

VI. School of Engineering

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Hang Liu, Ph.D.	<i>Associate Dean for Graduate Programs and Faculty and Professor of Electrical Engineering and Computer Science</i>
Melvin G. Williams, Jr.	<i>Associate Dean for Professional Programs</i>

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Associates of the Faculty

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Ossama Ali Ahmed	<i>Lecturer in Civil and Environmental Engineering</i>
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Philip C. Jones, J.D.	<i>Lecturer in Civil and Environmental Engineering</i>
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S. Samuel Lin, Ph.D.	<i>Lecturer in Civil and Environmental Engineering</i>
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Melvin Williams, Jr., M.S.E., VADM (ret) *Associate Dean (External Affairs); Director of Engineering Management Program, Director of Materials Science & Engineering Program, Lecturer in Engineering Management*

Adam Wolfe, Ph.D., P.E. *Adjunct Associate Professor of Mechanical Engineering*

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Diane L. Damiano, Ph.D. *Chief, Functional and Applied Biomechanics Section, NIH, Bethesda, MD*

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Dennis McCahill, Ph.D.	<i>Retired</i>
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Scott Stewart	<i>Principal, SKandA Structural Engineers, Washington, D.C.</i>
Gene VanDyck, Ph.D.	<i>General Dynamics</i>
William (Bill) Whiting	<i>Vice President, The Whiting-Turner Contracting Co., Washington DC</i>

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Jose R. Latimer, Ph.D.	<i>Executive for Homeland Protection Mission Area, Johns Hopkins Applied Physics Laboratory, Laurel, MD</i>
Chang-Tien Lu, Ph.D.	<i>Professor of Computer Science, Virginia Tech, Arlington, VA</i>

Jude Nitsche	<i>Principal, Nitsche and Associates LLC, Alexandria, VA</i>
Lawrence Schuette, Ph.D.	<i>Director of Global Science, Technology and Innovation, Lockheed Martin Corporation, Bethesda, MD</i>
Scott E. Stickels	<i>CTO, Applied Physical Sciences Corporation, Arlington, VA</i>
Harold Szu, Ph.D.	<i>Distinguished Retired Scientist, Night Vision Lab, Ft. Belvoir, VA</i>
Cheng Xiuzhen, Ph.D.	<i>Professor of Computer Science, IEEE Fellow, The George Washington University, Washington, D.C.</i>

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Gil Crouse, Ph.D.	<i>Chief Engineer for Advanced Aircraft Development, Aurora Flight Sciences, a Boeing Co., Manassas, VA</i>
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David Didion, Ph.D.	<i>Retired NIST Fellow, National Institute of Standards and Technology, Port Republic, MD</i>
Terry DuBois, Ph.D.	<i>Sr. Research Engineer, US Army Communications, Electronics, Research, Development and Engineering Center, Aberdeen Proving Ground, MD</i>
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Jude Nitsche	<i>Principal, Nitsche and Associates LLC, Alexandria, VA</i>
Steven Russell, Ph.D.	<i>Project Manager, Ship Systems Engineering, Office of Naval Research, Arlington, VA</i>

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McLean, VA*

Stephen Wilson *Deputy Director, Ship Signatures Department, NSWC Carderock,
Bethesda, MD*

History

The engineering program was established in 1896, soon after the founding of The Catholic University of America. The School of Engineering was formally established as a separate school in 1930 and was shortly thereafter renamed the School of Engineering and Architecture. In 1992, the School of Engineering and Architecture separated and became the School of Engineering and the School of Architecture and Planning. Prior to 1950, the primary focus of the school was on undergraduate professional programs, although graduate programs had always been offered. However, research activity and graduate professional offerings have increased at a steady rate since 1950. Today the School of Engineering offers bachelor's, master's, and doctoral degrees in six academic programs, as well as master's degrees in Engineering Management, Materials Science and Engineering, and Data Analytics.

Mission

To discover and impart the truth through excellence in engineering teaching, research, and service while providing a personalized and caring environment in which faculty, staff, and students realize their full potential.

Vision

The Catholic University of America's School of Engineering attracts people who care. Our students learn and grow in an environment where faculty, staff, and fellow students care about not just academic success but about one another as persons, and about the challenges facing humanity in an ever-more connected and complex world. The past century has seen a tremendous growth in technology, bringing huge improvements in the human condition but also bringing dangers and unforeseen consequences, as our ability to affect one another and our world becomes magnified by scientific progress and technical innovation. For humanity to flourish in the 21st century, tomorrow's leaders will need to understand not only how to solve technical problems, but how to see those problems in broad context, and how to think deeply about the moral, ethical, and social issues that relate to technological advances. The Catholic University of America School of Engineering *cultivates minds that are motivated to place analytical and technical knowledge at the service of others, and create engineering solutions to problems and new ways of thinking for the common good.* Our efforts reflect Pope Francis's call for sustainable development that honors the dignity of each person and embraces our responsibility to care for one another and for the world that is our common home.

Goals and Objectives

Goal 1: Distinction. Distinguish the Catholic University School of Engineering through actions and communications as the Engineering School with teaching and research excellence, ethical character development, caring service, and the advantages of location in the capital of the United States of America.

Goal 2: Prosperity. The School will achieve prosperity by expanding and strengthening existing programs and establishing unique and timely new academic programs that serve the region, nation, and world with superior technical competence, incorporate moral and ethical values, and prepare future leaders.

Goal 3: Opportunity. The School will provide the best opportunities for faculty, staff, and students to realize their full potential.

Each program's curriculum ensures that graduates have an ability to apply knowledge of mathematics, science, and engineering; to design and conduct experiments, as well as to analyze and interpret data; to design systems, components, or processes to meet desired needs; to function on multi-disciplinary teams; to identify, formulate, and solve engineering problems; to understand professional and ethical responsibility; to communicate effectively; to understand the need for, and to engage in, lifelong learning;

and to use the techniques, skills, and modern engineering tools necessary for engineering practice. The school works closely with the departments in assessment and improvement of the various programs. School-level efforts are focused on the core or common part of the curricula, in particular, providing a vehicle for working with departments and schools outside of engineering on curriculum development and improvement.

Student surveys and evaluation of various data collected by and maintained by the school and the office of Planning, Institutional Research, and Student Learning Outcomes Assessment are used as appropriate in improvement efforts. The dean's office also coordinates improvement efforts with other offices on campus such as career services, enrollment management, the dean of undergraduate studies, and the registrar. Technology can play an important role in solving many of the problems facing humankind. The engineer of tomorrow will have the responsibility to engineer in a socially conscious way. The engineering programs of The Catholic University of America permit maximum flexibility so that students may pursue courses of study that reflect a balance between technology and social awareness.

Undergraduate Curricula and Academic Regulations

Degree Programs

The School of Engineering offers programs leading to the degrees of Bachelor of Biomedical Engineering, Bachelor of Civil Engineering, Bachelor of Electrical Engineering, Bachelor of Mechanical Engineering, Bachelor of Science in Computer Science, and Bachelor of Science in Environmental Engineering. The undergraduate programs in biomedical engineering, civil engineering, electrical engineering, and mechanical engineering are accredited by the Engineering Accreditation Commission of ABET, and the program in computer science is accredited by the Computing Accreditation Commission of ABET.

Academic Advising

Once admitted to the School of Engineering, each student is assigned an academic advisor, usually a full-time faculty member. Typically, students remain with their advisors for the duration of their studies. Students are required to consult with their advisors at least once a semester, but have the possibility of meeting with their advisor at any time during the academic year. Students must obtain approval from their advisors for registration and to make any course changes, such as adding or dropping a course. The Associate Dean of Undergraduate Programs advises general (undecided) engineering students. Ordinarily, at the end of the first year of study, an undecided student will be asked to designate the program in which he or she wishes to earn a degree, if he or she has not already done so. The undecided student will consult with the Associate Dean of Undergraduate Programs and the chair of the designated program and, once accepted, will be reassigned to an advisor from the designated program.

Transfer Students

Historically, many junior and senior engineering students have transferred to the school from community colleges and four-year liberal arts colleges. Experience with these students indicates that they are able to perform academically similarly to the way in which they performed in their previous institutions. Students who have completed pre-engineering programs may normally begin the junior year of studies. Students who wish to transfer to the school are advised to contact the appropriate department to determine which of their previous courses are transferable.

Transfer Credits

With pre-approval from the Associate Dean of Undergraduate Programs, students can take courses at institutions outside of the Consortium and transfer these credits to the school, within limits set by the university. The school has a rigorous procedure to evaluate courses for equivalency taken by transfer students and courses to be taken at institutions outside of the Consortium. The Associate Dean of Undergraduate Programs must approve all transfer credits.

Internships

The school believes that students can benefit from academic year and summer internships, which provide opportunities for students to learn while doing actual engineering work. The Center for Academic and Career Success and the school assist students in obtaining internships. The Department of Civil and Environmental Engineering requires internships as an integral part of its program -the construction concentration requires two while the rest of the department requires one. The program in biomedical engineering has a long history of placing students in internships with hospitals and research laboratories in the Washington, D.C., area and is expanding its industrial internship opportunities. The electrical engineering and computer science programs have summer internship and co-op programs with the Naval Research Laboratories. The mechanical engineering program also strongly encourages its students to pursue internship opportunities.

Interdisciplinary Studies

Students may elect to pursue an interdisciplinary course of study in dual degree programs leading to an engineering or a computer science degree and a degree in an academic concentration in the School of Arts and Sciences. Interested students should contact the dean's office for more information. In addition, a program leading to the dual degrees of Bachelor of Science in Architecture, offered by the School of Architecture and Planning, and Bachelor of Civil Engineering is available to students who want to combine the practice of architecture and engineering.

Interested students should contact either the School of Architecture and Planning or the Department of Civil and Environmental Engineering for specific information.

Minors

A minor, or sub-concentration, in the humanities, social sciences, philosophy, or religious studies is available to students who complete the requirements for the sub-concentration as stipulated by the respective department or school. Normally, a sub-concentration consists of six or seven courses in one disciplinary area.

Engineering students can also obtain a minor in computer science, neuroscience, or data analytics. Students should check with their departments for specific requirements for the minor. Completed applications for a minor must be submitted to the Office of the Dean of the School of Engineering.

Accelerated Bachelor's/Master's Degree Programs

An accelerated bachelor's/master's program allows undergraduate students to pursue a bachelor's degree and a master's degree in a shorter time than would be required if both degrees were pursued separately. This is made possible by allowing a number of approved graduate engineering courses (500 level or greater) taken as part of the requirements for the bachelor's degree to be applied toward the master's degree. Students should speak to their advisor for additional information regarding admission requirements and the application process.

Study Abroad Program

The School of Engineering has established a student exchange program with Hong Kong Polytechnic University. Through the established student exchange program, qualified engineering students at Catholic University may study abroad during the second semester of their junior year. The Catholic University engineering undergraduate programs have developed modified curricula for their study abroad students to ensure that the participating students graduate on time. Students who are interested in this program should contact the dean's office for general information and their department for specific coursework. To be eligible to participate in the study abroad program, students must be in good standing and possess a minimum cumulative GPA of 3.00 at the end of their sophomore year. For more information please see the School of Engineering website at: <http://engineering.catholic.edu>

English Requirement

All students are required to take at least one English writing course, normally ENG 101, Rhetoric and Composition. The particular course depends on placement at the time of matriculation and the level of English language proficiency for international students.

Mathematics Requirement

All incoming freshmen are required to take a math placement exam. Students with insufficient scores will be required to take remedial math courses, such as MATH 108 (Elementary Functions), before taking MATH 121 (Calculus I). Remedial math courses do not count toward the degree requirements. Special requirements are imposed because the study of mathematics is integral to engineering. In particular, an engineering student may not advance to the sophomore level in mathematics (MATH 221, ENGR 222) without a minimum grade point average of 1.50 in the freshman year mathematics courses. A minimum grade point average of 1.75 is required in the freshman and sophomore mathematics courses as a prerequisite for admission to upper-division engineering courses.

Senior Design Requirement

All seniors in the School of Engineering must complete a two semester sequence in Senior Design. Each department within the School of Engineering offers ENGR 441 and ENGR 442, Interdisciplinary Senior Design I and II. This allows students from all majors within the School of Engineering to work in interdisciplinary teams. Another option for Senior Design is ENGR 420 and ENGR 421, Social Innovations I and II. The Social Innovations course sequence includes an additional emphasis on entrepreneurship.

GPA Requirement for Graduation

Students must have a minimum cumulative average of 2.0 in the course of studies required for the degree program to graduate.

A student whose cumulative GPA is less than 2.0 will be placed on academic probation for the following regular semester. In other words, a student whose cumulative GPA is below 2.0 at the end of the spring semester is on probation through the end of the following fall semester, even if the student takes Summer Session courses to raise his/her cumulative GPA. Also, a student whose cumulative GPA is below 2.0 at the end of the fall semester is on probation through the end of the following spring semester. While on probation, a student may register for no more than four courses and may not participate in extracurricular activities such as student government or athletics. A student may be academically dismissed for the following reasons: failure to gain a 2.0 cumulative GPA after two consecutive semesters on academic probation, failure in three courses in any given semester, or a cumulative GPA of less than 1.5 at the end of any academic year.

General Degree Requirements

Although the minimum number of courses required for an engineering degree is 40 credit-bearing courses, specific programs may require a somewhat larger total. In general, the curricula of the various programs are similar in the first two years, and students can transfer easily between programs during this period. The coursework during the last two years is discipline specific and can be tailored to meet the student's interests. The general requirements for the degree consist of four main areas: math and science components, a liberal study component, a general engineering component, and a discipline-specific technical component.

Math and Science Component:

For Engineering degrees, the Math and Science component consists of five mathematics courses and four science courses including laboratories.

For the Bachelor of Science in Computer Science, the component consists of two science courses and six math courses. The student is then required to complete an additional course that can be chosen from approved math or science electives.

Liberal Study Component (nine courses). The liberal study component emphasizes the religious, economic, historical, and philosophical aspects of modern civilization. It complements the technical component and demonstrates that technology is only one segment of culture and learning. It consists of one English composition course, two Theology and Religious studies courses, two core Philosophy courses, one approved course in professional Ethics in Engineering, one course in either social sciences, fine arts,

or literature, and two additional liberal studies courses. The requirement of religion courses is consistent with Catholic University's mission and goals, while the engineering ethics courses provide opportunities for students to increase their understanding of professional and ethical responsibilities. The English composition course emphasizes the need for engineers to communicate effectively. The two additional liberal studies courses must be selected in consultation with a student's advisor from a list of approved courses. These liberal study courses provide exposure to the broad range of studies necessary to understand the impact of engineering solutions in a global and societal context and provide knowledge of contemporary issues relevant to engineering practice.

General Engineering Component (ten courses). The general engineering component is common to most disciplines. It consists of seven courses in engineering design, laboratory, CAD, computer programming, engineering mechanics, electrical networks and electronics, and two discipline-relevant courses selected from a set of four engineering courses.

Engineering Common Component ([1] [2] [3] [4])

- **CSC 113 Computer Programming**
- **ENGR 102 Introduction to Engineering Design and Professionalism**
- **ENGR 106 Computer-Aided Engineering Tools**
- **ENGR 201 Engineering Mechanics I ([5])**
- **ENGR 211 Thermodynamics**
- **ENGR 212 Electrical Networks**
- **ENGR 401 Senior Seminar I**

A selection of courses as specified:

- **ENGR 202 Engineering Mechanics II (CE], ME)**
- **ENGR 301 Solid Mechanics (CE, ENV, ME)**
- **ENGR 321 Electronic Circuits I (BE, EE)**
- **ENGR 331 Fluid Mechanics (BE, CE, ENV, ME)**
- **ENGR 403 Control Systems (BE, EE, ME)**

Discipline-Specific Technical Component. The discipline-specific technical component consists of at least 12 courses and program electives covering topics relevant to a particular discipline.

Standard First-Year Engineering Program

The normal program for engineering students in the first year is presented below. Students with advanced placement and interdisciplinary programs may alter this program in consultation with their advisors.

First-Year Program

Course #	Course Title	1st	2nd
CSC 113	Computer Programming	3	-
ENG 101	Rhetoric and Composition	3	-
ENGR 102	Introduction to Engineering Design and Professionalism	3	-
MATH 121	Calculus I	4	-
PHIL 201	The Classical Mind	3	-
ENGR 201	Engineering Mechanics I	-	3
MATH 122	Calculus II	-	4
PHIL 202	The Modern Mind	-	3
PHYS 215	University Physics I	-	4
TRS 201	Scripture and Jesus Christ	-	3
	Total	16	17

Departments of the School of Engineering

Department of Biomedical Engineering

Ordinary Professor	Peter Lum
Associate Professors	Gregory Behrmann; Sang Wook Lee; Christopher Raub; Otto Wilson, Jr., <i>Chair</i>
Lecturers	Christy Foreman; Jeffrey Hooper; Kristen Miller
Adjunct Associate Professor	Chris Danek
Research Ordinary Professor	Ugo Della Croce; Harold Szu
Research Associate Professor	Bidhan Chandra Bandyopadhyay; Li-Yueh Hsu

Mission of the Department

The mission of the Department of Biomedical Engineering at Catholic University is to educate men and women who can bridge engineering with life sciences in the service of human health and represent the biomedical engineering profession with distinction. Our department serves as a conduit for better understanding of biology through engineering concepts and for utilizing the complex organization of life systems in developing new technologies. The department emphasizes integrative bioengineering and regards the humanities as an integral part of undergraduate education.

Undergraduate Program

The Department of Biomedical Engineering offers an undergraduate degree program leading to the Bachelor of Biomedical Engineering. Biomedical engineers solve problems in medicine or biology by applying the principles and tools of modern engineering. The undergraduate program provides a broad scientific and technical background in engineering, establishing the foundation for lifelong learning on newly emerging health care technologies.

The accredited degree program is designed to prepare the student for a professional career in biomedical engineering or to enter graduate or medical school. The premedical track satisfies the entrance requirements of most medical schools in the United States. Qualified students are encouraged to complete a master's degree through a fifth year of full-time study, with their fourth and fifth years coordinated to accommodate various interests and career objectives.

Unique features of the Catholic University undergraduate program include a strong internship program through partnerships with federal biomedical laboratories, industry, and local hospitals; the unique Washington location (six hospitals within one mile of campus, and a metropolitan area possessing the richest biomedical research environment in the world); the benefits of personalized education and training that come with a smaller academic environment; and well-funded initiatives in biomaterials, biomedical instrumentation, medical imaging and bio-optics, rehabilitation engineering, home care technologies, and tele-medicine that provide a nurturing environment for designing and evaluating innovative technologies for addressing real-world health care problems.

Standard Program First Year

Biomedical Engineering students take a first year program similar to all other engineering programs. In addition to the Math and Physics courses, students take ENGR 102, ENGR 106, CSC 113, and BE 491.

Second Year

Course #	Course Title	1st	2nd
CHEM 103	General Chemistry I	3	-
CHEM 113	General Chemistry I Lab	2	-
ENGR 201	Engineering Mechanics I	3	-
MATH 221	Calculus III	4	-
PHYS 216	University Physics II	4	-
BE 202	Biomechanics	-	3
BE 491	Seminar: Biomedical Engineering	-	0
CHEM 108	General Chemistry II	-	3
ENGR 211	Thermodynamics	-	3
ENGR 212	Electrical Networks	-	3
ENGR 222	Engineering Mathematics I	-	4

Total 16 16

Third Year

Course #	Course Title	1st	2nd
BIOL 105	Biology I	3	-
BIOL 115	Biology I Lab	2	-
BE 398	Biomechanical Design	3	0
ENGR 321	Electronic Circuits	3	-
ENGR 331	Fluid Mechanics	3	-
ENGR 355	Electrical Laboratory I	1	-
MATH 309	Probability and Statistics for Engineers	3	-
BE 315	Intro Biomedical Systems Analysis	-	3
BE 413	Biomedical Instrumentation	-	3
BE 491	Seminar: Biomedical Engineering	-	0
BIOL 418	Physiology	-	4
PHIL 362	Professional Ethics in Engineering	-	3
TRS 202 A/B	The Church and the Human Person	-	3
	Total	18	16

Fourth Year

Course #	Course Title	1st	2nd
BE 501	Biomaterials	3	-
ENGR 401	Senior Seminar I	1	-
ENGR 403	Control Systems	3	-
ENGR 441	Interdisciplinary Senior Design I	3	
	Engineering Program Electives	3	9
	Liberal Studies Electives	3	3
	Literature, Fine Arts, Social Science	-	3
ENGR 442	Interdisciplinary Senior Design II	-	3
	Total	16	18

Educational Objectives of the Undergraduate Program

The educational objectives of the biomedical engineering undergraduate program are that graduates will:

1. Work in careers in biomedical engineering or related fields (e.g. other engineering disciplines, medicine, law, etc.) and will continue developing the necessary skills to obtain leadership positions and other positions of increasing responsibilities.
2. Work in research careers by applying their background and knowledge towards the advancement of technology and the betterment of society by contributing to educational and social institutions.
3. Continue to learn and to expand and develop their knowledge and skill sets so as to be able to adapt and thrive in a rapidly changing global environment.

Department of Civil and Environmental Engineering

Professors

Gunnar Lucko; Arash Massoudieh, *Chair*

Professors Emeriti	Timothy W. Kao; Dennis F. McCahill; John J. McCoy; Hsien Ping "Frank" Pao; Michael C. Soteriades
Assistant Professors	Bismark R. D. Agbelie; Jason Davison; Laura Micheli
Visiting Assistant Professor	Richard Thompson, Jr
Lecturers	Ossama Ali; Yahya Aliabadizadeh; John Bonita; Francesco Corvaro; Gregory McHugh; Kiavash Parvan; Long T. Phan; Brian Pietryka; Nina Rodriguez; Jonathan Weigand

Mission of the Department

The mission of the Civil and Environmental Engineering program is to provide students with a balanced education, strong in the scientific, engineering, humanistic, and social bases, so that they may attain leadership roles in their profession and "use their knowledge and skill for the enhancement of human welfare and the environment" (Code of Ethics, American Society of Civil Engineers).

Civil Engineering Program

The undergraduate professional program in civil engineering leads to the Bachelor of Civil Engineering degree. It includes studies in structural and geotechnical engineering, environmental engineering and water resources, and construction engineering and management, aimed at helping graduates to pursue a career in civil engineering or to pursue graduate studies. Sufficient electives are available in the program to allow a greater concentration in one of these areas or to elect technical courses in other areas.

The Department of Civil and Environmental Engineering, in conjunction with the School of Architecture and Planning, offers dual degrees in civil engineering and architecture. Interested students should contact either the department or the school for specific information.

Civil Engineering Standard Program First Year

See standard first-year engineering program in the general engineering section.

It is recommended to join the American Society of Civil Engineers student chapter. It is required that students undertake at least one summer internship in a civil engineering related position after the first year.

The students take two elective courses and two selected elective courses according to their respective concentration (Construction Management, Water Resources and Environmental Engineering, Transportation, Structural and Geotechnical Engineering).

Second Year

Course #	Course Title	1st	2nd
ENGR 106	Computer Aided Engineering	3	-
ENGR 201	Engineering Mechanics I	3	-
MATH 221	Calculus III	4	-
CHEM 107	General Chemistry I	3	-
CHEM 113	General Chemistry Lab	2	-
CEE 310	Civil Engineering Systems	3	-
CEE 302	Construction Management and Systems Economics	-	3
ENGR 202	Engineering Mechanics II	-	3
ENGR 222	Engineering Mathematics I	-	4
ENGR 301	Solid Mechanics	-	3
CHEM 110	Introduction to Earth Science	-	3
	Total	18	16

Third Year

Course #	Course Title	1st	2nd
MATH 309	Probability and Statistics for Engineers	3	-
ENGR 331	Fluid Mechanics	3	-
TRS 202 A/B	The Church and the Human Person	3	-

	Liberal Studies Elective	3	-
CEE 383	Ethics & Stewardship	3	-
CEE 312	Theory of Structures	3	-
CEE 366	Soil Mechanics	-	2
CEE 367	Soil Lab	-	1
CEE 372	Hydraulics	-	3
CEE 402	Structural Steel Design	-	3
CEE 374	Introduction to Transportation	-	3
ENGR 438	Introduction to Environmental Engineering	-	3
	Total	18	15

Fourth Year

Course #	Course Title	1st	2nd
CEE 403	Reinforced Concrete Design	3	-
ENGR 441	Interdisciplinary Senior Design I	3	3
	CE Concentration Required Courses	3	3
	CE Concentration Electives	3	3
ENGR 401	Senior Seminar I	1	-
CEE 468	Foundation Engineering		3
ENGR 442	Interdisciplinary Senior Design II		
	Literature, Fine Art, or Social Science		3
	Liberal Studies Elective	3	-

Total	16	15
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Internship Requirement

Internships are a vital component in engineering education because they allow students to experience professional engineering practice and often lead to part-time or full-time employment opportunities. Undergraduate students in the Department of Civil and Environmental Engineering must complete at least one summer internship (two summer internships in construction concentration) related to their engineering studies. These last approximately 10 weeks and are typically paid. Internships can be performed in any city, state, or country. Students are responsible for arranging for internships with industry companies. After successful completion, students must write a two-page essay reflecting upon their internship experience that is signed by a company official and submitted to the department as proof that the requirement has been fulfilled. Students are urged to make early and active use of the various services offered by the Center for Academic and Career Success and to attend all career fairs. In cases of extreme hardship, students should see their advisor for assistance or reduction, but must provide written evidence of their efforts to arrange an internship.

Theology and Religious Studies Requirement

Students in the School of Engineering must take two required TRS courses. TRS 201, Foundations of Theology: Scripture and Jesus Christ is taken as part of the required courses of the FYE program. Note: TRS 201 is a prerequisite for all other TRS courses. Thus, all students must complete TRS 201 during or prior to their penultimate semester, since they will be unable to register for the remaining required TRS courses if they postpone TRS 201 until their final semester. The second required course is TRS 202, The Church and the Human Person. This course is offered in two separate formats: TRS 202A and TRS 202B. Either format will satisfy Engineering's TRS 202 requirement.

Concentrations

The Concentration Elective Courses are taken according to the concentration of the students. Selected electives are required by the respective program. Program electives are chosen by the student. The list of concentration elective courses for each concentration is provided below:

Structural/Geotechnical Engineering (STG)

Concentration Required Courses

CEE 414	3	Advanced Vibrations and Structural Dynamics
CEE 426	3	Introduction to Finite Elements

Concentration Electives

CEE 406	3	Advanced Structural Systems
CEE 416	3	Prestressed Concrete
CEE 463	3	Applied Hydrology
CEE 489	3	Construction Scheduling Techniques
ENGR 418	3	Experimental Techniques for Graduate Students

Construction Engineering and Management (CEM)

Concentration Required Courses

CEE 301	3	Construction Systems and Planning
CEE 490	3	Construction Operations Analysis

Concentration Electives

CEE 482	3	Value Engineering (in odd-numbered years)
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CEE 483	3	Engineering Entrepreneurship, Sustainability, and Lean Methods
CEE 487	3	Estimating and Bidding
CEE 489	3	Construction Scheduling Techniques
CEE 382	3	Construction Law, Operations, and Project Delivery (in even-numbered years)
CMGT 474	3	Strategic Management (off-campus)

Environmental Engineering (ENV)

Concentration Required Courses

BIOL 105	4	Mechanisms of Life I
CHEM 108	3	General Chemistry II

Concentration Electives

CHEM 442	3	Environmental Chemistry Laboratory
CEE 463	3	Applied Hydrology
CEE 464	3	Surface Water Quality
CEE 491	3	Engineering Hydrogeology and Groundwater Flow
CEE 496	3	Water and Wastewater Treatment Engineering
ENGR 408	3	Batteries, Fuel Cells, and Energy Storage

Transportation Engineering (TRN)

Selected Electives

CEE 478	3	Transportation Systems Management and Operations
CEE 473	3	Traffic Engineering and Flow Theory

Program Electives

APRL 489	3	Geographical Information Systems
CEE 400	3	Transportation Planning
CEE/	3	Introduction to Systems Analysis
CMGT 475		
CEE 425	3	Nondestructive Testing and Evaluation
CEE 499	3	Transportation Safety Engineering

Educational Objectives of the Undergraduate Program

The educational objectives of the civil engineering undergraduate program are as follows:

1. The graduates are expected to be able to acquire skills to analyze and design civil engineering systems, evaluate alternatives, and discover/assess innovative solutions to problems in various areas of civil engineering in a changing environment.
2. The graduates are expected to be able to learn, understand, and utilize modern engineering tools for professional practice and leadership, and to be able to critically evaluate the results provided by such tools.
3. The graduates are expected to understand the importance of moral and ethical values as well as environmental stewardship in the global/societal context, and to make sound judgment calls on ethical issues related to their profession.

Standard Program

Elective courses specific to each concentration will be selected by the students. For the civil/architectural concentration courses please refer to the departmental course tracking sheets for details.

Internships are a vital component in engineering education because they allow students to experience professional engineering practice and often lead to part-time or full-time employment opportunities.

Undergraduate students in the Department of Civil and Environmental Engineering must complete at least one summer internship (two summer internships in construction concentration) related to their civil engineering studies. These last approximately 10 weeks and are typically paid. Internships can be performed in any city, state, or country.

Students are responsible for arranging internships with industry companies. After successful completion, students must write a two-page essay reflecting upon their internship experience that is signed by a company official and submitted to the department as proof to consider the requirement fulfilled. Students are urged to actively and early use the various services, consultations, and databases by the Center for Academic and Career Success and to attend all career fairs.

In case of extreme hardship, students should see their advisor for assistance or reduction, but must provide written evidence of their efforts to arrange an internship.

For the capstone design, students must take CEE 520, Design of Structural Systems I (2 credits) and CEE 521, Design of Structural Systems II (3 credits). In CEE 520 students learn about modern tools commonly used in the practice of various civil engineering disciplines, while CEE 521 provides students a major design experience by allowing them to work on a design project.

Recommended Program Electives

CEE 500	Transportation Planning
CEE 504	Stress - Strain Behavior of Soils
CEE 516	Prestressed Concrete
CEE 562	Seepage and Slope Stability
CEE 563	Applied Hydrology
CEE 564	Surface Water Quality
CEE 572	Intelligent Transportation Systems
CEE 574	Forensic Engineering
CEE 575	Introduction to Systems Analysis
CEE 578	Project Management
CEE 582	Value Engineering
CEE 583	Eng, Entrepreneurship, Sustain, and Lean Methods
CEE 587	Estimating and Bidding
CEE 591	Engineering, Hydrogeology and Groundwater Flow
CEE 594	Construction Law, Operations, and Project Delivery
CEE 596	Water and Wastewater Treatment Engineering
CEE 599	Transportation Safety Engineering
CMGT 574	Strategic Management (Off Campus)

Environmental Engineering Program

The undergraduate program in environmental engineering leads to the Bachelor of Science in Environmental Engineering degree.

Environmental Engineering Standard Program First Year

See standard first-year engineering program in the general engineering section.

Second Year

Course #	Course Title	1st	2nd
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BIOL 105	Mechanisms of Life	4	-
BIOL 115	Mechanisms of Life Lab	2	-
CHEM 103	General Chemistry I	3	-
CHEM 113	General Chemistry Lab I	2	-
ENGR 201	Engineering Mechanics	3	-
MATH 221	Calculus III	4	-
ENGR 222	Engineering Mathematics I	-	4
ENGR 438	Intro to Environmental Engineering	-	3
TRS 202 A/B	The Church and the Human Person	-	3
	Liberal Studies Electives	-	6
	Total	16	16

Third Year

Course #	Course Title	1st	2nd
MATH 309	Probability and Statistics	3	-
CHEM 101	Principles of Environmental Science	3	-
ENGR 331	Fluid Mechanics	3	-
CEE 383	Ethics and Stewardship	3	-

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ENGR 391	Introduction to Materials Science and Engineering	3	-
	Liberal Studies Elective	-	3
CEE 366	Soil Mechanics	-	2
CEE 367	Soil Testing	-	1
CEE 372	Applied Hydraulics	-	3
ENGR 211	Thermodynamics	-	3
ME 437	Air Pollution Control	-	3
	Total	15	15

Fourth Year

Course #	Course Title	1st	2nd
CEE 427	Environmental Processes	3	-
CEE 465	Water Resources Engineering	3	-
CEE 491	Hydrogeology	3	-
CHEM 311	Analytical Chemistry	5	-
ENGR 401	Senior Seminar	1	-
ENGR 441	Interdisciplinary Senior Design I	3	
CEE 357	Solid Waste Management	-	3
CEE 497	Wastewater Treatment	-	3

ENGR 442	Interdisciplinary Senior Design II	-	3
ME 311	Introduction to Energy Systems	-	3
	Literature, Fine Arts, or Social Science	-	3
	Total	18	15

Theology and Religious Studies Requirement

Students in the School of Engineering must take two required TRS courses. TRS 201, Scripture and Jesus Christ is taken as part of the required courses of the FYE program. Note: TRS 201 is a prerequisite for all other TRS courses. Thus, all students must complete TRS 201 during or prior to their penultimate semester, since they will be unable to register for the remaining required TRS course if they postpone TRS 201 until their final semester. The second required course is TRS 202, The Church and the Human Person. This course is offered in two separate formats: TRS 202A and TRS 202B. Either format will satisfy Engineering's TRS 202 requirement.

Department of Electrical Engineering and Computer Science

Professors	Hang Liu; Nader Namazi, <i>Chair</i>; Charles C. Nguyen
Associate Professors	Lin-Ching Chang; George Nehmetallah
Assistant Professors	Hieu Bui; Matthew Jacobs; Minhee Jun
Visiting Assistant Professors	Chaofan Sun
Lecturers	Charles Campbell Jr.; Vincent Cassella; Aysegul Cuhadar; Robert Kamocsai; Vadim Knyazev; Francis Linehan; Mohsen Marefat; Quang Nguyen; Sridava Rao; Kevin Russo; Hanney Shaban

Mission of the Department

The mission of the Department of Electrical Engineering and Computer Science is to educate men and women in the disciplines of electrical engineering and computer science in order to prepare them professionally so that they can contribute and service the needs of society with a commitment founded on moral and ethical principles.

Electrical Engineering Program

The incessant expansion of the Internet, wireless communications, information technology, network and information security, robotics, computer engineering, and alternative energy technologies continues to fuel demand for electrical engineers and computer scientists. Therefore, majoring in electrical engineering offers excellent professional prospects and challenging career opportunities.

Our dedicated and internationally recognized faculty are committed to providing a top-notch education that prepares students to successfully enter the job market or to continue for advanced studies at the graduate level.

We have strong technical programs in electrical engineering and computer science with carefully designed curricula. Students enjoy a friendly and cooperative learning environment that offers advantages such as small class sizes, low student-teacher ratios, personalized interaction with faculty members, and student participation in funded research projects. Our instructional laboratories are equipped with state-of-the-art instrumentation and equipment. Both undergraduate and graduate students can participate in funded research activities performed in our many research laboratories that are actively involved in areas including signal processing and visualization, applied electromagnetics and optics, telecommunications and information networks, robotics and intelligent control, and material properties.

Bachelor of Electrical Engineering Standard Program First Year

See standard first-year engineering program in the general engineering section.

Second Year

Course #	Course Title	1st	2nd
CHEM 107	General Chemistry I	3	-
CHEM 113	General Chemistry Lab I	2	-
ENGR 201	Engineering Mechanics I	3	-
MATH 221	Calculus II	4	-
PHYS 216	University Physics II	4	-
ENGR 207	Robots and Sensors	-	3
ENGR 211	Thermodynamics	-	3
ENGR 212	Electrical Networks	-	3
ENGR 222	Engineering Mathematics I	-	4
TRS 202 A/B	The Church and the Human Person	3	-

Total 16 16

Third Year

Course #	Course Title	1st	2nd
EE 311	Signals and Systems	3	-
EE 342	Electromagnetic Fields and Waves I	3	-
EE 357	Electromagnetic Laboratory	1	-
ENGR 321	Electronic Circuits	3	-
ENGR 355	Electrical Laboratory I	1	-
MATH 309	Probability and Statistics for Engineers	3	-
PHIL 362	Professional Ethics in Engineering	3	-
EE 312	Microprocessors	-	3
EE 326	Switching Circuits and Logic Design	-	3
EE 327	Switching Circuits and Logic Design Lab	-	1
EE 362	Analog and digital signal processing	-	3
	Literature, Fine Arts, or Social Science	-	3
	Total	17	13

Fourth Year

Course #	Course Title	1st	2nd
EE 413	Communication Systems	3	-
EE 457	Communications Laboratory	1	-
ENGR 401	Senior Seminar I	1	-
ENGR 403	Control Systems	3	-
ENGR 441	Interdisciplinary Senior Design	3	-
	Program Electives	3	6
	Liberal Studies Electives	3	3
ENGR 442	Interdisciplinary Senior Design II	-	3
	Total	17	12

Concentrations

Students in the Computer Engineering Concentration select program electives tailored to this area of specialization.

Recommended Program Electives

New courses are frequently added. For this reason students should consult their advisor regarding the department's recommendations and approval of each semester's program electives.

EE 502	Optical Systems and Devices
EE 504	Introduction to Fourier Optics
EE 514	Introduction to Hardware Accelerated Computing
EE 515	Advanced Digital Signal Processing
EE 516	Power Systems
EE 519	Digital Systems Design
EE 521	Programmable Logic Devices and HDL Design
EE 522	Linear System Analysis
EE 524	Secure Programming

EE 526	Computer and Network Security
EE 530	Parallel and Heterogeneous Computing
EE 531	Data Communications Networks
EE 534	Communication and Computer Network Simulation
EE 540	Introduction to Antenna Systems
EE 541	Electromagnetic Theory
EE 542	Antennas and Propagation for Wireless Communications
EE 543	Remote Sensing
EE 544	RF and Microwave Circuits
EE 545	High Resolution Radar Signal Processing
EE 546	Electrical Properties of Materials
EE 548	Optical Signal and Image Processing
EE 550	Semiconductor Optoelectronics - Materials and Devices
EE 561	Random Signal Theory
EE 563	Fundamentals of Acoustics
EE 565	Information Security
EE 569	Computer Security and Privacy
EE 572	Basics of Information Coding and Transmission
EE 576	Introduction to Robotics
EE 581	Cryptography and Steganography
ENGR 520	Mathematical Analysis for Graduate Students
ENGR 543	Wireless Sensor Networks
ENGR 570	Basics of High Performance Computing for Engineers
ENGR 652	Advanced Optical and Image Processing
PHYS 406	Introduction to Modern Physics
PHYS 428	Optics
PHYS 431	Introduction to Quantum Theory

Educational Objectives of the Electrical Engineering Program

Graduates of the electrical engineering program within a few years of graduation will:

1. Use their broad knowledge of electrical engineering as a foundation for ongoing learning, and will have realized some success early in their professional careers and/or in the pursuit of graduate studies.
2. Use their creative and critical reasoning skills to solve technical problems, ethically and responsibly, in service to society.
3. Use their mathematical and scientific knowledge to solve emerging real-world problems related to power, electronics, control systems, image analysis, signal processing, and communication systems, and will use their communication, organization, and teamwork skills for the execution of complex technological solutions.
4. Use their communication skills in bridging the divide between advanced technology and end users in the practice of electrical engineering.

Standard Program

For the alternative energy track in electrical engineering, courses vary from the standard program. Please refer to the departmental course tracking sheets for details.

Computer Science Program

The Computer Science Program, offering a Bachelor of Science in Computer Science, is designed to prepare graduates for leading roles in the computer science profession. The core areas of this program include operating systems, information processing, programming languages, computer graphics, hardware accelerated architectures, and information security. Many computer science electives are available to broaden the student's perspective in this field. Completion of this program also prepares the graduate for further graduate studies. Areas of special interest include data and communication networks, multimedia processing, bioinformatics, information assurance, and intelligent information systems. The department also offers a computer science minor, catering to students from other majors seeking to expand their command of information technologies.

The setting for this education is in a modern computer environment. The concentration of in-course studies, combined with laboratory studies, enhances the abilities of the students. Other school programs including electrical, civil, biomedical, and mechanical engineering offer a broad range of courses to computer science students as additional program electives for students with special interests.

Bachelor of Science in Computer Science Standard Program

First Year

Course #	Course Title	1st	2nd
CSC 120	Intro to Computational Thinking	3	-
CSC 123	C/C++ Programming	3	-
ENG 101	Rhetoric/Composition	3	-
MATH 121	Calculus I	4	-
PHIL 201	Classical Mind	3	
CSC 223	Object Oriented Programming	-	3
	Science Elective	-	3
MATH 121	Calculus II	-	4
PHIL 202	Modern Mind	-	3

TRS 201	Faith Seeking Understanding	-	3
		Total	16

Second Year

Course #	Course Title	1st	2nd
CSC 210	Discrete Mathematics	3	-
CSC 280	Data Structures	3	-
	Liberal Studies Elective	3	-
	Science Elective	3	-
TRS 202A/B	The Church and the Human Person	3	-
CSC 212	Theory of Computing	-	3
CSC 326	Switching Circuits and Logic Design	-	3
CSC 327	Switching Circuits and Logic Design Lab	-	1
CSC 370	Concepts of Programming Languages	-	3
	Literature, Fine Arts, or Social Science	-	3
	Science/Math Elective	-	3
		Total	15

Third Year

Course #	Course Title	1st	2nd
CSC 322	Introduction to Computer Graphics	3	-
CSC 323	Introduction to Computer Networks	3	-
CSC 390	Computer Organization & Architecture	3	-
MATH 309	Probability and Statistics for Engineers	3	-
PHIL 362	Engineering Ethics	3	-
CSC 363	Software Engineering	-	3
CSC 306	Introduction to Operating Systems	-	3
	Liberal Studies Elective	-	3
	Math Elective	-	3
	Computer Science Program Elective	-	3
	Total	15	15

Fourth Year

Course #	Course Title	1st	2nd
CSC 409	Web Programming	3	-
CSC 442	Introduction to Database Systems	3	-

ENGR 441	Interdisciplinary Senior Design I	3	-
	Computer Science Program Electives	3	6
	Math Electives	3	3
CSC 411	Analysis of Algorithm	-	3
ENGR 442	Interdisciplinary Senior Design II	-	3
	Total	15	15

Educational Objectives of the Computer Science Program

The educational objectives of the computer science program are to develop alumni who possess:

1. The broad knowledge of computer science to serve as a foundation for ongoing lifelong learning, and who will have demonstrated some success early in their professional careers and/or in the pursuit of graduate studies.
2. The creative and critical reasoning skills to solve technical problems, ethically and responsibly, in service to society.
3. Mathematical and scientific knowledge to solve emerging real world problems related to programming, networking, information security, image analysis, and advanced computing systems, and the necessary communication, organization, and teamwork skills for the execution of complex technological solutions.
4. The necessary communication skills to bridge the divide between advanced technology and end users in the practice of computer science.

Department of Mechanical Engineering

Professors	J. Steven Brown; Sen Nieh
Professors Emeriti	Mario Casarella; Yun Chow Whang
Associate Professors	Jandro Abot; John A. Judge; Xiaolong Luo; Diego Turo; Joseph Vignola, <i>Chair</i> ; Zhaoyang Wang
Assistant Professors	Christian Bomela; Chuan-Fu Lin; Sergio Picozzi

Adjunct Professors	George Mattingly
Adjunct Associate Professors	Adam Wolfe
Adjunct Assistant Professors	Shane Guan; Srinidhi Nagaraja; Tongele N. Tongele
Lecturers	Sepideh Akhbari Far; Matthew Guild; Barbara Marchetti; Rocco Mennella; Bruno Sarli

Mission of the Department

The mission of the Department of Mechanical Engineering is to develop professional mechanical engineers with strong technical expertise rooted in a liberal arts tradition, by nurturing a high-quality learning and research environment.

Mechanical Engineering Standard Program

The Department of Mechanical Engineering offers undergraduate degree programs leading to the degree Bachelor of Mechanical Engineering. Mechanical engineering includes activities such as the design and control of systems and components for heating and power generation, aircraft, propulsion, and aerospace engineering, refrigeration and air conditioning, environmental protection, complex structure and mechanical systems, vibration and acoustics, micro-and-nano-devices, mechatronics, lab-on-a-chip, biofabrication, intelligent and composite materials, 3-D imaging, computers, and robotics. The undergraduate program provides a broad scientific and technical background in engineering, establishing the foundation for lifelong learning in newly emerging technologies. Computer software is continuously integrated in the design, analysis, and laboratory phases of the curriculum. Flexibility exists in the selection of upper-level technical courses to accommodate the students' interests and diverse career goals. These elective courses can prepare students for immediate careers in mechanical engineering, further studies at the graduate level in engineering, and alternative careers in such fields as law, business, or management.

Students need to complete 130 credits to graduate. The program is individualized for each student through elective courses.

First Year

See standard first-year engineering program in the general engineering section.

Second Year

Course #	Course Title	1st	2nd
CHEM 107	General Chemistry I	3	-
CHEM 113	General Chemistry Lab	2	-

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ENGR 301	Solid Mechanics	3	-
MATH 221	Calculus II	4	-
PHYS 216	University Physics II	4	-
TRS 202 A/B	The Church and the Human Person	3	-
ENGR 106	Computer Aided Engr. Tools	-	3
ENGR 202	Engineering Mechanics II	-	3
ENGR 211	Thermodynamics	-	3
ENGR 212	Electrical Networks	-	3
ENGR 222	Engineering Mathematics I	-	4
	Total	19	16

Third Year

Course #	Course Title	1st	2nd
MATH 309	Probability and Statistics for Engineers	3	-
ENGR 331	Fluid Mechanics	3	-
ENGR 391	Introduction to Materials Science and Engineering	3	-

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ME 344	System Dynamics	3	-
	ME Program/Concentration Selected Electives	3	3
ME 342	Junior Design	-	3
ME 362	Heat Transfer	-	3
ME 392	Mechanical Systems and Dynamics Laboratory	-	2
PHIL 362	Professional Ethics in Engineering	-	3
	Literature, Fine Arts, or Social Science	-	3
	Total	15	17

Fourth Year

Course #	Course Title	1st	2nd
ENGR 401	Senior Seminar I	1	-
ENGR 403	Control Systems	3	-
ENGR 441	Interdisciplinary Senior Design I	3	-
ME 487	Thermal-Fluid Science Lab	2	-
	ME Program/Concentration Electives	6	6
ENGR 442	Interdisciplinary Senior Design II	-	3

Liberal Studies Electives	-	6
Total	15	15

Concentrations

In addition to the traditional Mechanical Engineering (ME) program, the Department also offers concentrations/tracks in Energy and Environment (E&E) and Aerospace Engineering (AE) through six technical electives in junior and senior years, according to the concentration of the students. Selected electives are required by the respective program/concentration. Program electives are chosen by the student from a variety of concentration elective courses for each concentration, as explained below:

Traditional Mechanical Engineering (ME) Program:

Selected Electives

ME 311	3	Introduction to Energy and Energy Systems
ME 314	3	Fundamentals of Mechatronics
ME 404	3	Structural Mechanics

Program Electives

ME Program Elective (3)	- 1
ME Program Elective (3)	- 2
General Technical Elective (3)	

Energy and Environment (E&E) Concentration:

Selected Electives

ME 311	3	Introduction to Energy and Energy Systems
ME 427	3	Renewable Energy and Technology
ENGR 438	3	Introduction to Environmental Engineering

Program Electives

E&E Concentration Elective (3)	- 1
E&E Concentration Elective (3)	- 2
General Technical Elective (3)	

Aerospace Engineering (AE) Concentration:

Selected Electives

ME 371	3	Introduction to Aerospace Engineering
ME 404	3	Structural Mechanics
ME 476	3	Aerodynamics

Program Electives

AE Concentration Elective (3)	- 1
AE Concentration Elective (3)	- 2

General Technical Elective (3)

Educational Objectives of the Undergraduate Program

The educational objectives of the Mechanical Engineering Program are that the graduates will:

1. Use their technical and intellectual competence, versatility, and ethical foundations while engaged in careers or advanced studies within the traditional mechanical engineering discipline as well as other fields of interest (e.g., other engineering disciplines, law, medicine, finance).
2. Be productive team members while solving problems of local, national, and international scope within a modern global, environmental, and ethical framework.
3. Contribute to professional, educational, and social institutions by applying their knowledge and skill towards the advancement of technology and the betterment of society.
4. Continue to learn and further develop and expand their knowledge and skill sets.

[1] BE=Biomedical Engineering; CEE=Civil and Environmental Engineering; EE=Electrical Engineering; ME=Mechanical Engineering.

[2] Biomedical Engineering students take BIOL 105 (4 credits), BE students take CHEM 104 (3 credits)

[3] Students who elect to take the pre-med track will be required to take two semesters of organic chemistry.

[4] Courses marked by an asterisk have substantial design content. Other graduate 500 series courses taken as program electives are subject to departmental approval. New courses are frequently added. For this reason, students should consult with their advisors regarding the department's recommendations and approval of each semester's program electives.

[5] ME and CEE students take ENGR 201 (3 credits) during the 2nd semester.

[6] Implies that EE selects ENGR 202.

Courses Offered

A full listing of undergraduate courses offered by the School of Engineering can be found below. Consult [Cardinal Students](#) for additional information about courses and to determine course offerings by semester.

BE	202	Biomechanics
BE	315	Introduction to Biomedical Systems Analysis
BE	398	Junior Biomechanical Design
BE	401	Biomaterials
BE	402	Advanced Biomechanics

BE	413	Biomedical Instrumentation I
BE	414	Introduction to Biomedical Optics
BE	417	Advanced Biomedical Optics
BE	421	Neural Control of Movement
BE	427	Cell & Tissue Engineering
BE	428	Rehabilitation Engineering
BE	433	Human Factors Engineering and Ergonomics
BE	438	Medical Device Usability
BE	439	Clinical Engineering - Medical Equipment Management
BE	439X	Engineering World Health - Study Abroad
BE	441	Home Care Technologies I: Foundations
BE	446	Medical Device Design and Regulation
BE	447	Biomedical Research Methods
BE	456	Bone
BE	458	Biomedical Engineering Innovation and Entrepreneurship
BE	462	Bioethics
BE	463	Education Engineering - STEM

BE	471	Cardio-Pulmonary Biomechanics
BE	481	Medical Imaging
BE	491	Seminar in Biomedical Engineering
BE	494	Research Practicum
BE	495	BMED Internship Projects
CEE	101	Elementary Construction Surveying
CEE	102	Introduction to Earth Science
CEE	301	Construction Systems and Planning
CEE	302	Construction Management Systems and Economics
CEE	310	Civil Engineering Systems
CEE	312	Theory of Structures
CEE	366	Introduction to Soil Mechanics
CEE	367	Soil Testing for Engineers
CEE	372	Engineering Hydraulics
CEE	374	Introduction to Transportation Systems and Design
CEE	402	Structural Steel Design
CEE	403	Reinforced Concrete Design

CEE	406	Advanced Structural Systems
CEE	407	Energy and Buildings
CEE	408	Transportation Characteristics
CEE	409	Highway Infrastructure Systems
CEE	410	Introduction to Civil Engineering Systems
CEE	411	Geographical Information Systems
CEE	413	Transportation Systems Evaluation
CEE	414	Advanced Vibrations and Structural Dynamics
CEE	415	Sustainable Buildings Design
CEE	416	Prestressed Concrete
CEE	419	Applied Computational Methods in Civil Engineering
CEE	420	Senior Capstone Design I
CEE	421	Senior Capstone Design II
CEE	423	Structural Loads of Civil Structures
CEE	426	Introduction to Finite Elements
CEE	433	Laboratory Project
CEE	438	Introduction to Environmental Engineering

CEE	451	Fundamentals of Engineering Review
CEE	463	Applied Hydrology
CEE	464	Surface Water Quality
CEE	465	Water Resources Engineering
CEE	468	Foundation Engineering
CEE	472	Intelligent Transportation Systems Connected Vehicles
CEE	473	Traffic Engineering and Flow Theory
CEE	474	Traffic Analysis and Simulation
CEE	475	Introduction to Systems Analysis
CEE	478	Transportation Systems Management and Operations
CEE	480	Advanced Water Treatment
CEE	482	Value Engineering
CEE	483	Entrepreneurship, Sustain, and Lean Methods
CEE	484	Construction Law
CEE	487	Estimating and Bidding
CEE	489	Construction Scheduling Techniques
CEE	490	Construction Operations Analysis

CEE	491	Engineering Hydrogeology and Groundwater Flow
CEE	497	Water and Wastewater Treatment Engineering
CSC	104	Introduction to Computers I
CSC	105	Introduction to Computers II
CSC	106	Introduction to Computer Programming for Non-Engineers
CSC	107	Introduction to Computer Security
CSC	108	Security and Privacy Cyber Concepts
CSC	110	Intro to Computers Using Fortran
CSC	113	Introduction to Computer Programming with MATLAB
CSC	113H	Introduction to Computer Programming with MATLAB (Honors)
CSC	114	Computer Concepts
CSC	120	Introduction to Computational Thinking
CSC	123	C/C++Programming Course
CSC	203	Assembly Language Programming
CSC	210	Discrete Mathematics
CSC	212	Theory of Computing
CSC	223	Object-Oriented Programming with Java

CSC	280	Data Structures
CSC	306	Introduction to Operating Systems
CSC	311	Design and Analysis of Algorithms
CSC	312	Microprocessor Programming
CSC	322	Introduction to Computer Graphics
CSC	323	Introduction to Computer Networks
CSC	326	Switching Circuits and Logic Design
CSC	327	Switching Circuits and Logic Design Laboratory
CSC	363	Software Engineering
CSC	370	Concepts of Programming Languages
CSC	390	Computer Organization and Architecture
CSC	391	Computer Systems Architecture
CSC	406	Introduction to Secure Computing
CSC	407	Unix Systems Programming
CSC	409	Web Design & Programming
CSC	410	Fundamentals of Cloud Computing
CSC	411	Analysis of Algorithms

CSC	426	Computer and Network Security
CSC	427	Fundamentals of Neural Networks
CSC	430	Introduction to Data Analytics
CSC	431	Data Communication Networks
CSC	434	Communication and Computer Network Simulation
CSC	436	Distributed Computing and Networking
CSC	442	Introduction to Database Management
CSC	443	Introduction to Knowledge Management
CSC	447	Artificial Intelligence
CSC	450	Fundamentals of Multimedia
CSC	451	Pattern Recognition
CSC	471	JAVA, OOP, Network Programming
CSC	475	Introduction to Computer Vision
CSC	476	Introduction to Robotics
CSC	480	Numerical Analysis and Optimization
CSC	484	Introduction to Machine Learning
DA	101	Making Sense of Data

DA	314	Statistics for Data Analysis
EE	311	Signals and Systems
EE	312	Microprocessor Programming and Design
EE	322	Electronic Circuits II
EE	326	Switching Circuits and Logic Design
EE	327	Switching Circuits and Logic Design Laboratory
EE	342	Electromagnetic Fields and Waves
EE	356	Electrical Laboratory II
EE	357	Electromag Laboratory
EE	362	Analog and Digital Signal Processing
EE	404	Solid State Devices
EE	406	Advance Digital Logic Design
EE	413	Communication Systems and Networks
EE	416	Power Systems
EE	420	Hybrid Gas/Electric Vehicles
EE	421	Programmable Logic Devices and HDL Design
EE	422	Mixed Signal VLSI Design

EE	423	Electromagnetic Compatibility
EE	426	Computer and Network Security
EE	427	Fundamentals of Neural Networks
EE	431	Data Communication Networks
EE	434	Communication and Computer Network Simulation
EE	436	Distributed Computing and Networking
EE	441	Electromagnetic Theory
EE	443	Introduction to Remote Sensing and Imaging Applications
EE	445	Basics of Computational Electromagnetics
EE	446	Basics of Time Domain Electromagnetics
EE	447	Artificial Intelligence
EE	452	Mathematical Analysis for Electromagnetics
EE	457	Communications Laboratory
EE	459	Introduction to Wind Energy Technology
EE	460	Photovoltaics
EE	461	Photovoltaics Laboratory
EE	462	Introduction to Electric Power

EE	472	Basics of Information Coding and Transmission
EE	475	Control Systems Analysis and Synthesis
ENGR	102	Introduction to Engineering Design and Professionalism
ENGR	106	Computer Aided Engineering Tools
ENGR	192	iOS App Design
ENGR	201	Engineering Mechanics I
ENGR	202	Engineering Mechanics II
ENGR	207	Programming Robots and Sensors
ENGR	211	Thermodynamics
ENGR	212	Electric Networks
ENGR	222	Engineering Mathematics I
ENGR	301	Mechanics of Solids
ENGR	314	Introduction to Alternative Energy
ENGR	321	Electronic Circuits I
ENGR	331	Fluid Mechanics
ENGR	355	Electrical Laboratory I
ENGR	370	Engineering Business Fundamentals

ENGR	391	Introduction to Materials Science & Engineering
ENGR	401	Senior Seminar I
ENGR	403	Control Systems
ENGR	408	Batteries, Fuel Cells, and Energy Storage
ENGR	413	Introduction to 3D-Printing Science & Engineering
ENGR	420	Social Innovation Startups
ENGR	421	Social Innovation Startups II
ENGR	425V	Engineering the Future: Design Solutions for World Challenges
ENGR	434	Pollution and Climate Change
ENGR	438	Introduction to Environmental Engineering
ENGR	441	Interdisciplinary Senior Design I
ENGR	442	Interdisciplinary Senior Design II
ENGR	443	Mobile Computing
ME	311	Introduction to Energy and Energy Systems
ME	314	Fundamentals of Mechatronics
ME	342	Junior Design

ME	344	System Dynamics
ME	362	Heat Transfer
ME	371	Introduction to Aerospace Engineering
ME	392	Dynamics Laboratory
ME	404	Structural Mechanics
ME	423	Engineering Aspects of Acoustics and Music
ME	426	Alternative Energy Engineering
ME	427	Renewable Energy and Technology
ME	428	Energy Storage: Technology and Design
ME	432	Design of Power and Propulsion Systems
ME	433	Energy Conservation and HVAC
ME	434	Design of HVAC and Refrigeration
ME	437	Air Pollution and Control
ME	438	Design of Solar Energy and Wind Power
ME	445	Applied Gas Dynamics
ME	457	Applied Rigid Body Dynamics
ME	458	Introduction to Ocean Engineering
ME	471	Optimal Design of Energy Systems

ME	476	Aerodynamics
ME	487	Thermal Science Lab
ME	489	Smart Structures