
AE 544	**Building Envelope**	3.0
CAE 491	**Senior Project Design I**	3.0
CIVE 310	**Soil Mechanics I**	4.0
CIVE 400	**Structural Design I**	3.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
	Term credits	*16.0*
Term 11		**Credits**
CIVE 401	**Structural Design II**	3.0
CIVE 410	**Foundations**	3.0
CAE 492	**Senior Project Design II**	3.0
	Technical elective (1)	3.0
	Liberal Studies elective (2)	3.0
	Term credits	*15.0*
Term 12		**Credits**
CAE 493	**Senior Project Design III**	3.0
CIVE 402	**Structural Design III**	3.0
	Liberal Studies elective (3)	3.0
	Technical elective (2)	3.0
	Technical elective (3)	3.0
	Term credits	*15.0*
	Total credits (minimum)	**192.5**

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.

Chemical Engineering

Bachelor of Science Degree: 192.0 credits

Required courses

General education requirements		Credits
HIST 285	Technology in Historical Perspective	3.0
HUM 106	Humanities and Communications I	3.0
HUM 107	Humanities and Communications II	3.0
HUM 108	Humanities and Communications III	3.0
PHIL 315	Engineering Ethics	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives	15.0
	Free electives	6.0

Foundation requirements		Credits
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 150	Freshman Engineering Design I	1.0
TDEC 151	Freshman Engineering Design II	1.0
TDEC 152	Freshman Engineering Design III	1.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0

Professional requirements		Credits
CHE 201	**Process Material Balances**	3.0
CHE 202	**Process Energy Balances**	3.0
CHE 250	**Chemical Engineering Process Principles**	3.0
CHE 301 WI	**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 WI	**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 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.

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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

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

- *Provide students with a solid scientific and mathematical foundation, knowledge of engineering principles and their application to the solution of problems, and a sense of engineering judgment, which comprise the technical competencies necessary to plan, design, construct, operate, and maintain large-scale infrastructure, environmental, and natural resource systems and structures*
- *Develop an awareness of mitigating adverse impacts of projects on the social, economic, and natural environments locally, regionally and globally*
- *Prepare students for professional practice through preparation for professional licensing, development of ethical judgment, and appreciation of lifelong learning and graduate and other advanced study*
- *Provide experience in and develop proficiency for working in multidisciplinary teams; working with the public; and acquiring necessary*

oral, writing, and graphical communication skills

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: 192.5 credits

General education requirements		Credits
ECON 211	Principles of Economics I (Micro)	3.0
ECON 212	Principles of Economics II (Macro)	3.0
HIST 285	Technology in Historical Perspective	3.0
HUM 106	Humanities and Communications I	3.0
HUM 107	Humanities and Communications II	3.0
HUM 108	Humanities and Communications III	3.0
MATH 201	Linear Algebra	4.0
ENGR 361	Statistical Analysis of Engineering Systems	4.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives	9.0
	Free electives	3.0

Foundation requirements		Credits
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 150	Freshman Engineering Design I	1.0
TDEC 151	Freshman Engineering Design II	1.0
TDEC 152	Freshman Engineering Design III	1.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0

TDEC 222	**Systems II**	3.0
TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0
TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0

Major requirements		**Credits**
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
CIVE 240	**Engineering Economics**	3.0
CIVE 250	**Construction Materials**	4.0
CIVE 251	**Engineering Surveying**	3.0
CIVE 252	**Introduction to Transportation Infrastructure**	3.0
CIVE 370	**Introduction to Structural Analysis**	3.0
CIVE 371	**Introduction to Structural Design**	3.0
CIVE 310	**Soil Mechanics I**	4.0
CIVE 320	**Fundamentals of Fluid Flow**	4.0
CIVE 330	**Hydraulics I**	3.0
CIVE 341	**Municipal Water Facilities**	3.0
CIVE 360	**Water Quality Infrastructure**	3.0
CIVE 375	**In Situ Material Behavior**	3.0
CIVE 420	**Water and Waste Treatment I**	3.0
CIVE 430	**Hydrology**	3.0
CIVE 477 WI	**Seminar I**	2.0
CIVE 478	**Seminar II**	1.0
EGEO 220	**Engineering Geology**	4.0
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.**

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.

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Recommended Plan of Study

BS Civil Engineering

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
CIVE 251	Engineering Surveying	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
CIVE 252	Introduction to Transportation Infrastructure	3.0
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
MATE 221	Introduction to Mechanical Behavior of Materials	3.0
	Term credits	*16.0*
Term 6		**Credits**
CIVE 320	Fundamentals of Fluid Flow	4.0
EGEO 220	Engineering Geology	4.0
MEM 202	Engineering Mechanics: Statics	3.0
CIVE 240 WI	Engineering Economics Analysis	3.0
	Liberal Studies elective	3.0

	Term credits	*17.0*
Term 7		**Credits**
CIVE 250	**Construction Materials**	4.0
CIVE 330	**Hydraulics**	3.0
ENVE 300	**Introduction to Environmental Engineering**	3.0
MEM 230	**Mechanics of Materials I**	4.0
	Term credits	*14.0*
Term 8		**Credits**
CIVE 310	**Soil Mechanics I**	4.0
CIVE 370	**Introduction to Structural Analysis**	3.0
CIVE 372	**Structural Laboratory**	1.0
CIVE 430	**Hydrology**	3.0
ECON 211	**Principles of Economics I (Micro)**	3.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
	Term credits	*17.0*
Term 9		**Credits**
CIVE 371	**Introduction to Structural Design**	3.0
CIVE 375	**In Situ Material Behavior**	3.0
ECON 212	**Principles of Economics II (Macro)**	3.0
CIVE 420	**Waste and Water Treatment I**	3.0
MATH 201	**Linear Algebra**	4.0
	Term credits	*16.0*
Term 10		**Credits**
CAE 491	**Senior Project Design I**	3.0
CIVE 477 WI	**Senior Seminar I**	2.0
	Liberal Studies elective	3.0
	Professional electives	6.0
	Term credits	*14.0*
Term 11		**Credits**
CAE 492	**Senior Project Design II**	3.0
CIVE 478	**Senior Seminar II**	1.0
	Elective	3.0
	Liberal Studies elective	3.0
	Professional electives	6.0
	Term credits	*16.0*
Term 12		**Credits**
CAE 493	**Senior Project Design III**	3.0
	Elective	3.0
	Liberal Studies elective	3.0
	Professional electives	6.0
	Term credits	*15.0*
	Total credits (minimum)	**191.0**

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 Department of Electrical and Computer Engineering prepares men and women to lead productive and rewarding professional lives at the forefront of engineering in the 21st century, and pursues research to advance the state of the art in electrical and computer engineering and engineering education.

Program Objectives

- *Provide our students with the core technical competencies in computer engineering, in a manner that recognizes the diversity of our profession and affords the flexibility to pursue different specialization areas*
- *Provide our students with the opportunity to learn in multidisciplinary courses to function as effective team members in an increasingly diverse engineering environment.*
- *Provide our students with the broad education necessary to understand the impact of technology in a global and societal context*
- *Provide our students with practical experiences to facilitate their development as educated professionals in a global and diverse workplace. Through these experiences, expose our student to the need for and desirability of lifelong learning*

- *Develop awareness among our students that research advances the state of knowledge in our profession to serve society better, and provide our qualified students with the opportunity to conduct research as undergraduates*

Computer Engineering

Bachelor of Science Degree: 192.0 credits

Degree Requirements

Required courses

General education requirements		Credits
ECON 211	**Principles of Economics I (Micro)**	3.0
HIST 285	**Technology in Historical Perspective**	3.0
HUM 106	**Humanities and Communications I**	3.0
HUM 107	**Humanities and Communications II**	3.0
HUM 108	**Humanities and Communications III**	3.0
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	Liberal studies electives	12.0

Foundation requirements		Credits
ECE 200	**Foundations of Intelligent Systems**	3.0
ECE 201	**Foundations of Electric Circuits**	3.0
TDEC 110	**Mathematical Foundations of Engineering I**	3.0
TDEC 111	**Physical Foundations of Engineering I**	3.0
TDEC 112	**Mathematical Foundations of Engineering II**	3.0
TDEC 113	**Physical Foundations of Engineering II**	3.0
TDEC 114	**Mathematical Foundations of Engineering III**	3.0
TDEC 115	**Physical Foundations of Engineering III**	3.0
TDEC 120	**Chemical and Biological Foundations of Engineering I**	3.0
TDEC 121	**Chemical and Biological Foundations of Engineering II**	3.0
TDEC 122	**Chemical and Biological Foundations of Engineering III**	3.0
TDEC 130	**Engineering Design and Laboratory I**	3.0
TDEC 131	**Engineering Design and Laboratory II**	3.0
TDEC 132	**Engineering Design and Laboratory III**	3.0
TDEC 150	**Freshman Engineering Design I**	1.0
TDEC 151	**Freshman Engineering Design II**	1.0
TDEC 152	**Freshman Engineering Design III**	1.0
TDEC 201	**Energy I**	3.0
TDEC 202	**Energy II**	3.0

TDEC 211	**Materials I**	3.0
TDEC 221	**Systems I**	3.0
TDEC 222	**Systems II**	3.0
TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0
TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0

Professional requirements		**Credits**
CS 171	**Computer Programming I**	3.0
CS 172	**Computer Programming II**	3.0
CS 260	**Data Structures**	3.0
CS 451	**Software Engineering**	3.0
ECE 491	**Senior Project Design I**	2.0
ECE 492	**SeniorProject Design II**	2.0
ECE 493	**Senior Project Design III**	4.0
ECEC 302	**Digital System Projects**	4.0
ECEC 304	**Design with Microcontrollers**	4.0
ECEC 352	**Secure Computing**	4.0
ECEC 355	**Computer Structures**	4.0
ECEL 301	**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
MATH 290	**Linear Modeling for Engineers**	4.0
	Computer engineering senior sequence	9.0-12.0
	ECE technical electives	9.0-12.0
	Free electives	5.0-11.0

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.

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Recommended Plan of Study

BS Computer Engineering

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
ECE 200	Fundamentals of Intelligent Systems	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
ECE 201	Foundations of Electric Circuits	3.0
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
ECEC 490	Special Topics in Engineering: Programming for Engineers	3.0
	Term credits	*16.0*
Term 6		**Credits**
ECEC 302	Digital System Projects	4.0
ECEL 301	Electrical Engineering Laboratory I	2.0
HIST 285	Technology in Historical Perspective	3.0
CS 171	Computer Programming I	3.0
MATH 290	Linear Modeling for Engineers	4.0

	Term credits	*16.0*
Term 7		**Credits**
CS 172	**Computer Programming II**	3.0
ECEL 302	**ECE Laboratory II**	2.0
ECES 302	**Transform Methods and Filtering**	4.0
MATH 221	**Discrete Mathematics**	3.0
PHIL 315	**Engineering Ethics**	3.0
	Term credits	*15.0*
Term 8		**Credits**
CS 260	**Data Structures**	3.0
ECEC 355	**Computer Structures**	4.0
ECEL 303	**ECE Laboratory III**	2.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
	Liberal Studies elective [1]	3.0
	Term credits	*15.0*
1	See the Department's Web site for a list of acceptable liberal studies electives.	
Term 9		**Credits**
ECEC 304	**Design with Microcontrollers**	4.0
ECEC 352	**Secure Computing**	4.0
ECEL 304	**ECE Laboratory IV**	2.0
	ECE Technical elective [1]	4.0
	Liberal Studies elective	3.0
	Term credits	*17.0*
1	ECE Technical electives are 300 or 400 level ECE courses from any track.	
Term 10		**Credits**
CS 451	**Software Engineering**	3.0
ECE 491	**Senior Design I**	2.0
	Elective	3.0
	Liberal Studies elective	3.0
ECEC 411	**Computer Hardware** [1]	3.0
or		
ECEC 431	**Introduction to Computer Networks**	3.0
	Term credits	*14.0*
1	One full computer engineering (CE) sequence must be completed in order to graduate. **Sequence A:** ECEC 411 Computer Hardware; ECEC 421 Operating Systems I; and ECEC 422 Operating Systems II; OR **Sequence B:** ECEC 431 Computer Networking; ECEC 432 Internet Architecture and Protocols; and ECEC 433 Network Programming.	
Term 11		**Credits**
MATE 492	**Senior Design II**	2.0
	Elective	3.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
ECEC 421	**Introduction to Operating Systems I**	3.0
or		
ECEC 432	**Internet Architecture and Protocols**	3.0
	Term credits	*14.0*
Term 12		**Credits**
ECE 493	**Senior Design III**	4.0
	Elective	4.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
ECEC 422	**Introduction to Operating Systems II**	3.0
or		
ECEC 433	**Network Programming**	3.0
	Term credits	*17.0*
	Total credits (minimum)	**190.0**

Computer Science

The program of study in computer science is designed to prepare students for careers in a rapidly changing profession and to allow easy entrance to 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 both 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, data structures and algorithms, numerical and scientific computation, operating systems, programming languages, and human-computer interaction. Please contact the department for a current list of computer science elective and track courses.

The B.S. program has been accredited by the Computing Accreditation Commision (CAC) of the Accreditation Board of Engineering and Technology (ABET) since 1986. Accreditation of the B.A. program will be sought as soon as the program is eligible.

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.

Specific Objectives:

- For students to understand and be able to apply the underlying principles of Computer Science to a variety of problem domains.
- To develop stong analytical skills and good communication skills so that students can quickly assess how to solve problems and communicate their solution. To be able to work in groups and appreciate the dynamic and collaborative nature of problem solving.
- To equip students with a thorough understanding of the development process of software including design, implementation, documentation, and testing.
- To provide students with the skills to keep current in an ever changing technological world.
- To enable students 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.

Computer Science

The Department of Computer Science offers both a Bachelor of Science (B.S.) and a Bachelor of Arts (B.A.). Students may choose the program that best fits their needs and future goals.

The Bachelor of Science (B.S.) program emphasizes foundation courses in the sciences and in applied mathematics, leading to careers involving applications in science and engineering.

The Bachelor of Arts (B.A) program emphasizes foundation courses in the humanities and the social sciences, leading to careers involving applications in those areas.

The Bachelor of Science (B.S.) Degree Requirements

The Bachelor of Arts (B.A) Degree Requirements

Computer Science

Bachelor of Science Degree: 186.5 credits

Degree Requirements

General education requirements		47.0 Credits
ECON 211	**Principles of Economics I (Micro)**	3.0
ECON 212	**Principles of Economics II (Macro)**	3.0
HUM 106	**Humanities and Communications I**	3.0
HUM 107	**Humanities and Communications II**	3.0
HUM 108	**Humanities and Communications III**	3.0
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0
	General education electives	12.0
	Humanities and communication electives	9.0
	History electives	6.0

Engineering Foundation requirements		3.0 Credits
TDEC 150	**Freshman Engineering Design I**	1.0
TDEC 151	**Freshman Engineering Design II**	1.0
TDEC 152	**Freshman Engineering Design III**	1.0

Mathematics requirements*		12.0 Credits
TDEC 110	**Mathematical Foundations of Engineering I**	3.0
TDEC 111	**Physical Foundations of Engineering I**	3.0
TDEC 112	**Mathematical Foundations of Engineering II**	3.0
TDEC 160	**Computation Lab I**	1.0
TDEC 180	**Special Topics in Engineering**	1.0
TDEC 180	**Special Topics in Engineering**	1.0

*With approval, students may take the following math sequence instead of the TDEC courses listed above: MATH 121, MATH 122, MATH 123 and MATH 200.

Additional mathematics requirements		15.0 Credits
MATH 201	**Linear Algebra**	4.0
MATH 221	**Discrete Mathematics**	3.0

MATH 311	**Probability and Statistics I**	4.0
MATH 312	**Probability and Statistics II**	4.0

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 TDEC sequences below as well as the Computer Science department for a complete list of acceptable science courses.)

BIO 102	**Biology I: Cells and Tissues**	4.0
BIO 104	**Biology II: Growth and Heredity**	4.0
BIO 106	**Biology III: Organismal Biology**	4.0
or		
CHEM 101	**General Chemistry I**	4.0
CHEM 102	**General Chemistry II**	4.0
CHEM 103	**General Chemistry III**	5.0
or		
PHYS 111	**Physics I**	4.5
PHYS 112	**Physics II**	4.5
PHYS 211	**Physics III**	4.5
or		
TDEC 111	**Physical Foundations of Engineering I**	3.0
TDEC 113	**Physical Foundations of Engineering II**	3.0
TDEC 115	**Physical Foundations of Engineering III**	3.0
TDEC 130	**Engineering Design and Laboratory I**	3.0
TDEC 131	**Engineering Design and Laboratory II**	3.0
TDEC 132	**Engineering Design and Laboratory III**	3.0
or		
TDEC 120	**Chemical and Biological Foundations of Engineering I**	3.0
TDEC 121	**Chemical and Biological Foundations of Engineering II**	3.0
TDEC 122	**Chemical and Biological Foundations of Engineering III**	3.0
TDEC 130	**Engineering Design and Laboratory I**	3.0
TDEC 131	**Engineering Design and Laboratory II**	3.0
TDEC 132	**Engineering Design and Laboratory III**	3.0

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 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 265	**Advanced Programming Tools and Techniques**	3.0
CS 451	**Software Engineering**	3.0
CS 452 WI	**Software Engineering Workshop I**	3.0
CS 453 WI	**Software Engineering Workshop II**	3.0
ECE 200	**Fundamentals of Intelligent Systems**	3.0
	Computer science track* courses	18.0
	Computer science electives	9.0

Other courses		**13.5 Credits**
	Free electives	13.5

Computer Science Tracks

Students must complete two of the following Computer Science tracks for a total of 18.0 credits:

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
Human-Computer Interactions		
CS 337	**Psychology of Human-Computer Interactions**	3.0
CS 338	**Graphical User Interfaces**	3.0
CS 430	**Computer Graphics**	3.0
or		
PSY 330	**Cognitive Psychology**	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	**Numeric Solutions to Differential Equations**	3.0
Operating Systems		
CS 361	**Concurrent Programming**	3.0
CS 370	**Operating Systems**	3.0
CS 472	**Computer Networks**	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

Writing-Intensive Course Requirements

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

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

Recommended Plan of Study

BS Computer Science

TDEC

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
CS 164	**Introduction to Computer Science**	3.0
HUM 106	**Humanities and Communications I**	3.0
TDEC 110	**Mathematical Foundations of Engineering I** [1]	3.0
TDEC 150	**Freshman Engineering Design I**	1.0
TDEC 160	**Computational Lab I**	1.0
UNIV 101	**The Drexel Experience**	1.0
BIO 102	**Biology I: Cells and Tissues**	4.0
or		
CHEM 101	**General Chemistry I** [2]	4.0
	Term credits	*16.0*

1 With approval, MATH 121 may be selected as an alternative to TDEC 110.
2 Alternate science sequences include (PHYS 111, PHYS 11, and PHYS 211) or one of the TDEC science sequences: (TDEC 111, TDEC 113, TDEC 115, TDEC 130, TDEC 131, and TDEC 132) or (TDEC 120, TDEC 121, TDEC 122, TDEC 130, TDEC 131, and TDEC 132).

Term 2		Credits
HUM 107	**Humanities and Communications II**	3.0
TDEC 112	**Mathematical Foundations of Engineering II** [1]	3.0
CS 171	**Computer Programming I**	3.0
TDEC 151	**Freshman Engineering Design II**	1.0
TDEC 180	**Special Topics in Engineering**	1.0
UNIV 101	**The Drexel Experience**	1.0
BIO 104	**Biology II: Growth and Heredity**	4.0
or		
CHEM 102	**General Chemistry II** [2]	4.0
	Term credits	*16.0*

1 With approval, two math courses (MATH 122 and MATH 123) may be selected as an alternative to TDEC 112.
2 Alternate science sequences include (PHYS 111, PHYS 11, and PHYS 211) or one of the TDEC science sequences: (TDEC 111, TDEC 113, TDEC 115, TDEC 130, TDEC 131, and TDEC 132) or (TDEC 120, TDEC 121, TDEC 122, TDEC 130, TDEC 131, and TDEC 132).

Term 3		Credits
CS 172	**Computer Programming II**	3.0
HUM 108	**Humanities and Communications III**	3.0
TDEC 114	**Mathematical Foundations of Engineering III** [1]	3.0
TDEC 152	**Freshman Engineering Design III**	1.0
TDEC 180	**Special Topics in Engineering**	1.0
BIO 106	**Biology III: Organismal Biology**	4.0
or		
CHEM 103	**General Chemistry III** [2]	5.0
	Term credits	*15.0*

1 With approval, MATH 200 may be selected as an alternative for TDEC 114.
2 Alternate science sequences include (PHYS 111, PHYS 11, and PHYS 211) or one of the TDEC science sequences: (TDEC 111, TDEC 113, TDEC 115, TDEC 130, TDEC 131, and TDEC 132) or (TDEC 120, TDEC 121, TDEC 122, TDEC 130, TDEC 131, and TDEC 132).

Term 4		Credits
CS 260	**Data Structures**	3.0

CS 270	**Mathematical Foundations of Computer Science**	3.0
	Elective	3.5
	History elective	3.0
	Science elective	4.0
	Term credits	*16.5*
Term 5		**Credits**
COM 230	**Techniques of Speaking**	3.0
CS 265	**Advanced Programming Tools and Techniques**	3.0
ECE 200	**Fundamentals of Intelligent Systems**	3.0
MATH 201	**Linear Algebra**	4.0
	Science elective	3.0
	Term credits	*16.0*
Term 6		**Credits**
CS 281	**Systems Architecture I**	4.0
CS 360	**Programming Language Concepts**	3.0
HIST 285	**Technology in Historical Perspective**	3.0
MATH 221	**Discrete Mathematics**	3.0
	Elective	4.0
	Term credits	*17.0*
Term 7		**Credits**
CS 282	**Systems Architecture II**	4.0
CS 350 WI	**Software Design**	3.0
	General studies elective	3.0
	Science elective	3.0
	Computer science elective	3.0
or		
	Computer Science track course [1]	3.0
	Term credits	*16.0*
1	See the Degree requirements for a list of Computer Science track options.	
Term 8		**Credits**
CS 451	**Software Engineering**	3.0
ECON 211	**Principles of Economics I (Micro)**	3.0
MATH 311	**Probability and Statistics I**	4.0
PHIL 311	**Computer Ethics**	3.0
	Science elective	3.0
	Computer programming elective [1]	3.0
or		
	Computer Science track course	3.0
	Term credits	*19.0*
1	See the Degree requirements for a list of Computer Science track options.	
Term 9		**Credits**
ECON 212	**Principles of Economics II (Macro)**	3.0
MATH 312	**Probability and Statistics II**	4.0
	General studies elective	3.0
	Computer science elective	3.0
or		
	Computer Science track course [1]	3.0
	Term credits	*13.0*
1	See the Degree requirements for a list of Computer Science track options.	
Term 10		**Credits**
	Elective	3.0
	General studies elective	3.0
	Humanities/Communications elective	3.0
	Two Computer science electives	6.0
or		
	Computer science track courses [1]	6.0
	Term credits	*15.0*
1	See the Degree requirements for a list of Computer Science track options.	
Term 11		**Credits**
CS 452 WI	**Software Engineering Workshop I**	3.0
	General studies elective	3.0
	Two Computer science electives	6.0

or		
	Computer science track courses	6.0
	Term credits	*12.0*
Term 12		**Credits**
CS 453 WI	**Software Engineering Workshop II**	3.0
	Elective	3.0
	Humanities/Communications elective	3.0
	Two Computer science electives	6.0
or		
	Computer science track courses	6.0
	Term credits	*15.0*
	Total credits (minimum)	**186.5**

Computer Science

Bachelor of Arts Degree: 186.5 credits

Degree Requirements, B.A. Program

General education requirements		Credits
ECON 211	**Principles of Economics I (Micro)**	3.0
ECON 212	**Principles of Economics II (Macro)**	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	9.0
	International area studies	6.0
	Sociology/behavior science electives	12.0
	Diversity studies electives	6.0

Science requirements		Credits
	Electives*	18.0
***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 102	**Biology I: Cells and Tissues**	4.0
BIO 104	**Biology II: Growth and Heredity**	4.0
BIO 106	**Biology III: Organismal Biology**	4.0
or		
CHEM 101	**General Chemistry I**	4.0
CHEM 102	**General Chemistry II**	4.0
CHEM 103	**General Chemistry III**	5.0

Mathematics requirements		Credits
MATH 101	**Introduction to Analysis I**	4.0
or		
MATH 121	**Calculus I**	
MATH 102	**Introduction to Analysis II**	4.0
or		
MATH 122	**Calculus II**	
MATH 239	**Intermediate Calculus**	4.0

or		
MATH 123	**Calculus III**	
MATH 221	**Discrete Mathematics**	3.0
STAT 201	**Statistics I**	4.0

Computer science requirements		**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 452 WI	**Software Engineering Workshop I**	3.0
CS 453 WI	**Software Engineering Workshop II**	3.0
ECE 200	**Fundamentals of Intelligent Systems**	3.0
	Computer science track* courses	18.0
	Computer science electives	9.0

Other courses		**Credits**
	Free electives	30.5

***Computer Science Tracks**

Students must complete two of the following Computer Science tracks for a total of 18.0 credits:

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
Human-Computer Interactions		
CS 337	**Psychology of Human-Computer Interactions**	3.0
CS 338	**Graphical User Interfaces**	3.0
CS 430	**Computer Graphics**	3.0
or		
PSY 330	**Cognitive Psychology**	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	**Numeric Solutions to Differential Equations**	3.0
Operating Systems		
CS 361	**Concurrent Programming**	3.0
CS 370	**Operating Systems**	3.0
CS 472	**Computer Networks**	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

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

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

Recommended Plan of Study

BA Computer Science

Bachelor of Arts Degree 5-yr co-op

Term 1		Credits
CS 164	Introduction to Computer Science	3.0
ENGL 101	Expository Writing and Reading	3.0
MATH 101	Introduction to Math Analysis I	4.0
UNIV 101	The Drexel Experience	1.0
BIO 102	Biology I: Cells and Tissues	4.0
or		
CHEM 101	General Chemistry I	4.0
or		
PHYS 103	General Physics I	4.0
	Term credits	*15.0*

Term 2		Credits
ENGL 102	Persuasive Writing and Reading	3.0
CS 171	Computer Programming I	3.0
MATH 102	Introduction to Math Analysis II	4.0
UNIV 101	The Drexel Experience	1.0
BIO 104	Biology II: Growth and Heredity	4.0
or		
CHEM 102	General Chemistry II	4.0
or		
PHYS 104	General Physics 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
MATH 239	Intermediate Calculus	4.0
	Elective	3.0
BIO 106	Biology III: Organismal Biology	4.0
or		
CHEM 103	General Chemistry III	5.0
or		
PHYS 211	Physics III	4.5
	Term credits	*17.0*

Term 4		Credits
CS 260	Data Structures	3.0
CS 270	Mathematical Foundations of Computer Science	3.0
	Arts and Humanities elective	3.0
	Diversity Studies elective	3.0
	Social Science elective	3.0
	Term credits	*15.0*

Term 5		Credits
CS 265	Advanced Programming Tools and Techniques	3.0
ECE 200	Fundamentals of Intelligent Systems	3.0
MATH 221	Discrete Mathematics	3.0
	Science elective [1]	3.0
	Social Science elective	3.0
	Term credits	*15.0*

1	Including the laboratory science courses, the final total for all science electives should be a minimum of 18.0 credits.	
Term 6		**Credits**
CS 281	**Systems Architecture I**	4.0
CS 360	**Programming Language Concepts**	3.0
STAT 201	**Statistics I**	4.0
	Elective	3.0
	Arts and Humanities elective	3.0
	Term credits	*17.0*
Term 7		**Credits**
CS 350 WI	**Software Design**	3.0
	Elective	3.0
	Arts and Humanities elective	3.0
	Social Science elective	3.0
	Computer science elective	3.0
or		
	Computer Science track course [1]	3.0
	Term credits	*15.0*
1	See the Degree requirements for a list of Computer Science track options.	
Term 8		**Credits**
CS 451	**Software Engineering**	3.0
ECON 211	**Principles of Economics I (Micro)**	3.0
PHIL 311	**Computer Ethics**	3.0
	Elective	3.0
	Computer science elective	3.0
or		
	Computer Science track course	3.0
	Term credits	*15.0*
Term 9		**Credits**
ECON 212	**Principles of Economics II (Macro)**	3.0
	Elective	3.0
	Diversity Studies elective	3.0
	Social Science elective	3.0
	Computer science elective	3.0
or		
	Computer Science track course	3.0
	Term credits	*15.0*
Term 10		**Credits**
	Two electives	6.0
	International Studies elective	3.0
	Two Computer science electives	6.0
or		
	Computer science track courses	6.0
	Term credits	*15.0*
Term 11		**Credits**
CS 452 WI	**Software Engineering Workshop I**	3.0
	Elective	3.5
	International Studies elective	3.0
	Two Computer science electives	6.0
or		
	Computer science track courses	6.0
	Term credits	*15.5*
Term 12		**Credits**
CS 453 WI	**Software Engineering Workshop II**	3.0
	Two electives	6.0
	Two Computer science electives	6.0
or		
	Computer science track courses	6.0
	Term credits	*15.0*
	Total credits (minimum)	**184.5**

Electrical Engineering

The Department of Electrical and Computer Engineering has implemented "ECE 21," the new ECE curriculum for the 21st century. ECE 21 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.

ECE 21 balances technical depth and breadth: depth through the selection of a track and breadth through courses selected in other tracks and the laboratories. It also provides for special cases and special needs.

The track structure, which starts in the pre-junior year and continues through the end of the senior year, allows students to spend time concentrating in one major area of electrical engineering. The structure can accommodate a number of student types and career objectives. Most students will continue to receive traditional or near-traditional ECE education. Those who have non-ECE career objectives can use the senior year to get exposure to languages, business, or management, for example.

The ECE 21 curriculum offers three different tracks, or areas of study: telecommunications/digital signal processing, electronics, and electrical engineering. To fulfill their track requirements, all ECE students will select eight courses. 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 Department of Electrical and Computer Engineering prepares men and women to lead productive and rewarding professional lives at the forefront of engineering in the 21st century, and pursues research to advance the state of the art in electrical and computer engineering and engineering education.

Program Objectives

- *Provide our students with the core technical competencies in electrical engineering, in a manner that recognizes the diversity of our profession and affords the flexibility to pursue different specialization areas*
- *Provide our students with the opportunity to learn in multidisciplinary courses to function as effective team members in an increasingly diverse engineering environment*
- *Provide our students with the broad education necessary to understand the impact of technology in a global and societal context*
- *Provide our students with practical experiences to facilitate their development as educated professionals in a global and diverse workplace.*

Through these experiences, expose our student to the need for and desirability of lifelong learning

- *Develop awareness among our students that research advances the state of knowledge in our profession to serve society better, and provide our qualified students with the opportunity to conduct research as undergraduates*

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. Senior-level sequence options are available in digital signal processing and communications.

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

Required courses

General education requirements		Credits
ECON 211	Principles of Economics I (Micro)	3.0
HIST 285	Technology in Historical Perspective	3.0
HUM 106	Humanities and Communications I	3.0
HUM 107	Humanities and Communications II	3.0
HUM 108	Humanities and Communications III	3.0
PHIL 315	Engineering Ethics	3.0
UNIV 101	The Drexel Experience	2.0
	Liberal studies electives	12.0

Foundation requirements		Credits
ECE 200	Foundations of Intelligent Systems	3.0
ECE 201	Foundations of Electric Circuits	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 150	Freshman Engineering Design I	1.0
TDEC 151	Freshman Engineering Design II	1.0
TDEC 152	Freshman Engineering Design III	1.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0

TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0
TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0

Professional requirements		**Credits**
ECE 491	**Senior Project Design I**	2.0
ECE 492	**SeniorProject Design II**	2.0
ECE 493	**Senior Project Design III**	4.0
ECEL 301	**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 290	**Linear Modeling for Engineers**	4.0
	Additional interdisciplinary courses (1)	4.0
	ECE track courses (8)	32.0
	Electrical engineering senior sequence	9.0-12.0
	ECE technical electives	9.0-12.0
	Free electives	0.0-6.0

Writing-Intensive Course Requirements

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

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

Recommended Plan of Study

BS Electrical Engineering

Electronics Concentration

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
ECE 200	Fundamentals of Intelligent Systems	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
ECE 201	Foundations of Electric Circuits	3.0
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
ECEC 490	Special Topics in Engineering: Programming for Engineers	3.0
	Term credits	*16.0*
Term 6		**Credits**
ECEE 302	Electronic Devices	4.0
ECEL 301	Electrical Engineering Laboratory I	2.0
ECES 302	Transform Methods and Filtering	4.0

HIST 285	**Technology in Historical Perspective**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0
	Term credits	*17.0*
Term 7		**Credits**
ECEE 352	**Analog Electronics**	4.0
ECEL 302	**ECE Laboratory II**	2.0
PHIL 315	**Engineering Ethics**	3.0
MATH 291	**Complex and Vector Analysis for Engineers**	4.0
	Core elective	4.0
	Term credits	*17.0*
Term 8		**Credits**
ECEE 304	**EM Fields and Waves**	4.0
ECEL 303	**ECE Laboratory III**	2.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
	Core elective	4.0
	Liberal Studies elective [1]	3.0
	Term credits	*16.0*
1	See the Department's Web site for a list of acceptable liberal studies electives.	
Term 9		**Credits**
ECEE 354	**Wireless and Optical Electronics**	4.0
ECEL 304	**ECE Laboratory IV**	2.0
	Interdisciplinary course	4.0
	Core elective	4.0
	Liberal Studies elective	3.0
	Term credits	*17.0*
Term 10		**Credits**
ECE 491	**Senior Design I**	2.0
ECEE 421	**Advanced Electronics I**	4.0
ECEE 471	**High Frequency Passive Circuits**	4.0
	Elective	3.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
	Term credits	*19.0*
Term 11		**Credits**
ECEE 422	**Advanced Electronic Circuits I**	3.0
ECEE 472	**RF Electronics**	4.0
MATE 492	**Senior Design II**	2.0
	Two Computer science electives	6.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
	Term credits	*21.0*
Term 12		**Credits**
ECE 493	**Senior Design III**	4.0
ECEE 433	**Digital Electronics**	4.0
ECEE 473	**Antennas and Radiating Systems**	4.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
	Term credits	*18.0*
	Total credits (minimum)	**207.0**

Recommended Plan of Study

BS Electrical Engineering

Electrical Engineering Concentration

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
ECE 200	Fundamentals of Intelligent Systems	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
ECE 201	Foundations of Electric Circuits	3.0
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
ECEC 490	Special Topics in Engineering: Programming for Engineers	3.0
	Term credits	*16.0*
Term 6		**Credits**
ECEE 302	Electronic Devices	4.0
ECEL 301	Electrical Engineering Laboratory I	2.0
ECES 302	Transform Methods and Filtering	4.0

HIST 285	**Technology in Historical Perspective**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0
	Term credits	*17.0*
Term 7		**Credits**
ECEL 302	**ECE Laboratory II**	2.0
ECES 304	**Dynamic Systems**	4.0
PHIL 315	**Engineering Ethics**	3.0
MATH 291	**Complex and Vector Analysis for Engineers**	4.0
	Core elective	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
	Core elective	4.0
	Liberal Studies elective [1]	3.0
	Term credits	*16.0*
1	See the Department's Web site for a list of acceptable liberal studies electives.	
Term 9		**Credits**
ECEL 304	**ECE Laboratory IV**	2.0
ECEP 352	**Electric Motor Control Principles**	4.0
	Interdisciplinary course	4.0
	Core elective	4.0
	Liberal Studies elective	3.0
	Term credits	*17.0*
Term 10		**Credits**
ECE 491	**Senior Design I**	2.0
ECES 490	**Special Topics: Energy and Control Systems I**	4.0
	Elective	3.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
	Term credits	*15.0*
Term 11		**Credits**
MATE 492	**Senior Design II**	2.0
ECES 490	**Special Topics: Energy and Control Systems II**	4.0
	Two Computer science electives	6.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
	Term credits	*18.0*
Term 12		**Credits**
ECE 493	**Senior Design III**	4.0
ECES 490	**Special Topics: Energy and Control Systems III**	4.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
	Term credits	*14.0*
	Total credits (minimum)	**196.0**

Recommended Plan of Study

BS Electrical Engineering

Telecommunications and DSP Concentration

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
ECE 200	Fundamentals of Intelligent Systems	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
ECE 201	Foundations of Electric Circuits	3.0
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
ECEC 490	Special Topics in Engineering: Programming for Engineers	3.0
	Term credits	*16.0*
Term 6		**Credits**
ECEE 302	Electronic Devices	4.0
ECEL 301	Electrical Engineering Laboratory I	2.0
ECES 302	Transform Methods and Filtering	4.0

HIST 285	**Technology in Historical Perspective**	3.0
MATH 290	**Linear Modeling for Engineers**	4.0
	Term credits	*17.0*
Term 7		**Credits**
ECEL 302	**ECE Laboratory II**	2.0
ECES 352	**Digital Signal Processing**	4.0
PHIL 315	**Engineering Ethics**	3.0
MATH 291	**Complex and Vector Analysis for Engineers**	4.0
	Core elective (300-level ECE course from other ECE tracks)	4.0
	Term credits	*17.0*
Term 8		**Credits**
ECEE 304	**EM Fields and Waves**	4.0
ECEL 303	**ECE Laboratory III**	2.0
ECES 306	**Modulation and Coding**	4.0
ENGR 361	**Statistical Analysis of Engineering Systems**	3.0
	Liberal Studies elective [1]	3.0
	Term credits	*16.0*
1	See the Department's Web site for a list of acceptable liberal studies electives.	
Term 9		**Credits**
ECEE 354	**Wireless and Optical Electronics**	4.0
ECEL 304	**ECE Laboratory IV**	2.0
	Interdisciplinary course	4.0
	Core elective (300-level ECE course from other ECE tracks)	4.0
	Liberal Studies elective	3.0
	Term credits	*17.0*
Term 10		**Credits**
ECE 491	**Senior Design I**	2.0
	Elective	3.0
	ECE Technical elective [1]	3.0
	Liberal Studies elective	3.0
ECES 421	**Communications I**	3.0
or		
ECES 434	**Discrete Time Systems**	4.0
	Term credits	*14.0*
1	ECE Technical Electives are 300 or 400 level ECE courses from any track.	
Term 11		**Credits**
MATE 492	**Senior Design II**	2.0
	Elective	3.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
ECES 422	**Communications II**	3.0
or		
ECES 435	**Statistical Signal Processing**	4.0
	Term credits	*14.0*
Term 12		**Credits**
ECE 493	**Senior Design III**	4.0
	ECE Technical elective	3.0
	Liberal Studies elective	3.0
ECES 423	**Communications III**	3.0
or		
ECES 436	**Speech and Image Signal Processing**	4.0
	Term credits	*13.0*
	Total credits (minimum)	**190.0**

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 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
• To provide students with a knowledge of the fundamentals underlying environmental engineering and the application of this knowledge to problem solving;
• To provide students with the ability to integrate knowledge from diverse sources, develop new knowledge, and apply that knowledge to environmental problem solving;
• To provide students with the abiliity to interact with others in the identification and solution of environmental problems;
• To provide students with a knowledge of the scientific, technological, economic, ethical, social and cultural contexts of environmental problems; and
• To provide students with the skills necessary to lead others in the resolution of environmental problems.

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

Environmental Engineering

Bachelor of Science Degree: 195.0 credits

General education requirements		Credits
ECON 211	**Principles of Economics I (Micro)**	3.0
ECON 212	**Principles of Economics II (Macro)**	3.0
HUM 106	**Humanities and Communications I**	3.0
HUM 107	**Humanities and Communications II**	3.0
HUM 108	**Humanities and Communications III**	3.0
MATH 310	**Introduction to Probability and Statistics**	4.0
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	4.0
	Liberal studies electives	9.0

Engineering core courses		Credits
TDEC 110	**Mathematical Foundations of Engineering I**	3.0
TDEC 111	**Physical Foundations of Engineering I**	3.0
TDEC 112	**Mathematical Foundations of Engineering II**	3.0
TDEC 113	**Physical Foundations of Engineering II**	3.0
TDEC 114	**Mathematical Foundations of Engineering III**	3.0
TDEC 115	**Physical Foundations of Engineering III**	3.0
TDEC 120	**Chemical and Biological Foundations of Engineering I**	3.0
TDEC 121	**Chemical and Biological Foundations of Engineering II**	3.0
TDEC 122	**Chemical and Biological Foundations of Engineering III**	3.0
TDEC 130	**Engineering Design and Laboratory I**	3.0
TDEC 131	**Engineering Design and Laboratory II**	3.0
TDEC 132	**Engineering Design and Laboratory III**	3.0
TDEC 150	**Freshman Engineering Design I**	1.0
TDEC 151	**Freshman Engineering Design II**	1.0
TDEC 152	**Freshman Engineering Design III**	1.0
TDEC 201	**Energy I**	3.0
TDEC 202	**Energy II**	3.0
TDEC 211	**Materials I**	3.0
TDEC 221	**Systems I**	3.0
TDEC 222	**Systems II**	3.0
TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0

TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0

Environmental engineering requirements		**Credits**
BIO 221	**Microbiology**	5.0
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	**Engineering Economic Analysis**	3.0
CIVE 320	**Fundamentals of Fluid Flow**	4.0
CIVE 330	**Hydraulics I**	3.0
CIVE 430	**Hydrology**	3.0
CIVE 431	**Ground Hydrology**	3.0
EGEO 220	**Engineering Geology**	4.0
ENVE 152	**Environmental Measurement**	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
ENVR 451	**Atmospheric Environment**	3.0
or		
ENVE 435	**Groundwater Remediation**	
ENVE 460	**Fundamentals of Air Pollution Control**	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	**Senior Project Design I**	3.0
ENVE 492	**Senior Project Design II**	3.0
ENVE 493	**Senior Project Design III**	3.0
ENVR 284 WI	**Ecology I: Physiological and Population Ecology**	5.0
or		
BIO 221	**Microbiology**	5.0
ENVR 401	**Chemistry of the Environment**	3.0
	Technical electives	12.0

Writing-Intensive Course Requirements

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

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

Recommended Plan of Study

BS Environmental Engineering

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
ENVE 152	Environmental Measurement	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
MATE 221	Introduction to Mechanical Behavior of Materials	3.0
BIO 221	Microbiology	5.0
or		
ENVR 284 WI	Ecology I: Physiological and Population Ecology	5.0
	Term credits	*18.0*
Term 6		**Credits**
CHE 201	Process Material Balances	3.0
CHEM 230	Quantitative Analysis	3.0
CHEM 231 WI	Quantitative Analysis Lab	2.0

CIVE 320	**Fundamentals of Fluid Flow**	4.0
ENVE 300	**Introduction to Environmental Engineering**	3.0
	Term credits	*15.0*
Term 7		**Credits**
CIVE 330	**Hydraulics**	3.0
ENVE 302	**Environmental Transport and Kinetics**	3.0
MATH 310	**Introduction to Probability and Statistics**	4.0
PHIL 315	**Engineering Ethics**	3.0
	Technical elective (1)	3.0
	Term credits	*16.0*
Term 8		**Credits**
CHEM 241	**Organic Chemistry I**	4.0
CIVE 430	**Hydrology**	3.0
ECON 211	**Principles of Economics I (Micro)**	3.0
EGEO 220	**Engineering Geology**	4.0
	Liberal Studies elective	3.0
	Term credits	*17.0*
Term 9		**Credits**
CHEM 242	**Organic Chemistry II**	4.0
ECON 212	**Principles of Economics II (Macro)**	3.0
CIVE 240 WI	**Engineering Economics Analysis**	3.0
	Liberal Studies elective	3.0
	Technical elective (1)	3.0
	Term credits	*16.0*
Term 10		**Credits**
ENVE 460	**Fundamentals of Air Pollution Control**	3.0
ENVE 485	**Professional Environmental Engineering Practice**	1.0
ENVR 401	**Chemistry of the Environment**	3.0
ENVE 491	**Senior Project Design I**	3.0
	Liberal Studies elective	3.0
	Technical elective (2)	3.0
	Term credits	*16.0*
Term 11		**Credits**
CIVE 431	**Ground Hydrology**	3.0
ENVE 410	**Solid and Hazardous Waste**	3.0
ENVE 421	**Water and Waste Treatment II**	3.0
ENVE 486	**Environmental Engineering Processing Lab I**	2.0
ENVE 492	**Senior Project Design II**	3.0
	Technical elective (3)	3.0
	Term credits	*17.0*
Term 12		**Credits**
ENVE 422	**Water and Waste Treatment Design**	3.0
ENVE 487	**Environmental Engineering Processing Lab II**	2.0
ENVE 493	**Senior Project Design III**	3.0
	Liberal Studies elective	3.0
ENVE 435	**Groundwater Remediation**	3.0
or		
ENVR 451	**Atmospheric Environment**	3.0
	Term credits	*14.0*
	Total credits (minimum)	**195.0**

Materials Engineering

Materials engineering is concerned with the production, properties, and utilization of metals, ceramics, polymers, composites, and electronic materials. Materials engineers play a vital role in our increasingly complex technological society by extending the limited supply of materials, improving existing materials, and developing new and superior materials and processes with an awareness of cost, reliability, safety, and social/environmental implications.

Students majoring in materials engineering get 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 techniques for characterizing materials and evaluating their performance. In addition, several required senior courses emphasize the role of materials in design.

A required senior design project, a wide variety of technical elective courses, and co-op experiences allow students in-depth exploration of selected areas.
A minor in materials engineering is also available.

Mission Statement
Our mission is to produce graduates who can excel in leadership positions in industry and academia at the national and international levels.

Program Objectives

- *Educate our students so that they possess the technical competencies required to interface with all engineering disciplines in the workplace*
- *Increase the number of materials engineering graduates who have the aptitude for postgraduate education at the nation's premier engineering institutions or professional schools, and who could become leaders in their chosen fields*
- *Enhance the skills of our undergraduates in experimental methods and modeling, with a focus on materials engineering*
- *Develop an ability in our students to successfully undertake lifelong learning in the discipline and practice of materials engineering or in any other profession*
- *Enhance the verbal and written communication skills of materials engineering students*

Senior Design Projects
Throughout the senior year, majors in materials engineering work on a capstone senior design project with guidance from a faculty advisor. Students, working in small groups, synthesize information from their courses to arrive at solutions to real-world engineering problems.

Materials Engineering

Bachelor of Science Degree: 192.0 credits

Required courses

General education requirements		Credits
ECON 211	Principles of Economics I (Micro)	3.0
ECON 212	Principles of Economics I (Macro)	3.0
HIST 285	Technology in Historical Perspective	3.0
HUM 106	Humanities and Communications I	3.0
HUM 107	Humanities and Communications II	3.0
HUM 108	Humanities and Communications III	3.0
PHIL 315	Engineering Ethics	3.0
UNIV 101	The Drexel Experience	1.0
	Technical electives	9.0
	Liberal studies electives	9.0
	Free electives	6.0

Foundation requirements		Credits
CHE 310	Transport Phenomena	4.0
CHEC 353	Physical Chemistry and Applications III	4.0
CHEM 241	Organic Chemistry I	4.0
MATH 201	Linear Algebra	4.0
PHYS 451	Quantum Structure of Materials	4.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 150	Freshman Engineering Design I	1.0
TDEC 151	Freshman Engineering Design II	1.0
TDEC 152	Freshman Engineering Design III	1.0

TDEC 201	**Energy I**	3.0
TDEC 202	**Energy II**	3.0
TDEC 211	**Materials I**	3.0
TDEC 221	**Systems I**	3.0
TDEC 222	**Systems II**	3.0
TDEC 231	**Evaluation/Presentation of Experimental Data I**	4.0
TDEC 232	**Evaluation/Presentation of Experimental Data II**	4.0

Professional requirements		**Credits**
MATE 214	**Introduction to Polymers**	4.0
MATE 221	**Introduction to Mechanical Behavior of Materials**	3.0
MATE 240	**Thermodynamics of MaterialsI**	4.0
MATE 245	**Kinetics of Materials**	4.0
MATE 280	**Advanced Materials Laboratory**	4.0
MATE 315	**Processing of Polymers**	4.5
MATE 340	**Fundamentals of Ceramics**	4.0
MATE 345	**Processing of Ceramics**	4.5
MATE 367	**Microstructure of Metallic Materials**	4.0
MATE 366 WI	**Processing of Metallic Materials**	4.5
MATE 370	**Mechanical Behavior of Solids**	3.0
MATE 400	**Materials Engineering Design ***	3.0
MATE 410	**Case Studies in Materials**	3.0
MATE 455	**Biomedical Materials**	3.0
MATE 458	**Advanced Biomaterials**	3.0
MATE 460	**Engineering Computational Laboratory**	4.0
MATE 491	**Senior Project Design I**	2.0
MATE 492	**Senior Project Design II**	2.0
MATE 493	**Senior Project Design III**	4.0

* Check with department for possible alternative.

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

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

Recommended Plan of Study

BS Materials Engineering

Bachelor of Science Degree

4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
CHEM 241	Organic Chemistry I	4.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*17.0*
Term 5		**Credits**
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
MATE 221	Introduction to Mechanical Behavior of Materials	3.0
MATH 201	Linear Algebra	4.0
	Term credits	*17.0*
Term 6		**Credits**
MATE 214	Introduction to Polymers	4.0
MATE 240	Thermodynamics of Materials	4.0
MATE 367	Microstructure of Metallic Materials	4.0
MATE 455	Biomedical Materials	3.0
	Liberal Studies elective	3.0

	Term credits	*18.0*
Term 7		**Credits**
MATE 245	**Kinetics of Materials**	4.0
MATE 315	**Processing of Polymers**	4.5
MATE 370	**Mechanical Behavior of Solids**	3.0
MATE 458	**Advanced Biomaterials**	3.0
	Liberal Studies elective	3.0
	Term credits	*17.5*
Term 8		**Credits**
CHE 310	**Transport Phenomenona**	4.0
MATE 340	**Fundamentals of Ceramics**	4.0
MATE 280	**Advanced Materials Laboratory**	4.0
MATE 400	**Materials Engineering Design**	3.0
	Liberal Studies elective	3.0
	Term credits	*18.0*
Term 9		**Credits**
CHEC 353	**Physical Chemistry and Applications III**	4.0
MATE 345	**Processing of Ceramics**	4.5
MATE 366 WI	**Processing of Metallic Materials**	4.5
	Liberal Arts elective	3.0
	Term credits	*16.0*
Term 10		**Credits**
MATE 460	**Engineering Computational Laboratory**	4.0
PHYS 451	**Quantum Structure of Materials**	4.0
MATE 491	**Senior Design I** [1]	2.0
	Liberal Studies elective	3.0
	Term credits	*13.0*
1	Meets with ECE 491 and is only offered in the Fall. Not offered in the Spring.	
Term 11		**Credits**
MATE 492	**Senior Design II**	2.0
MATE 410	**Case Studies in Materials**	3.0
	Elective	3.0
	Liberal Studies elective	3.0
	Technical elective (1)	3.0
	Term credits	*14.0*
Term 12		**Credits**
MATE 493	**Senior Design III**	4.0
	Elective	3.0
	Liberal Studies elective	3.0
	Technical elective (2)	3.0
	Technical elective (3)	3.0
	Term credits	*16.0*
	Total credits (minimum)	**196.5**

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 e 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

- *Deliver a comprehensive mechanical engineering curriculum which emphasizes both the foundations and breadth of the mechanical engineering profession*
- *Provide an education that equips students with the tools necessary to become successful mechanical engineers based on their co-op experience, strong communication skills, and awareness of the need for continuous professional development*
- *Provide an education that will allow mechanical engineering students to understand the social, economic, environmental, political, and ethical importance of their future profession*
- *Provide mechanical engineering students with a thorough understanding of the impact of mechanical engineers and the mechanical engineering profession in the development, implementation and creation of future technology.*

Mechanical Engineering and Mechanics

Bachelor of Science Degree: 195.0 credits

Required courses

Mathematics requirements		Credits
MATH 290	Math Modeling for Engineers	4.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 221	Systems I	3.0
TDEC 222	Systems II	3.0

Physics requirements		Credits
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 201	Energy I	3.0
TDEC 202	Energy II	3.0

Chemistry/biology requirements		Credits
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0

Design/laboratory requirements		Credits
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 150	Freshman Engineering Design I	1.0
TDEC 151	Freshman Engineering Design II	1.0
TDEC 152	Freshman Engineering Design III	1.0
TDEC 231	Evaluation and Presentation of Experimental Data I	4.0
TDEC 232	Evaluation and Presentation of Experimental Data II	4.0

Engineering economics requirements		Credits
CIVE 240	Project Economics and Decisions	3.0

Liberal studies requirements		Credits
HIST 285	**Technology in Historical Perspective**	3.0
HUM 106	**Humanities and Communications I**	3.0
HUM 107	**Humanities and Communications II**	3.0
HUM 108	**Humanities and Communications III**	3.0
PHIL 315	**Engineering Ethics**	3.0
UNIV 101	**The Drexel Experience**	2.0

Materials requirements		Credits
TDEC 211	**Materials I**	3.0

Mechanical requirements		Credits
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 311	**Thermal Fluid Science Laboratory**	2.0
MEM 331	**Experimental Mechanics Laboratory**	2.0
MEM 351	**Dynamic Systems Laboratory**	2.0
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 465	**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
	Liberal studies	12.0
	MEM designated electives*	12.0
	MEM undesignated electives*	6.0
	MEM/CoE electives**	6.0
	MEM/Science/technical electives***	6.0
	Free electives	6.0

* All MEM students must complete a minimum of four of the advanced MEM fundamentals courses, plus any other two MEM courses 300 level or higher.

** Any MEM or College of Engineering course 300 level or higher.

*** Any MEM or science/engineering course 300 level or higher.

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 423	**Mechanics of Vibration**	4.0
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:

B.S. 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, with the exception of Biomechanical Engineering and Design and Manufacturing (these concentrations require specific courses, a senior design project and a suggested co-op experience).

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

Bachelor of Science Degree 4-yr co-op 5-yr co-op

Term 1		Credits
HUM 106	Humanities and Communications I	3.0
TDEC 110	Mathematical Foundations of Engineering I	3.0
TDEC 111	Physical Foundations of Engineering I	3.0
TDEC 120	Chemical and Biological Foundations of Engineering I	3.0
TDEC 130	Engineering Design and Laboratory I	3.0
TDEC 150	Freshman Engineering Design I	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 2		**Credits**
HUM 107	Humanities and Communications II	3.0
TDEC 112	Mathematical Foundations of Engineering II	3.0
TDEC 113	Physical Foundations of Engineering II	3.0
TDEC 121	Chemical and Biological Foundations of Engineering II	3.0
TDEC 131	Engineering Design and Laboratory II	3.0
TDEC 151	Freshman Engineering Design II	1.0
UNIV 101	The Drexel Experience	1.0
	Term credits	*17.0*
Term 3		**Credits**
HUM 108	Humanities and Communications III	3.0
TDEC 114	Mathematical Foundations of Engineering III	3.0
TDEC 115	Physical Foundations of Engineering III	3.0
TDEC 122	Chemical and Biological Foundations of Engineering III	3.0
TDEC 132	Engineering Design and Laboratory III	3.0
TDEC 152	Freshman Engineering Design III	1.0
	Term credits	*16.0*
Term 4		**Credits**
MEM 202	Engineering Mechanics: Statics	3.0
TDEC 201	Energy I	3.0
TDEC 211	Materials I	3.0
TDEC 221	Systems I	3.0
TDEC 231	Evaluation/Presentation of Experimental Data I	4.0
	Term credits	*16.0*
Term 5		**Credits**
MEM 230	Mechanics of Materials I	4.0
TDEC 202	Energy II	3.0
TDEC 222	Systems II	3.0
TDEC 232	Evaluation/Presentation of Experimental Data II	4.0
MEM 201	Fundamentals of Computer-aided Design	3.0
	Term credits	*17.0*
Term 6		**Credits**
HIST 285	Technology in Historical Perspective	3.0
MEM 238	Engineering Mechanics: Dynamics	4.0
CIVE 240 WI	Engineering Economics Analysis	3.0
MATH 290	Linear Modeling for Engineers	4.0
MEM 310	Thermal Analysis	4.0

	Term credits	*18.0*
Term 7		**Credits**
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
MEM 380	**Special Topics in Mechanical Engineering** [1]	3.0
	Term credits	*16.0*
1	Course number and name not yet formalized.	
Term 8		**Credits**
MEM 311	**Thermal Fluid Science Laboratory**	2.0
MEM 345	**Heat Transfer**	4.0
MEM 355	**Performance Enhancement of Dynamic Systems**	4.0
MEM 435	**Introduction to CAD/CAM**	4.0
	Mechanical Engineering and Mechanics elective (from list) [1]	3.0-4.0
	Term credits	*17.0-18.0*
1	MEM 330 Mechanics of Materials II; MEM 410 Thermodynamics Analysis II; MEM 437 Manufacturing Processes I; or MEM 459 Microcomputer-Based Control Systems II.	
Term 9		**Credits**
MEM 351	**Dynamic Systems Laboratory**	2.0
MEM 361	**Engineering Reliability**	3.0
	Two Mechanical Engineering and Mechanics electives (from list) [1]	8.0
	Liberal Studies elective	3.0-4.0
	Term credits	*16.0-17.0*
1	MEM 320 Fluid Dynamics I; MEM 423 Mechanics of Vibrations; MEM 440 Thermal System Design; or MEM 458 Microcomputer-Based Control Systems I.	
Term 10		**Credits**
MEM 491	**Senior Design I**	3.0
	MEM/CoE elective	3.0-4.0
	Mechanical Engineering and Mechanics elective (from list) [1]	3.0-4.0
	Liberal Studies elective	3.0-4.0
	MEM/Science/Technical elective	3.0-4.0
	Term credits	*15.0-19.0*
1	MEM 320 Fluid Dynamics I; MEM 423 Mechanics of Vibrations; or MEM 440 Thermal System Design.	
Term 11		**Credits**
MEM 492	**Senior Design II**	3.0
	Mechanical Engineering and Mechanics elective (undesignated) [1]	3.0-4.0
	MEM/CoE elective	3.0-4.0
	Liberal Studies elective	3.0-4.0
	MEM/Science/Technical elective	3.0-4.0
	Term credits	*15.0-19.0*
1	Any 300 level (or higher) MEM elective.	
Term 12		**Credits**
MEM 493	**Senior Project Design III**	3.0
	Two electives	6.0
	Mechanical Engineering and Mechanics elective (undesignated) [1]	3.0-4.0
	Liberal Studies elective	3.0-4.0
	Term credits	*15.0-17.0*
1	Any 300 level (or higher) MEM elective.	

	Total credits (minimum)	**195.0**

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 423	**Mechanics of Vibrations**	4.0
MEM 420	**Aerodynamics**	3.0
MEM 425	**Aircraft Design/Performance**	3.0
MEM 380	**Special Topics in Mechanical Engineering: Engineering Finite Element Analysis**	3.0
MEM 428	**Introduction to Composites I**	3.0
MEM 380	**Special Topics in Mechanical Engineering: Gas Turbines/Jet Propulsion**	3.0
MEM 426	**Aerospace Structures**	3.0
MEM 453	**Aircraft Flight Dynamics & Control I**	3.0
MEM 454	**Aircraft Flight Dynamics & Control II**	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
MEM 502	**Biofluid Dynamics**	3.0
MEM 684	**Mechanics of Biological Tissues**	3.0
MEM 475	**Medical Robotics I**	3.0
MEM 478	**Computer-Aided Tissue Engineerng**	4.0
MEM 685	**Mechanics of Human Joints**	4.0
MEM 686	**Mechanics of Human Motion**	3.0
MEM 476	**Medical Robotics II**	3.0
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
ANAT 101	**Anatomy and Physiology I**	5.0
ANAT 102	**Anatomy and Physiology II**	5.0
MEM 800	**Special Topics: Introduction to Forensic Biomechanics**	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 380	**Special Topics in Mechanical Engineering: Design, Analysis and Simulation for Manufacturing**	3.0
MEM 437	**Manufacturing Process I**	3.0
MEM 438	**Manufacturing Process II**	3.0
MEM 330	**Mechanics of Materials**	4.0
MEM 431	**Machine Design**	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
MEM 462	**Introduction to Engineering Management**	3.0
MEM 427	**Introduction to Finite Element Methods**	3.0
MEM 380	**Special Topics in Mechanical Engineering: Quality Engineering I**	3.0
MEM 380	**Special Topics in Mechanical Engineering: Quality Engineering II**	3.0
MEM 717	**Heat Transfer in Manufacturing Processes**	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
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
MEM 428	**Introduction to Composites I**	3.0
MEM 429	**Introduction to Composites II**	3.0
MEM 424	**Biomechanics**	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 458	**Microcomputer-based Control Systems I**	3.0
MEM 459	**Microcomputer-based Control Systems II**	4.0
MEM 425	**Aircraft Design/Performance**	4.0
MEM 455	**Introduction to Robotics**	3.0
MEM 456	**Robotics II**	3.0
MEM 453	**Aircraft Flight Dynamics & Control I**	3.0
MEM 454	**Aircraft Flight Dynamics & Control II**	3.0
MEM 457	**Robotics III**	3.0

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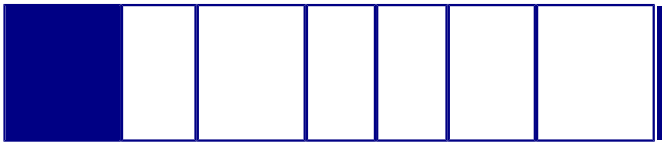

Thermal and Fluid Sciences

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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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 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): 192.0 credits

Degree Requirements

Software engineering requirements		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	**Sofware Verification and Validation**	3.0
SE 410	**Software Evolution**	3.0
SE 491	**Design Project I**	2.0
SE 492	**Design Project II**	2.0
SE 493	**Design Project III**	4.0

Computer science requirements		Credits
CS 260	**Data Structures**	3.0
CS 361	**Concurrent Programming**	3.0
CS 338	**Graphical User Interfaces**	3.0
CS 472	**Computer Networks**	3.0

Information systems requirements		Credits
INFO 210	**Database Management Systems**	3.0
INFO 310	**Human Computer Interaction II**	3.0
INFO 420 WI	**Software Project Management**	3.0

Computer engineering requirements		Credits
ECE 200	**Fundamentals of Intelligent Systems**	3.0

Computing electives		Credits
	Additional IS courses (CS courses see advisor)	18.0

Mathematics/statistics requirements		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 205	Statistical Inference I	4.0
STAT 206	Statistical Inference II	4.0

Basic Science requirements (Choose one of the following sequences)		Credits
BIO 102	Biology I: Cells and Tissues	4.0
BIO 104	Biology I: Growth and Heredity	4.0
BIO 106	Organismal Biology	4.0
or		
CHEM 101	General Chemistry I	4.0
CHEM 102	General Chemistry II	4.0
CHEM 103	General Chemistry III	5.0
or		
PHYS 111	Physics I	4.5
PHYS 112	Physics II	4.5
PHYS 211	Physics III	4.5
	Additional science electives	4.5 - 8.5

Liberal studies requirements		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
	Additional liberal studies electives	6.0

Business requirements		Credits
ECON 211	Principles of Economics I (Micro)	3.0
ECON 212	Principles of Economics II (Macro)	3.0
ACCT 111	Financial Accounting	3.0

University requirements		Credits
UNIV 101	The Drexel Experience	2.0

Other courses	Credits
Free electives	24.0

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

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

Recommended Plan of Study

BS Software Engineering

Bachelor of Science Degree — 5-yr co-op

Term 1		Credits
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
BIO 102	**Biology I: Cells and Tissues**	4.0
or		
CHEM 101	**General Chemistry I**	4.0
or		
PHYS 111	**Physics I** [1]	4.5
	Term credits	*15.0*

1 Students may only take Physics 111 in the first term of the Freshman year if they have taken AP Calculus. If not, students can schedule Physics I in the second term.

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**	1.0
BIO 104	**Biology II: Growth and Heredity**	4.0
or		
CHEM 102	**General Chemistry II**	4.0
or		
PHYS 112	**Physics II**	4.5
	Term credits	*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
	Liberal Studies elective	3.0
BIO 106	**Biology III: Organismal Biology**	4.0
or		
CHEM 103	**General Chemistry III**	5.0
or		
PHYS 211	**Physics III**	4.5
	Term credits	*17.0*

Term 4		Credits
COM 230	**Techniques of Speaking**	3.0
CS 260	**Data Structures**	3.0
INFO 210	**Database Management Systems**	3.0
SE 210	**Software Specification and Design I**	3.0
	Natural science elective	3.0
	Term credits	*15.0*

Term 5		Credits
COM 310 WI	**Technical Communication**	3.0
CS 270	**Mathematical Foundations of Computer Science**	3.0
MATH 221	**Discrete Mathematics**	3.0
SE 211	**Software Specification and Design II**	3.0

	Science elective	3.0
	Term credits	*15.0*
Term 6		**Credits**
ECE 200	**Fundamentals of Intelligent Systems**	3.0
SE 320	**Software Verification and Validation**	3.0
STAT 205	**Statistical Inference I**	4.0
	Elective	3.0
	Science elective	3.0
	Term credits	*16.0*
Term 7		**Credits**
SE 410	**Software Evolution**	3.0
STAT 206	**Statistical Inference II**	4.0
	Elective	3.0
	Liberal Studies elective	3.0
	Computing elective [1]	3.0
	Term credits	*16.0*
1	Any non-required ISYS/INFO course. See advisor for Computer Science (CS) course options.	
Term 8		**Credits**
CS 361	**Concurrent Programming**	3.0
PHIL 105	**Critical Reasoning**	3.0
SE 310	**Software Architecture I**	3.0
	Elective	3.0
	Two Computing electives	6.0
	Term credits	*18.0*
Term 9		**Credits**
INFO 310	**Human Computer Interaction II**	3.0
SE 311	**Software Architecture II**	3.0
	Two electives	6.0
	Computing elective	3.0
	Term credits	*15.0*
Term 10		**Credits**
CS 472	**Computer Networks**	3.0
ECON 211	**Principles of Economics I (Micro)**	3.0
INFO 420 WI	**Software Project Management**	3.0
PSY 101	**General Psychology I**	3.0
SE 491	**Design Project I**	2.0
	Elective	3.0
	Term credits	*17.0*
Term 11		**Credits**
ECON 212	**Principles of Economics II (Macro)**	3.0
PSY 330	**Cognitive Psychology**	3.0
SE 492	**Design Project II**	2.0
	Elective	3.0
	Two Computing electives	6.0
	Term credits	*17.0*
Term 12		**Credits**
CS 338	**Graphical User Interfaces**	3.0
PHIL 311	**Computer Ethics**	3.0
ACCT 111	**Financial Accounting**	3.0
SE 493	**Design Project III**	4.0
	Elective	3.0
	Term credits	*16.0*
	Total credits (minimum)	**192.0**

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 tDEC 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		**16.5 Credits**
AE 210	**Introduction to AE Building Systems**	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

		8.0 Credits
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	**Engineering Economics**	3.0

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. Calculus prerequisites should include TDEC 110, 112, and 114 or MATH 121-123 and 200. Physics requirements are TDEC 111, 113, and 115, or PHYS 111, 112, and 211. 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		**13.0 Credits**
ECE 200	**Fundamentals of Intelligent Systems**	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 Credits**

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.

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.

Note: students who declared the computer science minor prior to the summer of 2004 (academic year 2003-2004) should contact the Department for more information about the requirements for fulfilling the minor.

Mathematics prerequisites:		**Credits**
One of the following two-term mathematics sequences must be completed before entering the program:		
TDEC 110	**Mathematical Foundations of Engineering I**	3.0
TDEC 112	**Mathematical Foundations of Engineering II**	3.0
or		
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 counted toward 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		**9.0 - 12.0 Credits**
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**	3.0
or		
SE 101	**Fundamentals of Software Engineering I**	3.0
SE 102	**Fundamentals of Software Engineering II**	3.0

Students complete one of the following advanced courses:*:*

CS 265	**Advanced Programming Tools and Techniques**	3.0
SE 103	**Fundamentals of Software Engineering III**	3.0

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

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

Advanced Electives*		**6.0-7.0 Credits**
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		
CS 282	**Systems Architecture II**	4.0
CS 361	**Concurrent Programming**	3.0
CS 370	**Operating Systems**	3.0
CS 461	**Database Systems**	3.0
CS 472	**Computer Networks**	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
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	**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).**

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 TDEC curriculum. In mathematics, this would cover calculus (TDEC 110, 112, and 114 or MATH 121-123 and 200) and differential equations (TDEC 221 and 222, or MATH 210). Knowledge of linear algebra is also recommended. Physics requirements are TDEC 111, 113, and 115, or PHYS 111, 112, and 211. Courses taken to meet these requirements will not count toward the minor.

Required courses		**14.0 Credits**
ECE 200	**Fundamentals of Intelligent Systems**	3.0
ECE 201	**Fundamentals of Electrical Circuits**	3.0
ECES 302	**Transform Methods & Filtering**	4.0
ECEL 301	**ECE Laboratory I**	2.0
ECEL 302	**ECE Laboratory II**	2.0

Electives **12.0 Credits**
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.

Minor in Engineering Management

The minor in engineering management focuses on the management of technical organizations and projects. The core courses cover entrepreneurship and the development of new technology products and projects.

The student's selection of electives are from a large list of multi-disciplinary engineering and non-engineering courses. This enables students to tailor the elective cycle to their professional development interests. The Engineering Management Program will permit reasonable latitude for students to suggest additional courses for inclusion based on stated professional development goals.

While this minor is primarily designed to provide engineering management knowledge and skills to other engineers, with the equivalent science background students from other sciences can also complete this minor.

The minor consists of a minimum of 24 credits total, with five required core courses. Students select three additional elective courses approved by the department.

Prerequisites
The tDEC 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		**15.0 Credits**
CIVE 240 WI	**Engineering Economics**	3.0
MEM 462 WI	**Introduction to Engineering Management**	3.0
MEM 380	**Special Topics in Mechanical Engineering: Technical Development for Engineers**	3.0
MEM 380	**Special Topics in Mechanical Engineering: Introduction to Entrepreneurial Engineering**	3.0
MEM 380	**Special Topics in Mechanical Engineering: Introduction to Project Management for Engineers**	3.0

Students select a minimum of three additional elective courses. The following list provides suggested electives. Based on individual professional development goals, students may request departmental approval for other electives not included in this list:

CIVE 446	**Contract Specifications and Engineering Law**	3.0
CHE 335	**Statistics and Design of Experiments**	3.0
CHE 451	**Safety Engineering**	3.0
CS 337	**Psychology of Human-Computer Interactions**	3.0
COM 310 WI	**Technical Communication**	3.0
ECEP 354	**Energy Management Principles**	3.0
ENVE 335	**Industrial Safety**	3.0
ENVR 331	**Industrial Hygiene I**	3.0
MEM 361	**Engineering Reliability**	3.0

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 tDEC 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		**15.0 Credits**
ENVE 152	**Environmental Measurement**	3.0
ENVE 300	**Introduction to Environmental Engineering**	3.0
ENVE 302	**Environmental Transport and Kinetics**	3.0
CIVE 330	**Hydraulics**	3.0
ENVR 401	**Chemistry of the Environment**	3.0

		9.0 Credits
Students select a minimum of nine 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

Minor in Materials Engineering

In addition to the core engineering curriculum and the courses required for the major in chemical, civil, electrical, or mechanical engineering, students electing to pursue the minor in materials engineering must fulfill the following requirements.

Required courses		Credits
At least 21.0 credits from the following courses		
MATE 214	**Introduction to Polymers**	4.5
MATE 240	**Thermodynamics of MaterialsI**	4.0
MATE 340	**Fundamentals of Ceramics**	4.0
MATE 364	**Microstructure of Metallic Materials**	3.5
MATE 370	**Mechanical Behavior of Solids**	3.0
PHYS 451	**Quantum Structure of Materials**	4.0

***Taken in the sophomore or pre-junior year.**

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 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 cited list. Students pursuing the minor are encouraged to select a senior design topic that is relevant to materials.

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 courses; (b) at least eight credits from additional required courses or from the laboratory components and recommended electives.

Required courses		Credits
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 465	**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

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.

Requirements		Credits
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 Software Engineering electives	6.0