THE CATHOLIC UNIVERSITY OF AMERICA

# Catalog Announcements - 2015-2016

## School of Engineering

**Officers of Instruction**

**Faculty**

| | |
|---|---|
| Charles C. Nguyen, D.Sc. | *Dean and Professor of Electrical Engineering and Computer Science* |
| Jandro Abot, Ph.D. | *Clinical Associate Professor of Mechanical Engineering* |
| Mohammad Arozullah, Ph.D. | *Professor of Electrical Engineering and Computer Science* |
| Gregory Berhmann, Ph.D. | *Clinical Assistant Professor of Biomedical Engineering* |
| Ujjal Bhowmik, Ph.D. | *Clinical Assistant Professor of Electrical Engineering and Computer Science* |
| J. Steven Brown, Ph.D., P.E. | *Associate Professor of Mechanical Engineering* |
| Mario J. Casarella, Ph.D. | *Professor Emeritus of Mechanical Engineering* |
| Lin-Ching Chang, Ph.D. | *Associate Professor of Electrical Engineering and Computer Science* |
| Chanseok Jeung, Ph.D. | *Assistant Professor of Civil Engineering* |
| Edward D. Jordan, Ph.D., P.E. | *Professor Emeritus of Mechanical Engineering* |
| John A. Judge, Ph.D. | *Associate Professor of Mechanical Engineering* |
| Timothy W. Kao, Ph.D., P.E. | *Professor Emeritus of Civil Engineering* |
| Ozlem Kilic, D.Sc. | Associate Professor of Electrical Engineering and Computer Science |
| Eric Kommer, Ph.D., P.E. | *Assistant Professor of Mechanical Engineering* |
| Sahana N. Kukke, Ph.D. | *Assistant Professor of Biomedical Engineering* |
| Poul V. Lade, Ph.D. | *Professor of Civil Engineering* |
| Sang Wook Lee, | |

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|---|---|
| Ph.D. | *Assistant Professor of Biomedical Engineering* |
| Hang Liu, Ph.D. | *Associate Professor of Electrical Engineering and Computer Science* |
| Max Liu, Ph.D., P.E. | *Assistant Professor of Civil Engineering* |
| Gunnar Lucko, Ph.D. | *Associate Professor of Civil Engineering* |
| Peter Lum, Ph.D. | *Associate Professor of Biomedical Engineering* |
| Xiaolong Luo, Ph.D. | *Assistant Professor of Mechanical Engineering* |
| Arash Massoudieh, Ph.D. | *Associate Professor of Civil Engineering* |
| Scott Mathews, Ph.D. | *Associate Professor of Electrical Engineering and Computer Science* |
| John J. McCoy, D.Sc. | *Professor Emeritus of Civil Engineering* |
| Robert Meister, Ph.D. | *Professor Emeritus of Electrical Engineering and Computer Science* |
| Nader M. Namazi, Ph.D. | *Professor of Electrical Engineering and Computer Science* |
| Georges Nehmetallah, Ph.D. | Assistant Professor of Electrical Engineering and Computer Science |
| Sen Nieh, Ph.D. | *Professor of Mechanical Engineering* |
| Masataka Okutsu, Ph.D. | *Clinical Assistant Professor of Civil Engineering* |
| Hsien Ping Pao, Ph.D. | *Professor Emeritus of Civil Engineering* |
| Erion Plaku, Ph.D. | *Assistant Professor of Electrical Engineering and Computer Science* |
| Christopher Raub, Ph.D. | *Assistant Professor of Biomedical Engineering* |
| Phillip A. Regalia, Ph.D. | *Professor of Electrical Engineering and Computer Science* |
| Patricio Simari, Ph.D. | *Assistant Professor of Electrical Engineering and Computer Science* |
| Michael C. Soteriades, D.Sc., P.E. | *Professor Emeritus of Civil Engineering* |
| Lu Sun, Ph.D. | *Professor of Civil Engineering* |
| Binh Q. Tran, Ph.D. | *Associate Professor of Biomedical Engineering* |
| Diego Turo, Ph.D. | *Clinical Assistant Professor of Mechanical Engineering* |

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|---|---|
| Joseph Vignola, Ph.D. | *Associate Professor of Mechanical Engineering* |
| Zhaoyang Wang, Ph.D. | *Associate Professor of Mechanical Engineering* |
| Yun Chow Whang, Ph.D. | *Professor Emeritus of Mechanical Engineering* |
| Otto C. Wilson, Ph.D. | *Associate Professor of Biomedical Engineering* |

**Associates of the Faculty**

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|---|---|
| Mostafa Ardakani, Ph.D. | *Lecturer in Civil Engineering* |
| Joseph M. Bishop, Ph.D. | *Lecturer in Civil Engineering* |
| John Bonita, Ph.D., P.E. | *Lecturer in Civil Engineering* |
| Charles E. Campbell Jr., Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| Vincent Casella | *Lecturer in Electrical Engineering and Computer Science* |
| Isaac Chang, Ph.D. | *Adjunct Assistant Professor of Biomedical Engineering* |
| Jim Christ, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| Keefe Coburn | *Lecturer in Electrical Engineering and Computer Science* |
| Aysegul Cuhadar | *Lecturer in Electrical Engineering and Computer Science* |
| Sandor Der | *Lecturer in Electrical Engineering and Computer Science* |
| Jeffrey R. Didion, M.S. | *Lecturer in Mechanical Engineering* |
| Azad Ejaz, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| David Feit, Ph.D. | *Lecturer in Mechanical Engineering* |
| Joseph Findaro, J.D. | *Lecturer in Civil Engineering* |
| Wenjun Gu, M.S. | *Lecturer in Civil Engineering* |
| Lei He, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| Liling Huang | *Lecturer in Electrical Engineering and Computer Science* |

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|---|---|
| James W. Hudson, B.S. | *Lecturer in Civil Engineering* |
| Philip C. Jones, J.D. | *Lecturer in Civil Engineering* |
| William A. Joyce, P.E. | *Lecturer in Civil Engineering* |
| Vadim Knyazev, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| Mesfin Lakew, M.S. | *Lecturer in Civil Engineering* |
| William LaPlante, Ph.D. | *Lecturer in Mechanical Engineering* |
| S. Samuel Lin, Ph.D. | *Lecturer in Civil Engineering* |
| Francis Linehan, M.E.E. | *Lecturer in Electrical Engineering and Computer Science* |
| George Mattingly, Ph.D. | *Adjunct Professor of Mechanical Engineering* |
| John McTyre, M.S. | *Lecturer in Civil Engineering* |
| Mamta Nagaraja, Ph.D. | *Adjunct Assistant Professor of Mechanical Engineering* |
| Tien Nguyen | *Adjunct Assistant Professor of Electrical Engineering and Computer Science* |
| Tuan Nguyen, Ph.D., P.E. | *Adjunct Associate Professor in Mechanical Engineering* |
| Silas C. Nichols, Ph.D. | *Lecturer in Civil Engineering* |
| Ken O'Connell, Ph.D., P.E. | *Lecturer in Civil Engineering* |
| Mark Pettinato, M.S. | *Lecturer in Biomedical Engineering* |
| Long Phan, Ph.D. | *Lecturer in Civil Engineering* |
| Sridava Rao, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| Kenneth Romney, M.S., P.E. | *Lecturer in Mechanical Engineering* |
| Kevin Russo, M.S. | *Lecturer in Electrical Engineering and Computer Science* |
| Alfonz Ruth, Ph.D. | *Lecturer in Civil Engineering* |
| Lawrence Schuette, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |

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|---|---|
| Hanney Shaban, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| Jeffrey W. Shupp, M.D. | *Adjunct Assistant Professor in Biomedical Engineering* |
| Stephen Sullivan | *Lecturer in Civil Engineering* |
| Randy Swisher, Ph.D. | *Lecturer in Electrical Engineering and Computer Science* |
| Adam Wolfe, Ph.D., P.E. | *Adjunct Assistant Professor of Mechanical Engineering* |
| Bing Xu, Ph.D. | *Lecturer in Civil Engineering* |
| Abdulkadir Yavuz, Ph.D. | *Adjunct Assistant Professor of Mechanical Engineering* |
| Tse-Fou Zien, Ph.D. | *Adjunct Professor of Mechanical Engineering* |

**Biomedical Engineering Advisory Council**

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|---|---|
| Barbara Bregman, Ph.D. | *Professor, Georgetown University, Dept. of Neuroscience* |
| Kevin Cleary, Ph.D. | *Technical Director, Bioengineering Initiative, The Sheikh Zayed Institute for Pediatric Surgical Innovation, Children's National Health System, Washington, DC* |
| Diane L. Damiano, Ph.D. | *Chief, Functional & Applied Biomechanics Section, NIH, Bethesda, Md.* |
| Joseph Hidler, Ph.D. | *Chief Operating Officer, Aretech LLC, Ashburn, Va.* |
| Corinna Lathan, Ph.D. | *President, Anthrotronix Inc., Silver Spring, Md.* |
| Joel B. Mylkebust, Ph.D. | *Deputy Director, Office of Science & Engineering Laboratories, FDA, Silver Spring, Md.* |

**Civil Engineering Advisory Council**

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|---|---|
| Dr. Timothy W. Kao, P.E. | *Professor Emeritus of Civil Engineering and Former Chair, Department of Civil Engineering, The Catholic University of America* |
| Mr. Lawrence E. Moore, II, P.E. | *Director of Engineering, Clark Concrete Contractors, LLC, Bethesda, MD* |

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|---|---|
| Dr. Dennis McCahill | *Retired* |
| Ms. Melissa Prelewicz | *Associate Executive Director, American Association of Engineering Societies, American Society of Civil Engineers, Reston, VA* |
| Dr. Steven Smith, P.E. | *Principal Engineer and Group Manager, CTL Group, Washington Office, Columbia, MD* |
| Mr. Scott Stewart | *Principal, SK&A Structural Engineers, Washington, DC* |
| Mr. Bill Whiting | *Vice President, The Whiting-Turner Contracting Co., Washington DC* |

**Electrical Engineering and Computer Science Advisory Council**

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|---|---|
| Ramesh Bhardawaj, Ph.D. | *Senior Software Technology Researcher, Naval Research Laboratories, Washington, D.C.* |
| Thomas E. Bordley, Sc.D. | *Distinguished Staff, General Dynamics Advanced Technology Systems, Washington, D.C.* |
| Kevin Cleary, Ph.D. | *Technical Director, Bioengineering Initiative, Sheikh Zayed Center for Pediatric Surgical Innovation, Children's National Medical Center, Washington, D.C.* |
| Tarek El-Ghazawi, Ph.D. | *Professor, IEEE, Department of Electrical and Computer Engineering, The George Washington University, Washington, D.C.* |
| Jon Huppenthal | *President and CEO, SRC Computers, LLC, Colorado Springs, Co.* |
| Cheng Guan Koay, Ph.D. | *Senior Image Data Analyst, Walter Reed National Military Medical Center, Bethesda, Md.* |
| Jose R. Latimer, Ph.D. | *Business Area Executive for Homeland Protection, Applied Physics Laboratory, Johns Hopkins University, Baltimore, Md.* |
| Dunling Li, Ph.D. | *Senior Software Engineer, BST Software Solutions, Columbia, Md.* |
| Seong Mun, Ph.D. | *Director, Institute of Advanced Study Virginia Tech, Alexandria, Va.* |
| Jude Nitsche | *Nitsche and Associates LLC., Arlington, Va.* |
| Kay Stepper, Ph.D. | *Reginal Business Unit Leader, Robert Bosch LLC, Plymouth, Mi.* |

**Mechanical Engineering Advisory Council**

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|---|---|
| Richard Dame, Ph.D. | *President (Retired), Mega Engineering, Silver Spring, Md.* |
| David Didion, Ph.D. | *Retired NIST Fellow, National Institute of Standards and Technology, Port Republic, Md.* |
| Stan Halperson | *Executive Committee Member of ASME, Washington, D.C.* |
| Peter Herdic | *Naval Research Laboratories, Washington, D.C.* |
| Don Marlowe | *Standards Administrator (Retired), Science and Health Communication, U.S. Food and Drug Administration, Rockville, Md.* |
| Jude Nitsche | *Nitsche and Associates LLC, Alexandria, Va.* |
| Steven Russell, Ph.D. | *Project Manager, Ship Systems Engineering Office of Naval Research, Arlington, Va*. |
| Jaclyn A. Schade | *Registered Patent Agent, Pillsbury Winthrop Shaw Pittman LLP, McLean, Va.* |
| Owen G. Thorp IV, Ph.D. | *Captain, USNR, Permanent Military Professor, Weapons and System Engineering Department, US Naval Academy, Annapolis, MD* |
| Stephen Wilson | *Deputy Director, Ship Signatures Department, NSWC Carderock, W. 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 five academic programs, as well as master's degrees in Engineering Management and Materials Science and Engineering.

**Mission**

Historically, the engineering profession has placed great emphasis on technical expertise as a criterion for recognition and advancement. However, even the most thoroughly trained technical professional must be able to contribute something more to society with corresponding opportunities and obligations. As such, the environment in which an individual's training takes place affects the individual's later professional practice. If the environment were to be neutral on the issues of faith and

morals, the education would be narrowly superficial. Instead engineering education in a Catholic environment instills in students a sense of morality and ethics by presenting them with the logic and rationale of a systematic set of values for social and ethical responsibility. This is a distinctive trait of engineering education at The Catholic University of America.

The Catholic University of America's School of Engineering provides a personalized learning and research environment in which faculty, staff, and students achieve excellence in research, education, and service. The program emphasizes research and scholarship of the highest possible caliber and provides personalized instruction at both the graduate and undergraduate levels.

**Goals**

The goals of The Catholic University of America's School of Engineering include being a leader in undergraduate Catholic engineering education; providing nationally recognized student-oriented, research-based graduate programs; offering innovative professional master's programs that serve the metropolitan Washington area and complement and enhance the undergraduate and research-based graduate programs. The School of Engineering is dedicated to educating future engineering leaders. All graduates are prepared to enter and continue the practice of engineering, to begin graduate work in engineering, or to enter other professions such as business, law, and medicine.

More specifically, the goals of the School of Engineering are:

1. School is to substantially improve efficiency of support services (i.e., academic,research, IT, alumni, outreach) and invest in its structures (i.e., physical plant) to facilitate and support its aggressive goals in the areas of education, training, and research productivity.
2. School is to establish, nurture, and grow *research, training, and career* opportunities for faculty and students through strategic cooperative and collaborative relationships with local/regional institutions and industry.
3. School will expand existing and establish unique and timely new academic programs to its undergraduate and graduate students to serve the region, nation, and world through superior technical competence, incorporating moral and ethical values, and to prepare future leaders.
4. School will achieve research pre-eminence in a number of specific areas of engineering and applied science through establishment of interdisciplinary initiatives and interdisciplinary centers of research.

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 for 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, and Bachelor of Science in Computer Science. 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 adviser, usually a full-time faculty member. Normally, students remain with their advisers for the duration of their studies. Students are required to consult with their advisers at least once a semester, but have the possibility of meeting with their adviser at any time during the academic year. Students must obtain approval from their advisers for registration and to make any course changes, such as adding or/dropping a course. The dean advises general (undecided) engineering students. Ordinarily, at the end of the first year in residence, 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 dean and the chair of the designated program and, once accepted, will be reassigned to an adviser 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. The school has policies governing the acceptance of transfer students.

**Transfer Credits**

With preapproval from the dean, 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 dean 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 Career Services Office and the school assist students in obtaining internships. The Department of Civil 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 Engineering for specific information.

**Minors**

A minor, or subconcentration, in the humanities, social sciences, philosophy or religious studies is available to students who complete the requirements for the subconcentration as stipulated by the respective department or school. Normally, a subconcentration consists of six or seven courses in one disciplinary area. Applications for the minor are available in the Office of the Dean of the School of Engineering. Engineering students can also obtain a minor in computer science. Students should check with their departments for specific requirements for the minor. Completed applications 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. Contact the dean's office 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 CUA may study abroad during the second semester of their junior year. The CUA 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 Web site at: http://engineering.cua.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.

**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 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.

**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 extra-curricular 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, 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 (ten courses).* The math and science components for the majority of the engineering programs consist of five mathematics courses and five science courses, including laboratories.

*Liberal Study Component (nine courses).* The liberal study component emphasizes the religious, economical, historical, and philosophical aspects of modern civilization. It complements the technical component and illustrates that technology is only one segment of culture and learning. It consists of three religion courses, three engineering ethics courses, one English composition course, and two additional liberal studies courses. The requirement of religion courses is consistent with CUA'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 adviser 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 eight 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.

**Fundamentals in Engineering (FE) Exam Requirement**

All students are required to take the Fundamentals in Engineering (FE) as part of ENGR 402 – Senior Seminar II. The FE exam is administered by the National Council of Examiners for Engineering and Surveying (NCEES) and is the first step in becoming a licensed professional engineer. For more information see http://ncees.org/exams/fe-exam/ It is the student's responsibility to register and pay for the exam, and to sit for the exam at one of the approved testing sites.

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

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|---|---|
| ENGR 102 | Introduction to Engineering Design and Professionalism |
| ENGR 104 | Introduction to Engineering Laboratory |
| ENGR 106 | Computer-Aided Engineering Tools |
| CSC 113 | Computer Programming |

ENGR 201 Engineering Mechanics I ([5])

ENGR 211 Thermodynamics

ENGR 212 Electrical Networks

ENGR 401 Senior Seminar I

ENGR 402 Senior Seminar II

**A selection of courses as specified:**

ENGR 202 Engineering Mechanics II (EE[6], ME)

ENGR 301 Solid Mechanics (CE, ME)

ENGR 321 Electronic Circuits I (BE, EE)

ENGR 331 Fluid Mechanics (BE, CE, 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 advisers.

**First-Year Program**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| MATH 121 | Calculus I | 4 | - |
| MATH 122 | Calculus II | - | 4 |
| ENGR 102 | Introduction to Engineering Design and Professionalism | 3 | - |
| ENGR 104 | Introduction to Engineering Laboratory | 1 | - |
| ENGR 106 | Computer-Aided Engineering Tools | - | 2 |

| | | | |
|---|---|---|---|
| TRS 201 | Faith Seeking and Understanding | | 3 |
| PHIL 201 | The Classical Mind | 3 | |
| PHIL 202 | The Modern Mind | | 3 |
| ENG 101 | Rhetoric and Composition | 3 | |
| CSC 113 | Computer Programming | 3 | |
| PHYS 215 | University Physics I | - | 4 |
| | **Total** | **17** | **16** |

**Department of Biomedical Engineering**

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|---|---|
| **Associate Professors** | Peter Lum, *Chair*; Binh Tran*;* Otto Wilson, Jr. |
| **Assistant Professors** | Sang Wook Lee; Gregory Behrmann; Sahana Kukke; Christopher Raub |
| **Lecturers** | Kenneth A. Byrd; Mark Pettinato |
| **Adjunct Assistant Professors** | Isaac Chang; Jeffrey Shupp |
| **Research Ordinary Professor** | Harold Szu |

**Mission of the Department**

The mission of the Department of Biomedical Engineering at CUA 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 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 CUA 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 which ovide a nurturing environment for designing and evaluating innovative technologies for addressing real-world health care problems.

**Standard Program**

**First Year**

In addition to the standard first-year engineering program all biomedical engineering majors are required to take Biology 105 and BE 491 (Seminar Biomedical Engineering).

**Second Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| BE 491 | Seminar: Biomedical Engineering | 0 | 0 |
| ENGR 201 | Engineering Mechanics I | 3 | - |
| BE 202 | Biomechanics | - | 3 |
| ENGR 212 | Electrical Networks | - | 3 |
| ENGR 222 | Engineering Mathematics I | - | 4 |
| PHYS 216 | University Physics II | 4 | - |
| CSC 113 | Computer Programming | 3 | - |
| MATH 221 | Calculus III | 4 | - |
| ENGR 211 | Thermodynamics | - | 3 |
| CHEM 103/113 | General Chemistry I/Lab | 5 | - |

| | | | |
|---|---|---|---|
| CHEM 108 | General Chemistry II | - | 3 |
| | **Total** | **19** | **16** |

**Third Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| BE 491 | Seminar: Biomedical Engineering | 0 | 0 |
| BE 398 | Biomechanical Design | 3 | - |
| BE 315 | Intro Biomedical Systems Analysis | - | 3 |
| MATH 309 | Probability & Statistics for Engineers | 3 | - |
| ENGR 321 | Electronic Circuits | 3 | - |
| ENGR 331 | Fluid Mechanics | 3 | - |
| ENGR 355 | Electrical Laboratory I | 1 | - |
| BIOL 518 | Physiology | - | 4 |
| BE 513 | Biomedical Instrumentation | - | 3 |
| PHIL 362 | Professional Ethics in Engineering | - | 3 |
| | Liberal Studies Electives | 3 | 3 |
| | **Total** | **16** | **16** |

**Fourth Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| BE 497 | BMED Senior Design | 3 | - |
| BE 499 | BMED Senior Project Lab | - | 3 |
| BE 501 | Biomaterials | 3 | - |
| ENGR 503 | Control Systems | 3 | - |
| ENGR 401 | Senior Seminar I | 1 | - |

| | | | |
|---|---|---|---|
| ENGR 402 | Senior Seminar II | | 1 |
| | Program Electives | 3 | 9 |
| | Liberal Studies Electives | 3 | 3 |
| | **Total** | **16** | **16** |

**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 pursuing advanced degrees 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 Engineering**

| | |
|---|---|
| **Professors** | Poul V. Lade; Lu Sun, Chair |
| **Professors Emeriti** | John H. Baltrukonis; Timothy W. Kao; Dennis McCahill; John J. McCoy; Hsien Ping Pao; Michael C. Soteriades |
| **Associate Professors** | Gunnar Lucko; Arash Massoudieh |
| **Assistant Professor** | Chanseok Jeong; Max Liu; Masataka Okutsu |
| **Lecturers** | Mostafa K Ardakani; Joseph Bishop; John Bonita; Joseph Findaro; Minli Ge; Wenjun Gu; James W. Hudson; Philip C. Jones; William A, Joyce; Charbel Khoudry; Mesfin Lakew; S. Samuel Lin; Long Phan; John McTyre; Silas Nichols; Ken O'Connell; Alfonz Ruth; Steve Sullivan; Richard C. Thompson; Bing Xu |

**Mission of the Department**

The mission of the Civil 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.)

**Undergraduate 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 resource, and construction engineering and management, aimed at helping graduates 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 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.

**Standard Program**

**First Year**

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

**Second Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| ENGR 106 | Computer Aided Engr. Tools | 2 | |
| ENGR 211 | Thermodynamics | - | 3 |
| ENGR 212 | Electric Networks | - | 3 |
| ENGR 222 | Engineering Mathematics I | - | 4 |
| ENGR 301 | Mechanics of Solids | 3 | - |
| MATH 221 | Calculus III | 4 | - |
| CHEM 107 | General Chemistry | 3 | |
| CHEM 113 | General Chemistry Lab | 2 | |
| PHYS 216 | University Physics II | 4 | - |
| | Liberal Studies Electives | - | 3 |
| | TRS Elective | - | 3 |
| CE 101 | Surveying | - | 2 |
| | Internship (required all civil eng.) | summer | |
| | **Total** | **18** | **18** |

**Third Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| CE 302 | Civil Engineering Systems Mgmt | - | 3 |
| CE 312 | Theory of Structures | 3 | - |
| CE 366 | Soil Mechanics and Testing | 4 | - |
| CE 372 | Engineering Hydraulics | - | 3 |
| CE 402 | Structural Steel Design | - | 3 |
| CE 468 | Foundation Engineering | - | 3 |
| MATH 309 | Probability & Statistics for Engineers | 3 | - |
| ENGR 331 | Fluid Mechanics | 3 | - |
| ENGR 395 | Engineering Materials Lab | 1 | - |
| ENGR 538 | Intro. Environmental Engineering | - | 3 |
| MSE 395 | Intro to Materials Science | 2 | - |
| PHIL 362 | Professional Ethics | - | 3 |
| | Internship (required only for CEM) | summer | |
| | **Total** | **16** | **18** |

**Fourth Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| CE 374 | Introduction to Transportation Systems and Design | 3 | - |
| ENGR 401 | Senior Seminar I | 1 | - |
| CE 403 | Reinforced Concrete Design | 3 | - |
| CE 520 | Senior Capstone Design I | 2 | - |

| | | | |
|---|---|---|---|
| | Program Electives | 3 | 3 |
| | Selected Electives | 3 | 3 |
| CE 521 | Senior Capstone Design II | - | 3 |
| | Liberal Studies Elective | | 6 |
| ENGR 402 | Senor Seminar II (FE Exam) | - | 1 |
| | **Total** | **15** | **16** |

The Concentration Elective Courses are taken according to the concentration of the students. The list of concentration elective courses for each concentration is provided below:

**Structural/Geotechnical Engineering (STG)**

| | | |
|---|---|---|
| CE 514/ME 514 | 3 | Advanced Vibrations and Structural Dynamics |
| CE 526 | 3 | Introduction to Finite Elements |
| ENGR 202 | 3 | Dynamics |

**Construction Engineering and Management (CEM)**

| | | |
|---|---|---|
| CE 301 | 3 | Construction Systems and Planning |
| CE 589 | 3 | Construction Scheduling Techniques |
| CE 590 | 3 | Construction Operation Analysis |

**Environmental Engineering (ENV)**

| | | |
|---|---|---|
| BIOL 105 | 3 | Mechanics of Life I |
| CHEM 542 | 3 | Environmental Chemistry Laboratory |
| CHEM 108 | 3 | General Chemistry II |

**Transportation Engineering (TRN)**

| | | |
|---|---|---|
| APRL 589 | 3 | Geographical Information Systems |
| CE 570 | 3 | Innovative Infrastructure Management |
| CE 573 | 3 | Traffic Engineering and Flow Theory |

**Educational Objectives of the Undergraduate Program**

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

1. Engage in careers in civil engineering or related fields as effective problem solvers and/or will pursue and excel in graduate or professional studies.
2. Continue to learn and to expand their knowledge and skill sets while

engaging in professional practice and/or while pursuing graduate or professional studies.

3. Adhere to moral and ethical principles while solving technological problems within complex societal and global contexts and/or while pursuing graduate or professional studies.

**Standard Program**

Elective courses specific to each concentration of construction concentrators, environmental engineering 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 educational component to experience professional engineering practice and often lead to part-time or full-time employment opportunities.

Undergraduate students in the Department of Civil 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 at any city, state, or country.

Students are responsible to arrange 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 to consider the requirement fulfilled. Students are urged to actively and early use the various services, consultations, and database by the Office of Career Services 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 internship.

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

**Recommended Program Electives**

| | |
|---|---|
| CE 500 | Transportation Planning |
| CE 504 | Stress - Strain Behavior of Soils |
| CE 516 | Prestressed Concrete |
| CE 562 | Seepage and Slope Stability |
| CE 563 | Applied Hydrology |
| CE 564 | Surface Water Quality |
| CE 572 | Intelligent Transportation Systems |

| | |
|---|---|
| CE 574 | Forensic Engineering |
| CE 575 | Introduction to Systems Analysis |
| CE 578 | Project Management |
| CE 582 | Value Engineering |
| CE 583 | Eng, Entrepreneurship, Sustain, and Lean Methods |
| CE 587 | Estimating and Bidding |
| CE 591 | Engineering, Hydrogeology and Groundwater Flow |
| CE 594 | Construction Law, Operations, and Project Delivery |
| CE 596 | Warer and Wastewater Treatment Engineering |
| CE 599 | Transportation Safety Engineering |
| CENT 542 | Web Design |
| CENT 554 | Organizational Theory and Behavior |
| CMGT 574 | Strategic Management (Crystal City) |

**Department of Electrical Engineering and Computer Science**

| | |
|---|---|
| **Professors** | Mohammad Arozullah; Nader Namazi; Charles C. Nguyen; Phillip A. Regalia |
| **Professors Emeriti** | Andrew G. Favret; George E. McDuffie; Robert Meister |
| **Associate Professor** | Lin-Ching Chang; Hang Liu; Scott Mathews; Ozlem Kilic, *Chair* |
| **Assistant Professors** | Georges Nehmetallah; Erion Plaku; Patricio Simari |
| **Clincal Assistant Professors** | Ujjal Bhowmik |
| **Lecturers** | Charles Campbell Jr.; Vincent Cassella; Aysegul Cuhadar; Vinh Dang; Saiid Ganjalizadeh; Robert Kamocsai; Vadim Knyazev; Francis Linehan; Quang Nguyen; Sridava Rao; Kevin Russo; Lawrence Schuette; Hanney Shaban; Randy Swisher; David Tremper |

**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 which 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 which 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 |
|---|---|---|---|
| ENGR 201 | Engineering Mechanics I | 3 | - |
| ENGR 202 | Engineering Mechanics II | - | 3 |
| ENGR 211 | Thermodynamics | - | 3 |
| ENGR 212 | Electric Networks | - | 3 |
| ENGR 222 | Engineering Mathematics I | - | 4 |

| | | | |
|---|---|---|---|
| MATH 221 | Calculus III | 4 | - |
| PHYS 216 | University Physics II | 4 | - |
| PHIL 362 | Professional Ethics in Engineering | - | 3 |
| CHEM 107 | General Chemistry I | 3 | |
| CHEM 113 | General Chemistry Lab I | 2 | |
| | Liberal Studies Elective | 3 | - |
| | **Total** | **19** | **16** |

**Third Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| MATH 309 | Probability and Statistics for Engineers | 3 | - |
| ENGR 355 | Electrical Laboratory I | 1 | - |
| EE 311 | Signals and Systems | 3 | - |
| EE 312 | Microprocessors | - | 3 |
| ENGR 321 | Electronic Circuits I | 3 | - |
| EE 322 | Electronic Circuits II | - | 3 |
| EE 326 | Switching Circuits and Logic Design | 3 | - |
| EE 327 | Switching Circuits and Logic Design Lab | 1 | - |
| EE 342 | Electromagnetic Fields and Waves I | - | 3 |
| EE 356 | Electronic Circuits Laboratory II | - | 2 |
| EE 357 | Electromagnetic Laboratory | - | 1 |
| EE 362 | Analog and Digital Signal Processing | - | 3 |
| | Liberal Studies Elective | 3 | - |
| | **Total** | **17** | **15** |

**Fourth Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|

| | | | |
|---|---|---|---|
| EE 422 | Mixed Signal VLSI Design | 3 | - |
| EE 413 | Communication Systems | 3 | - |
| EE 457 | Communications Laboratory | 1 | |
| ENGR 503 | Control Systems | 3 | - |
| | Program Electives | - | 6 |
| EE 491, 492 | Engineering Practice and Design I, II | 2 | 3 |
| | Liberal Studies Elective | 3 | 6 |
| ENGR 401 | Senior Seminar I | 1 | - |
| ENGR 402 | Senior Seminar II | | 1 |
| | **Total** | **16** | **15** |

**Recommended Program Electives**

New courses are frequently added. For this reason students should consult their adviser 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 Heterogenous 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 & 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 506 | Introduction to Modern Physics |
| PHYS 528 | Optics |
| PHYS 531 | 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 on-going 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, tailoring 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 113 | Intro to Computer Programming with MatLab | 3 | |
| CSC 123 | C/C++ Programming | | 3 |
| CHEM 107/103 | General Chemistry I | 3 | - |
| CHEM 113 | General Chemistry I Lab | 2 | - |
| ENG 101 | Rhetoric/Composition | 3 | - |

| | | | |
|---|---|---|---|
| MATH 121,122 | Calculus I, II | 4 | 4 |
| PHYS 215 | University Physics I | - | 4 |
| PHIL 201, 202 | Classical Mind, Modern Mind | 3 | 3 |
| TRS 201 | Faith Seeking Understanding | - | 3 |
| | Total | 18 | 17 |

Second Year

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| CSC 210 | Discrete Mathematics | 3 | - |
| CSC 223 | Object-Oriented Programming w/Java | 3 | - |
| CSC 280 | Data Structures | - | 3 |
| CSC 326 | Switching Circuits and Logic Design | 3 | - |
| CSC 327 | Switching Circuits and Logic Design Lab I | 1 | - |
| CSC 390 | Computer Organization | - | 3 |
| CSC 212 | Theory of Computing | - | 3 |
| ENGR 222 | Engineering Math I | - | 4 |
| | Liberal Studies Electives | 6 | - |
| PHIL 362 | Professional Ethics in Engineering | - | 3 |
| | Total | 16 | 16 |

Third Year

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| CSC 322 | Introduction to Computer Graphics | 3 | - |
| CSC 323 | Introduction to Computer Networks | 3 | - |
| CSC 363 | Software Engineering | - | 3 |
| CSC 370 | Concepts of Programming Languages | 3 | - |
| MATH 309 | Probability and Statistics for Engineers | 3 | - |

| | | | |
|---|---|---|---|
| CSC 306 | Introduction to Operating Systems | - | 3 |
| MATH | 309, 501, 507, or 509 | - | 3 |
| | Liberal Studies Electives | 3 | 3 |
| | Program Elective | - | 3 |
| | Total | 15 | 15 |

Fourth Year

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| CSC 411 | Analysis of Algorithm | 3 | - |
| CSC 480 | Numerical Analysis and Optimization | 3 | - |
| CSC 442 | Introduction to Database Management | - | 3 |
| CSC 491, 492 | Senior Design I, II | 2 | 3 |
| CSC 312 | Microprocessor Programming & Design | - | 3 |
| | CSC Electives | 6 | 6 |
| | Total | 14 | 15 |

**Educational Objectives of the Computer Science Program**

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

1. The broad knowledge of computer science serving 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 and are solving technical problems, ethically and responsibly, in service to society.
3. Mathematical and scientific knowledge and are solving emerging real world problems related to programming, networking, information security, image analysis, and advanced computing systems, and are demonstrating that they possess 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**

**Professor** Sen Nieh, *Chair*

| | |
|---|---|
| **Associate Professors** | J. Steven Brown; John A. Judge; Joseph Vignola; Zhaoyang Wang |
| **Assistant Professor** | Eric Kommer; Xiaolong Luo |
| **Clinical Associate Professors** | Jandro Abot |
| **Clinical Assistant Professors** | Diego Turo |
| **Professors Emeriti** | Mario Casarella; Edward D. Jordan;Yun Chow Whang |
| **Adjunct Professor** | George Mattingly, Tse-Fou Zien |
| **Adjunct Associate Professor** | Tuan Nguyen |
| **Adjunct Assistant Professor** | Mamta Nagaraja; Adam Wolfe; Abdulkadir Yavuz |
| **Lecturers** | Jeffrey Didion; William LaPlante; Kenneth Romney |

**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 and motored vehicles, refrigeration and air conditioning, environmental protection, complex structure and mechanical systems, vibration and acoustics, micro-and-nano-devices, mechatronics, 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 |
|---|---|---|---|
| ENGR 301 | Solid Mechanics | 3 | - |
| MATH 221 | Calculus III | 4 | - |
| CHEM 107 | General Chemistry | 3 | - |
| CHEM 113 | General Chemistry Lab | 2 | |
| PHYS 216 | University Physics II | 4 | - |
| ENGR 106 | Computer Aided Engr. Tools | - | 2 |
| ENGR 202 | Engineering Mechanics II | - | 3 |
| ENGR 211 | Thermodynamics | - | 3 |
| ENGR 212 | Electric Networks | - | 3 |
| ENGR 222 | Engineering Math I | - | 4 |
| | Liberal Studies Elective | - | 3 |
| | **Total** | **16** | **18** |

**Third Year**

| Course # | Course Title | 1st | 2nd |
|---|---|---|---|
| MATH 309 | Probability & Statistics for Engineers | 3 | - |
| ME 314 | Fundamentals of Mechatronics | 3 | - |
| ENGR 331 | Fluid Mechanics | 3 | - |
| ENGR 395 | Engineering Materials Lab | 1 | - |
| MSE 395 | Introduction to Materials Science | 2 | - |

| | | | |
|---|---|---|---|
| ME 344 | System Dynamics | 3 | - |
| ME 311 | Intro Energy/Energy Systems | - | 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 |
| | Liberal Studies Elective | - | 3 |
| | **Total** | **15** | **17** |

**Fourth Year**

| **Course #** | **Course Title** | **1st** | **2nd** |
|---|---|---|---|
| ME 441 | Senior Design | 3 | - |
| ME 442 | Senior Project | - | 3 |
| ME 487 | Thermal-Fluid Science Lab | 2 | - |
| ME 503 | Structural Mechanics | - | 3 |
| ENGR 503 | Control Systems | 3 | - |
| ME 530 | Applied Energy Systems | 3 | - |
| | ME Program Electives | 6 | 3 |
| | Liberal Studies Electives | - | 6 |
| ENGR 401 | Senior Seminar I | 1 | - |
| ENGR 402 | Senior Seminar II | | 1 |
| | **Total** | **15** | **16** |

**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 competency, 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.

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[1] BE=Biomedical Engineering; CE=Civil Engineering; EE=Electrical Engineering; ME=Mechanical Engineering.

[2] Biomedical Engineering students take BIOL 105 (4credits), 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 CE 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 Station for additional information about courses and to determine course offerings by semester.

**Course Catalog for Biomedical Engineering, Civil Engineering, Electrical Engineering, Engineering, Engineering, General, General Engineering, and Mechanical Engineering**

**BE**

| | | |
|---|---|---|
| 202 | Biomechanics | Mechanics of deformable bodies. Mechanical properties of biomaterials, bone, ligaments, and muscle. Uniaxial tension, compression, bending, and torsion applied to orthopedic biomechanics. Rigid body planar kinematics and dynamics, finite element techniques with applications to the biomechanics of walking, running, cycling, and other athletic activities. Formerly offered as 265. Prerequisite: ENGR 201. |
| 301 | Biomaterials | Introduction to materials, their surface and mechanical properties. Biomaterials |

| | | |
|---|---|---|
| | | used in prosthetic devices, dentures, arterial grafts, orthopedic implants, and other medical applications. Biocompatibility, biomaterial/tissue interactions, and other factors involved in the design of implants, biosensors and neuroprostheses. |
| 315 | Introduction to Biomedical Systems Analysis | This course introduces the techniques for analysis and modeling of biological and physiological systems. Students will derive mathematical models of the systems developed in the co-requisite physiology and apply them to generate simulation data. Time and frequency domain issues will be addressed. Students will use computer methods to solve problems in data analysis, system identification, and model validation. Prerequisite ENGR 222, co-requisite BIOL 518. |
| 398 | Junior Biomechanical Design | Fundamentals of biomechanical design and design of mechanical elements for use in orthopedics and rehabilitation. Integration of static analysis, stress analysis, and failure theories with practical biomedical design constraints. Use of CAD, finite element techniques and interactive anthropometric computer graphics in ergonomics and rehabilitation. Group design homework projects in rehabilitation or other biomedical applications. Formerly offered as 298. Prerequisites: ENGR 106, 201; BE 202. |
| 413 | Biomedical Instrumentation I | |
| 421 | Neural Control of Movement | |
| 491 | Seminar in Biomedical Engineering | Presentations by faculty, graduate students, and guest speakers in the areas related to Biomedical Engineering; may include visits to laboratories and industry. Professional aspects of Biomedical Engineering presented through lectures and discussions by guest speakers, field trips, films, panel discussions. |
| 495 | BMED Internship Projects | Biomedical engineering internship projects. On-campus faculty supervised or off-campus student training, in which students are co-supervised by a professional at the supporting institution and a biomedical engineering faculty member. Includes a proposal, a mid-term report, and a final project presentation and report. |
| 497 | BMED Senior Design | Primary component is student design projects in biomedical or rehabilitation engineering. Also, guest lectures and group discussions deal with patent searches and application, product liability, the role of technical standards, the FDA regulatory process for medical devices, research and development, and professionalism. Prerequisite: BE 398. |
| 499 | BMED Senior Project Lab | Laboratory experiments and design projects in areas of biomedical engineering. Topics may include measurements of cell deformability, adhesive strength, and parameters of cell migration. Primary component is student design projects and their presentation in class. |
| **CE** | | |
| 101 | Elementary Construction Surveying | CE 101-Elementary Construction Surveying (1) Course Description: Introduction to the elements of the discipline of surveying, with concentration on applications for the construction process. Included are topics on: the background and history of the surveying profession and how it interacts with other disciplines; measurement concepts, error consideration, accuracy, precision, and significant figures; methods for distance measuring; elevation measurements and leveling; measuring angles, bearings and azimuths with |

| | | |
|---|---|---|
| | | transits; traverses and traverse computations; basic topography and mapping; a field trip to a major construction project to review surveying procedures; and a team project for completion of a traverse and an as-built survey for an existing building. |
| 102 | Introduction to Earth Science | The course is intended for all students, regardless of major. It introduces fundamental concepts of the processes that shape our earth. From volcanoes and earthquakes to the factors that control our weather, this course offers a solid approach to basic geology, hydrology, and climatology without requiring prior knowledge of physical science and mathematics. |
| 103 | Introduction to Oceanography | |
| 110 | Computers in Construction | Study of the key phases of a construction project, from feasibility studies to facility operations; major emphasis on use of state-of-the-art commercial computer software systems in support of estimation and scheduling functions. Basics of network scheduling concepts, using both activity-on-arrow and precedence diagrams. Basics of the construction estimating processes both by hand and with the latest computerized systems. |
| 301 | Construction Systems and Planning | Presentation of the entire process of bringing a constructed facility on line. Construction Documents: owner-contractor, owner-architect, owner-CM, and standard subcontract agreements, plans and specifications, shop drawings, general and special conditions, addenda and modifications, types of contracts, bidding and award concepts, change orders, and other key documents. Building Component Systems: foundation, structural, roofing, mechanical, electrical, barrier and fire control systems. Field trips to local construction sites. |
| 302 | Civil Engineering Systems Management | Engineering and management techniques and systems used in civil engineering projects. Methods for project estimating, cost control, and procurement of materials, equipment, and subcontracts. Options presented for scheduling, with concentration on the computerized Critical Path Method (CPM) of network analysis. Introduction to environmental aspects of civil works: sustainability; environmental impact statements. Also: engineering economics, labor relations, equipment management, productivity improvements, personnel management, and construction safety programs, plus field trips. As major project, student teams create a comprehensive Management Planning, Control, and Information System for a large project. |
| 312 | Theory of Structures | CE 312-Theory of Structures (3) Course Description: Analysis of determinate structures; Stability and determinacy; Influence lines and moving loads; Deflection methods. Analysis of indeterminate structures using the methods of compatibility of displacements; Slope-deflection method; Moment distribution method. Computer applications. Prerequisite: ENGR 201;ENGR 301 |
| 313 | Theory of Structures II | |
| 366 | Introduction to Soil Mechanics | Soil properties and identification; Engineered soils and their properties; Soil water and water pressure; Stresses in Soil Mass; Compressibility of Soils; Shear strength of soils; Lateral earth pressure; Slope stability; Bearing capacity of shallow foundations. Prerequisite: ENGR 301 |
| 367 | Soil Testing for Engineers | Laboratory experiments to study physical, mechanical and hydraulic properties of soils and use of these properties to predict the soil behavior in geotechnical structures. Experiments to determine grain size distribution, specific gravity, Atterberg limits, permeability, compaction, consolidation, direct shear and |

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| | | triaxial tests. Prerequisite: CE 366. |
| 372 | Engineering Hydraulics | Principles of engineering hydraulics as applied in the design of structures and systems for hydraulic developments: water pressure forces, flow in closed conduits, flow in open channels, water pumps; hydraulic modeling. Prerequisite: ENGR 331 |
| 374 | Introduction to Transportation Systems and Design | This is an introductory transportation engineering course that focuses on the highway mode of transportation and provides (1) the depth of coverage needed to serve as a basis for future transportation courses, and (2) the knowledge to answer questions likely to appear on the exam for professional registration in civil engineering. The objectives are to introduce the students to the field of transportation engineering, to acquaint them with the many areas and facets of the discipline, and to make them aware of the professional career opportunities in transportation engineering. |
| 400 | Seminar on Public Policy Issues | Case studies are developed that involved the interplay of legislative and administrative actions. Where appropriate, the third branch of government, the judiciary, is brought in. Issues cover a number of engineering topics including transportation and water resources development. Federal policy makers from the major agencies as well as Congressional Committee staff make invited presentations. Field trips to congressional hearings and administrative sessions. |
| 402 | Structural Steel Design | Principles and knowledge of component design for steel structures using the load and resistance factor design (LRFD) method are discussed. Topics include steel material properties, and the behavior and design of steel tension members, compression members (columns), beams and beam-columns, and bolted and welded connections. Prerequisite: CE 312. |
| 403 | Reinforced Concrete Design | Concrete constituent materials; Design and Analysis of Reinforced Concrete Rectangular Beams and T-Beams; Design of Reinforced Concrete Continuous Beams, One-Way Slabs, Columns, and Footings; Ultimate Strength Method of Design for Flexure, Shear, and Axial Load; Development Length of Reinforcement and Deflections; Use of current Codes and design aids. Computer applications. Prerequisite: CE 312. |
| 414 | Advanced Vibrations and Structural Dynamics | |
| 416 | Prestressed Concrete | |
| 420 | Senior Capstone Design I | Integrated design of simple structure including foundations, columns, beams, floor and wall slabs to meet specified functional and space requirements and building, steel, and concrete design code requirements. Commercial software will be used to analyze structural framework. Final designs will be presented as set of sketches with descriptive notes. Prerequisite: CE 402, CE 403. |
| 421 | Senior Capstone Design II | Development of Critical Path Method (CPM) Schedules using Microsoft Project software and standard practices in the commercial construction industry. Basic Introduction to Timberline Estimating Computer Program. Overview of the fundamentals and capabilities of SAP2000 for structural analysis and design of typical structures including both reinforced concrete and steel. Introduction to urban hydrology and storm water management (SWMM). Prerequisite: CE587, CE312, CE402, CE403, CE331, CE371 |
| 425 | Nondestructive | |

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| | Testing and Evaluation | |
| 426 | Introduction to Finite Elements | |
| 432 | Laboratory Project | Students conduct laboratory projects under the supervision of various faculty members. Experiments must be planned and instrumented and results presented. Fall Semester |
| 433 | Laboratory Project | Students conduct laboratory projects under the supervision of various faculty members. Experiments must be planned and instrumented and results presented. Spring Semester |
| 434 | Disaster - Mitigating Design and Practice for the Developing World I | |
| 435 | Disaster-Mitigating Design and Practice for the Developing World II | |
| 438 | Introduction to Environmental Engineering | |
| 454 | Oranizatinal Theory and Behavior | |
| 463 | Applied Hydrology | |
| 464 | Surface Water Quality | |
| 468 | Foundation Engineering | Identification and classification of soils. Hydraulic properties of soils and rock. Consolidation characteristics of soils. Stress-strain relationships of soils. Subsurface exploration. Footings and raft foundations. Foundations on compacted fill. Deep foundations. Foundations on clays and sands. Design of various types of foundations. Prerequisites: CE 312, CE 366. |
| 470 | Innovative Infrastructure Management | |
| 472 | Intelligent Transportation Systems Connected Vehicles | |
| 473 | Traffic Engineering and Flow Theory | |
| 475 | Introduction to Systems Analysis | |
| 478 | Transportation Systems Management and Operations | |

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| 482 | Value Engineering | |
| 483 | Entrepreneurship, Sustain, and Lean Methods | |
| 487 | Estimating and Bidding | |
| 489 | Construction Scheduling Techniques | |
| 490 | Construction Operations Analysis | |
| 491 | Water and Wastewater Treatment Engineering | |
| 499 | Transportation Safety Engineering | |

**CENT**

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| 223 | Object-Oriented Programming with Java | |
| 301 | University Math | |
| 303 | Probability and Statistics for Engineers | |
| 442 | Web Design | |
| 472 | Intelligent Transportation ssystems Connected Vehicles | |
| 475 | Introduction to Systems Analysis | |
| 475 | Transportation Planning | |

**CSC**

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| 104 | Introduction to Computers I | Intended for liberal arts majors who want an introduction to computing history, computer concepts, hardware, software, and application software such as operating systems, graphics, word processing, databases and spreadsheets. Introduces general problem-solving techniques including the concepts of step-wise refinement applied to the development of algorithms. Elementary programming in a high-level language. Not open to students who have completed MIS 104. Faculty. |
| 105 | Introduction to | This course is intended as an introduction to computer programming using |

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| | Computers II | Visual Basic.NET. Powerful and easy to use, Visual Basic has become the tool of choice for developing user-friendly applications in today's business world. The student will learn the fundamentals of accurate, modern programming methodology, and how to use Visual Basic as a front end to major applications. The course also includes a module on data controls, database programming and introduction to SQL. A wealth of learning aids, including exercises and programming projects, and case studies are provided for students to enhance their learning and programming skills. The course is comprised of the following modules: An Introduction to Computers with Visual Basic, Problem Solving with Programming Tools, Fundamentals of Programming, Modular Design, Decisions and Logical Operators, Repetition, Arrays & Controls, Files and access, Object-Oriented Programming, Relational databases and SQL. Prerequisite CSC 104 |
| 106 | Introduction to Computer Programming for Non-Engineers | |
| 113 | Introduction to Computer Programming with MATLAB | Intended for engineering students and others who want a comprehensive introduction to fundamental programming concepts using a block-structured language. General problem-solving techniques, including the concept of step-wise refinement applied to the development of algorithms. Programming style, structure, documentation, and testing. Prerequisites: None. |
| 123 | C/C++Programming Course | Intended for computer science majors. This is an introductory course in computer science. Like most computer science classes, this is a class in problem solving. The C/C++ language is used as a problem solving tool. Students will learn techniques such as algorithm development, step-wise refinement, top-down design, object-oriented programming, and basic principles of software engineering. The course will cover the basics of C and C++ language: variables, types, expressions, control structures, method definition, parameters, arrays, strings, classes, and data abstraction. Prerequisites: None. |
| 203 | Assembly Language Programming | An introduction to assembly language programming. Creation, editing, loading, execution, and on-line debugging of assembly language programs. Topics include addressing schemes, assembler directives and macros, subroutine linkages, and assembler processing. . Prerequisite: A grade of C or better in CSC 124. |
| 210 | Discrete Mathematics | This course studies the mathematical elements of computer science including propositional logic, sets, functions and relations, probability and combinatorics, mathematical induction, algorithms, matrices, graphs, trees, and Boolean logic. During the semester students will learn to recognize and express the mathematical ideas graphically, numerically, symbolically, and in writing. They will become self-regulated learners and help other students become cooperative learners. Prerequisites: None |
| 212 | Theory of Computing | A systematic study of theory of computing. Topics include Finite Automata, Fundamentals of computer programming languages grammars, Regular Languages, Context-Free and Context-Sensitive Languages, Turing machines, and Computability Theory. The class introduces the concepts of Computer Problems, Decidability, Reducibility, Intractability, and Computational Complexity. |
| 223 | Object-Oriented Programming with | Intended for computer science majors. This course is a continuation of CSC 123, focusing on a disciplined approach to designing, coding and testing |

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| | Java | programs; implementation of data abstractions; and an introduction and analysis of search and sort algorithms. Prerequisite: none |
| 280 | Data Structures | Systematic study of data structures encountered in computing problems; methods of representing structured data and techniques for operating on them. Typical topics include arrays, lists, stacks, tree structures, files, string, and linked structures. Sorting and searching algorithms; set representations and hash tables. Prerequisites: CSC 123 or CSC 223 |
| 306 | Introduction to Operating Systems | Major concept areas of operating system principles. Topics include job scheduling, concurrent processes, memory management, dynamic allocation, protection, I/O traffic controls and evaluation models. Prerequisite: CSC390 or CSC391 |
| 311 | Design & Analysis of Algorithms | This course presents the fundamental techniques for designing efficient computer algorithm, providing their correctness, and analyzing their complexity. General topics include sorting, selection, graph algorithms, and basic algorithm design paradigms (such as divide-and-conquer, dynamic programming and greedy algorithms), lower bounds and NP-completeness. Prerequisite: CSC 280 |
| 312 | Microprocessor Programming | This course presents the fundamentals of microprocessor architecture and interfacing. Topics include instruction set architecture, assembly language, debugging and IO device interfacing techniques. The PIC processor architecture will be studied, utilizing windows based integrated development environment and tools suite. A PIC hardware evaluation board is used as the basis for interfacing experiments. Software will be written in assembly language. The Pentium processor architecture and the PCI bus will be studied. A hardware/software project will be assigned toward the end of the course. The course is 50% lab and 50% lecture. Prerequisites: CSC326 |
| 322 | Introduction to Computer Graphics | Description: This course teaches the fundamentals of 2D and 3D computer graphics. Students will learn OpenGL and standard graphics algorithms. This introductory course will not only cover fundamental computer graphics concepts including transformation, viewing, modeling, rendering, illumination, and textures, but also cover the basic linear algebra (vector and matrix arithmetic). The completion of this course will prepare students ready for any advanced computer graphics course. Students are expected to be familiar with C/C++ programming. Prerequisite: CSC 280 |
| 323 | Introduction to Computer Networks | Introductory concepts of modern computer networks and its association with the Internet. Different protocol layers and architectures of a computer network. Particular emphasis will be given on application layer, transport layer, and network layer. Applications in multimedia networking and network management. Prerequisites: CSC 113 and CSC 123 |
| 326 | Switching Circuits and Logic Design | Analysis and design of digital circuits, number systems, combinational and sequential circuits. Basic computer arithmetic, applications and implementation of logic design. Prerequisite: CSC327 (Co-req) |
| 327 | Switching Circuits and Logic Design Laboratory | This laboratory course is meant for students in an introductory digital electronics course that emphasizes logic circuit analysis, applications, and design. The lab work consists of circuit projects that range from investigating basic logic concepts to synthesizing circuits for new applications. Most digital design projects will be implemented using complex programmable logic devices (CPLDs) and/or field programmable gate arrays (FPGAs). The projects are intended to challenge students and to provide them with directed laboratory experience that develops insight into digital principles, applications, and techniques of logic circuit analysis and design. Prerequisites: CSC 326 (co- |

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| | | req) |
| 363 | Software Engineering | The course will offer a wide perspective on software development, including: requirements analysis, technical design, estimating, modeling using UML, programming style, testing, and management issues. Hands-on practice through a team programming project using object-oriented programming language such as Java will be employed to promote learning and to produce high-quality software in an efficient and predictable manner. |
| 370 | Concepts of Programming Languages | This course is an introduction to concepts of programming languages, design and implementation of programming languages. This class will also cover C++ programming as it is one of the most efficient languages and broadly used in many areas. Prerequisites: CSC280 |
| 390 | Computer Organization and Architecture | An introduction to digital logic design including combinational And sequential circuits; synthesis of memory and computation Operations; illustrations of the organization of major hardware Components of a digital computer. Prerequisite: CSC326 |
| 391 | Computer Systems Architecture | An overview of advanced architectures, microprocessor structure, I/O subsystems, multiprocessor architecture, intra-system communication, buses, caches, memory hierarchies, addressing modes, microprogramming, parallelism, and pipelining. Prerequisites: CSC113 or CSC123 |
| 411 | Analysis of Algorithms | This course presents the fundamental techniques for designing and analyzing computer algorithms, providing their correctness, and analyzing their time complexity. Topics include sorting and selection algorithms, and basic algorithm design paradigms including brute force, ivide-and-conquer, greedy technique, dynamic programming, and basic graph algorithms. Prerequisite: CSC 280 |
| 442 | Introduction to Database Management | The course covers the fundamentals of database systems. The course will provide the student with the foundation of knowledge necessary to design, implementation, and management of database systems. Topics to be covered include file systems and database concepts, database models, relational database model, introduction to SQL, database design and implementation, database integrity, and normalization of database tables. Implementation techniques using commercial DBMS will be considered. The course includes individual database application programming projects. Prerequisite: CSC363 |
| 450 | Fundamentals of Multimedia | Introduction to Multimedia; multimedia authoring and tools; Basics of digital audio, image, video, and graphics - their representation, design, and simple processing; Multimedia Data compression - algorithms, standards, and techniques; Issues in multimedia communication and networking. Prerequisite: Senior Standing |
| 471 | JAVA, OOP, Network Programming | Principles and techniques of OOP and network programming presented in the Java programming environment. Explores advanced features of Java through programming projects. Topics include Objects and Classes, graphics programming with AWT, designing user interfaces with AWT, Applets, data structures, exceptions and debugging, input and output, multithreading, and networking. Prerequisite: 113 or 124 or permission of instructor. |
| 475 | Introduction to Computer Vision | This course covers basic principle of computer vision and various techniques in computer vision. Topics include (1) low-level computer vision: image formation, image sampling and quantization, image enhancement, filtering, and edge detection; (2) intermediate level computer vision: an introduction to 3-D cues like stereo, texture, shading and motion; and (3) high level computer vision: object recognition. Prerequisites: CSC 280 & CSC 311 or permission of |

instructor.

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| 480 | Numerical Analysis and Optimization | Numerical Analysis and Optimization methods to solve practical problems in computer science, business, engineering and science. Practical problem solving based on analyzing empirical, experimental or measured data where the precise mathematical model is approximated or not necessarily known. Limitations, trade-offs and margins of error are evaluated for various practical examples such as network traffic, engineering, science and business applications. MATLAB and/or C++ are used for computational problem solving. Suitable for computer science, mathematics, engineering, and business majors. Pre-requisites:ENGR222&CSC280 |
| 491A | Senior Design I | Systematic steps towards writing a research/development project proposal including background research, problem identification, requirement analysis, specifications, and design for developing a significant software system. The course will also introduce principles and case studies of computing ethics and professional practices. |
| 491B | Senior Design II | Continuation of CSC 491. Implementation, testing, and presentation of the design done in CSC 491. The course wraps up with a final demonstration of the project. |

**EE**

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| 311 | Signals and Systems | Techniques for analysis and synthesis of signals, both continuous and discrete. Engineering applications involving simple design problems. Mathematical modeling methods for both continuous and discrete time systems. Techniques include the Fourier Series, Fourier and Laplace Transforms. Computer-aided design methods used to obtain hands-on experience in analysis and simulation. Prerequisite: ENGR 212. |
| 312 | Microprocessor Programming and Design | This course presents the fundamentals of microprocessor architecture and interfacing. Topics include instruction set architecture, C/C++ language, debugging and IO device interfacing techniques. The PIC processor architecture will be studied, utilizing windows based integrated development environment and tools suite. A PIC hardware evaluation board is used as the basis for interfacing experiments. Software will be written in C/C++ language. The Pentium processor architecture and the PCI bus will be studied. A hardware/software project will be assigned towards the end of the course. The course is 50% lab and 50% lecture. Prerequisite: |
| 322 | Electronic Circuits II | Study of feedback, the analysis, design, and applications of operational amplifiers, oscillators, multivibrators, wideband amplifiers, tuned amplifiers, and power amplifiers. Prerequisites: ENGR 321. |
| 326 | Switching Circuits and Logic Design | Analysis and design of digital circuits, number systems, combinational and sequential circuits. Basic computer arithmetic, applications and implementation of logic design. Prerequisite: CSC327 (Co-req) |
| 327 | Switching Circuits and Logic Design Laboratory | This laboratory course is meant for students in an introductory digital electronics course that emphasizes logic circuit analysis, applications, and design. The lab work consists of circuit projects that range from investigating basic logic concepts to synthesizing circuits for new applications. Most digital design projects will be implemented using complex programmable logic devices (CPLDs) and/or field programmable gate arrays (FPGAs). The projects are intended to challenge students and to provide them with directed laboratory experience that develops insight into digital principles, applications, and techniques of logic circuit analysis and design. Prerequisites: CSC 326 (co-req) |

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| 342 | Electromagnetic Fields and Waves | Theory and application of electromagnetic waves. Maxwell's equations in vector differential form introduced; solutions to the wave equation for bounded and unbounded cases examined. The rectangular waveguide and the transmission line are studied. Radiation from simple geometrics included. Prerequisites: ENGR 222, PHYS 216. |
| 356 | Electrical Laboratory II | Correlated sequence of laboratory experiments designed to illustrate the theory of junior-level electrical engineering courses, including active filters, nonlinear applications of operational amplifiers, switching and logic circuits, digital system design, push-pull amplifiers, oscillators, A/D and D/A converters, signal processing and digital filters. Prerequisites: ENGR 355 |
| 357 | Electromag Laboratory | This laboratory course is offered in conjunction with the junior level courses on Electromagnetic Fields and Waves (EE342) and Analog and Digital Signal Processing (EE362). The electromagnetic component of the lab covers experiments related to the basic concepts, fundamental principles of antennas and electromagnetic fields. The signal processing component covers experiments related to techniques for analysis and synthesis of signals and includes techniques such as the Fourier series, Fourier and Laplace transforms digital filter design. Computer-aided design methods will be used to obtain hands-on experience in analysis and simulation. Prerequisite: In conjunction with EE342 Prerequisite: EE326, ENGR 355 |
| 362 | Analog and Digital Signal Processing | Analysis and synthesis of analog and digital filters. Laplace and Fourier analysis used in analog filter design, with z-transform analysis in digital filter design. Fundamentals of digital signal processing, relevant to digital filtering. Computer-aided design and simulation. Prerequisite: EE 311. |
| 404 | Solid State Devices | Electronic properties of materials including conductivity, dielectric and magnetic permittivity. Semiconductor theory with emphasis on junction devices. Introduction to semiconductor lasers. Prerequisite: EE 342. |
| 406 | Advance Digital Logic Design | Analysis and design of advanced digital circuits such synchronous and asynchronous sequential circuits. Advanced computer arithmetic hardware and introduction to the design of micro-architecture hardware and performance concepts such as pipelining. The course also includes projects for the applications and implementation of digital logic design using programmable logic devices (PLDs) and/or field programmable gate arrays (FPGAs) for rapid prototyping. |
| 413 | Communication Systems and Networks | (3) Lecture. This course deals with fundamental concepts of communication systems and networks. More specifically it covers the following topics: Concept of signals in the time and frequency domains. Digital communication Systems: Pulse Code Modulation (PCM), delta modulation and differential PCM, multiplexing and wave shaping. Modulation techniques: analog AM, FM, and PM schemes. Digital modulation schemes: On-Off Keying, Frequency Shift Keying and Phase Shift Keying, Optical Modulation Schemes. Computer communication networks: Local Area Networks , Performance of communication systems and networks: Noise considerations. Probability of Error, delay and throughput Concepts. Prerequisite: EE 311 |
| 415 | Control Systems Analysis and Synthesis | Mathematical modelling of linear systems, state-variable, time-domain, and frequency-domain analysis of control systems. Root locus, Bode diagram, and Nyquist criterion. Stability and Routh Hurwitz method. Computer control system analysis and design. Z-transform and Z-transfer function. Prerequisites: EE 311 |
| 420 | Hybrid Gas/Electric Vehicles | This course will cover the basic theory and engineering in modern hybrid gas/electric vehicles. Topics will include hybrid drive trains, regenerative |

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| | | braking, electrical energy storage, fuel efficiency calculations, performance metrics, the economics of hybrid vehicles, future design of automobiles, including ¿plug-in¿ electric vehicles, hydrogen powered vehicles, and fuel cells. This course will dedicate a few weeks exclusively to the Toyota Prius, covering not only the design and engineering of the Prius, but also the social and economic impact of this particular hybrid vehicle. Prerequisites ENGR 321 |
| 422 | Mixed Signal VLSI Design | Design of very large scale electronic circuits, including layout, circuit analysis and component selection, extensive use of SPICE and circuit layout CAD tools. Following current industry paradigms, the class emulates a design house, where chips are completely designed and thoroughly simulated prior to their fabrication in a foundry. |
| 457 | Communications Laboratory | A correlated sequence of laboratory experiments designed to illustrate the theory of senior level communication courses including sampling and analog to digital conversion, analog and digital amplitude, frequency and phase modulation and demodulation schemes, analog and digital fiber optic link design and architectures and protocols of local area networks. Prerequisite: EE 357 Co-requisite: EE 413 |
| 459 | Introduction to Wind Energy Technology | This course will take an interdisciplinary approach to understanding wind power, focusing first on the evolution of the technology and reviewing basic technical principles associated with wind turbines and their operation. There will also be an explanation of the electric industry context within which wind technology must operate and the challenges associated with integrating a variable resource such as wind into the utility industry¿s resource mix. The course will review the impacts and effectiveness of renewable energy policy in the U.S. over the past few decades, and will explore the economics of wind as well as the basics of the industry¿s structure and operations. Finally, the course will explore the potential for wind power in the U.S., as well as the barriers or constraints to achieving that potential. Prereqs: ENGR321 |
| 460 | Photovoltaics | This course covers a variety of topics related to solar photovoltaic devices, solar panels, and the generation of electrical energy form light. The course will concentrate on traditional silicon-based solar panels, with some discussion late in the semester about newer, more efficient types of solar cells. The course also covers some of the electrical and electronic hardware commonly included in photovoltaic systems, such as charge controllers, batteries, and inverters. Prerequisites: ENGR321 or Permission |
| 461 | Photovoltaics Laboratory | This course is intended to provide hand-on experience with photovoltaics. Students will design and construct circuits and hardware for converting solar energy into electricity, including: solar cells, solar panels, solar trackers, solar concentrators, conversion circuits and battery charging circuits. |
| 462 | Introduction to Electric Power | EE 462: Intro to Electric Power This course will provide a basic understanding of electric power systems, including the generation, transmission, and distribution of electricity. Topics will include basic AC system analysis, complex loads and power, quality factor, three phase systems, system stability, and power flow. The material presented will be approached within the contexts of the traditional power grid as well as touching upon the benefits and challenges presented by emerging alternative energy technologies. |
| 491A | Engineering Practice and Design I | Two-semester sequence teaches the tools of the engineering profession, including project organization, application of engineering design standards, technical writing, and effective presentation. First semester: researching the problem, learning design fundamentals and procedures, and refining written and oral communication skills. Second semester: implementation and detailed |

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| | | investigation of engineering design and tradeoffs. Prerequisite: Senior engineering status. |
| 491B | Engineering Practice and Design II | Two-semester sequence teaches the tools of the engineering profession, including project organization, application of engineering design standards, technical writing, and effective presentation. First semester: researching the problem, learning design fundamentals and procedures, and refining written and oral communication skills. Second semester: implementation and detailed investigation of engineering design and tradeoffs. Prerequisite: Senior engineering status. Prerequisite: EE491 |

**MSE**

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| 395 | Introduction to Materials Science | |

**ENGR**

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| 102 | Introduction to Engineering Design and Professionalism | Lectures focus on the design process and professionalism. Implementation of the design process through interdisciplinary design projects with emphasis on teamwork, scheduling, analysis, decision making, and oral and written communication skills. |
| 104 | Introduction to Engineering Laboratory | In this class, students will apply mathematics and science principles to engineering problems. Students will work in groups to 1) conduct experiments, 2) collect, analyze, and interpret experimental data, and 3) develop written technical reports and orally present results from the experiments. |
| 106 | Computer Aided Engineering Tools | Introduction to Graphical Communications Tools. Two-dimensional engineering drawings using Computer Aided Design (CAD) software; three-view drawings; auxiliary views; isometric and oblique projections; sections. Introduction to 3-D and advanced modeling using CAD Tools. |
| 201 | Engineering Mechanics I | Topics covered include: Vector algebra, force vectors; concurrent force systems and equilibrium of particles; moment systems and equilibrium of rigid bodies. Structural applications and machines; internal forces; friction; moments of inertia. Math 122 and Phys 215 are co-requisites. |
| 202 | Engineering Mechanics II | Kinematics and kinetics of particles and of rigid bodies in plane motion; equations of motion in various coordinate systems; integral forms, work and energy, impulse and momentum; computer simulation software. |
| 211 | Thermodynamics | An introductory course in thermodynamics, intended to introduce sophomores to the fundamentals of thermal processes. It is one of three courses composing the fundamentals of the thermo-fluid sciences curriculum, the other two being fluid mechanics and heat transfer. |
| 212 | Electric Networks | The basic theory of electric circuits including the basic laws and techniques used in the analysis of electric circuits, transient and steady state response, and steady state sinusoidal analysis are studied. Pre-requisite: PHYS 216 Co-requisite: MATH 222 |
| 222 | Engineering Mathematics I | Differential equations is the language of engineers and is an important tool for formulating mathematical models of physical problems encountered in everyday engineering practice. In this class, you will be taught various tools for formulating, solving, analyzing, and interpreting mathematical models of physical problems. Analysis of 1st & 2nd order differential equations using analytical, numerical, and graphical techniques will be taught. Lectures will be complemented by weekly computer laboratory sessions teaching and using Matlab for solving real-world problems in engineering. |

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| 301 | Mechanics of Solids | An introductory course in the mechanics of deformable bodies. Analysis of simple structural members to resist safely axial, torsional, and bending stresses caused by static loads on structural systems. |
| 314 | Introduction to Alternative Energy | This course will deal with the issues of alternative energy sources and sustainable energy sources. We will pay particular attention to the efficiency of each alternative energy source as well as what limitations exist in terms of extracting useable energy. The course will start out covering solar energy but will then move to other alternative energy sources such as Wind, Tides, Hydroelectric, Ocean Currents, and Geothermal. This course is not intended to be overly technical, in the sense that non-engineering majors should be able to understand the material. |
| 321 | Electronic Circuits I | The course presents the fundamentals of electronic circuits. The course includes the study of semiconductor materials, junction diodes, bipolar junction transistors, field effect transistors, and operational amplifiers. |
| 331 | Fluid Mechanics | A review of dimensions, units and properties of fluids; fluid statics; conservation of mass; conservation of momentum; inviscid flows; Bernoulli¿s equation; dimensional analysis; viscous flow in a pipe; laminar boundary layers. |
| 355 | Electrical Laboratory I | A correlated sequence of laboratory experiments to illustrate the fundamentals of electronic principles and components as a basis for engineering system design. Emphasis on analog filters, semiconductor devices, operational amplifiers, digital circuits, and transducers, followed by diodes, bipolar junction and field effect transistor applications. |
| 395 | Engineering Materials Laboratory | Experimental determination of mechanical properties of materials including steel, wood, plastics, and concrete. Determination of Young's Modulus, Poisson's ratio, ductility, yield strength, ultimate strength, toughness, and hardness for steel, aluminum and brass. Strength determination of wood specimens. Creep behavior of plastics; Strain gauge installation and use; Concrete mixing design; and the strength properties of concrete specimens. Report writing and application of basic statistical principles on experimental results. |
| 401 | Senior Seminar I | Current topics related to the engineering profession, and preparation for and taking of the Fundamentals in Engineering (FE) Examination. |
| 408 | Batteries, Fuel Cells, and Energy Storage | |
| 438 | Introduction to Enviromental Engineering | |
| 494 | Independent Study | |
| 494A | Independent Study | |
| 495 | Internship/Co-Op Program | |
| 495A | Internship/Co-Op | |
| 497 | Brazilian Summer Program | |

**ME**

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| 311 | Introduction to Energy and Energy Systems | This is a required, 3-credit course, primarily for Mechanical Engineering juniors. It is the first course for energies, and energy systems and technologies, including electric utility, power, propulsion, HVAC, refrigeration, and cryogenic systems. It is a course in applied thermal sciences, and discusses internal and external combustion heat engine cycles, heat pump cycles, mixtures and psychrometrics, fuels and combustion, and their associated engineering components and subsystems. An overview of form/type of energy, energy consumption, production, and reserves in the USA and the world, and modern direct energy converters are also discussed. Emphasis is placed on the quantitative analysis of performance of various energy systems and processes, and on the tradeoffs necessary for improved efficiency, operational characteristics, and environmental acceptability. |
| 314 | Fundamentals of Mechatronics | This is a 3-credit, upper-level course offered to engineering juniors, seniors and graduate students. This course covers the fundamentals of technologies involved to understand, design and optimize mechatronic systems. Topics include: electric circuits and components, semiconductor electronics, digital circuits, operational amplifiers, A/D & D/A converters, sensors and measurement systems, actuators, microcontrollers and interfacing, control system and system response. The course will take a narrative approach, emphasizing the understanding of fundamentals, the importance of building intuition and integration of engineering systems. |
| 342 | Junior Design | General topics: Standards; engineering economics; manufacturing processes; and intellectual property. Fundamentals of mechanical design: stress analysis; deflection analysis; failure theories; fatigue. Design of machine elements: screws; fasteners; springs; bearing; gears; shafts. Design process and the assignment of an open-ended design problem. An introduction to solid modeling. |
| 344 | System Dynamics | Major topics: Mathematical modeling of dynamic systems, Laplace transforms. Transient response analysis and frequency response analysis of mechanical, electrical and fluid systems. Computational solutions of responses of dynamic systems in state space. MATLAB used for analysis and design problems. |
| 362 | Heat Transfer | This is a survey course of basic heat transfer: conduction, convection, and radiation. The approach is to present the fundamental governing equation for each mechanism and discuss the relevant simplifications for practical engineering applications. This course emphasizes the practical aspects of the student's engineering education; hence, the course seeks to develop and refine the student's ability to analyze arbitrary engineering applications. |
| 373 | Fundamentals of Flight | This course presents the practical aspects of flight: basic aerodynamic principles; lift and drag calculations for airfoils and wings; airplane performance parameters (thrust, glide ratio, etc.); stability and control. Time permitting, elements of propulsion and space flight will also be introduced. |
| 392 | Dynamics Laboratory | Computer simulation of dynamic mechanical systems. Experimental methods for measuring the temporal and frequency response of dynamic systems. Statistical theories of measurement (error analysis, sampling, averaging, correlation). |
| 404 | Structural Mechanics | |
| 441 | Senior Design | Students will learn topics essential for the design of mechanical systems. Topics will include design, materials and manufacturing, lubrication, friction |

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| | | and wear, columns, and pressure vessels. Students will incorporate engineering standards, and use freehand sketching as well as PC based tools including CAD and Matlab. The course will emphasize individual and group projects. Effective communication of complex ideas through formal oral or written form and informal free hand sketching will be emphasized. |
| 442 | Senior Project | Provides students with optimum design and synthesis techniques of thermal and mechanical systems. Students apply the presented methods to creative design of complex thermal and mechanical systems. Risk, reliability, and economic analyses are introduced and utilized in the design process. Group discussion, teamwork, oral presentation, and oral reports. |
| 447 | Modelling and Simulation of Mechanical/Thermal-Fluid Systems | A practical course in the application of finite element methods, computational fluid dynamics, and computational heat transfer in solving real, complex mechanical and thermal-fluid systems. Emphasis will be given to the underlying physics of the problems, specifying boundary and initial conditions, specifying materials, and verifying and interpreting results. |
| 457 | Applied Rigid Body Dynamics | This course consists of a thorough coverage of kinematics and kinetics of particles, rigid bodies, and multibody systems in three dimensions. A Newton-Euler approach is used for developing equations of motion, and computer simulation of mechanical systems is used extensively. Emphasis is placed on engineering applications, including dynamics of marine, ground, and aerospace vehicles, robotics, machine tool dynamics, and biomechanics. Students are assumed to have familiarity with the fundamentals of particle and rigid body dynamics . Prerequisite: ENGR 202 |
| 487 | Thermal Science Lab | This course includes the hands-on performance of and the analysis of results for selected experiments to support the lecture courses of thermodynamics (ENGR 211), fluid mechanics (ENGR 331), heat transfer (ME 362), and energy systems (ME 311). Also, students are taught technical writing skills and are required to submit laboratory reports of professional quality. |

## Footnotes

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TABLE OF CONTENTS

**Last reviewed: August 25, 2015**