COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

J. Cole Smith, Dean
223 Link Hall
ecs.syracuse.edu (http://ecs.syracuse.edu)

About the College

Founded in 1901, Syracuse University's College of Engineering and Computer Science (ECS) enjoys a long-standing reputation for excellence and innovation. The college community is composed of outstanding students, faculty, and staff who are dedicated to personal excellence and success.

Today, the demand for individuals with degrees in engineering and computer science is greater than ever. Not only in traditional engineering settings, but also in areas such as law, medicine, public policy, finance, management, and communications.

Today's engineers and computer scientists must possess a broader set of perspectives, experiences, and skills to contribute successfully in a dynamic, rapidly changing world. ECS offers courses and programs that are designed to prepare leaders for a high-technology, diverse, and knowledge-based global community. Through courses and experiential learning, ECS offers students a breadth of opportunities and experiences that is unmatched by programs at most other universities.

The college offers ten undergraduate programs: bachelor of science programs in aerospace engineering, biomedical engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, environmental engineering, and mechanical engineering are accredited by the Engineering Accreditation Commission of ABET, and bachelor science program in computer science is accredited by the Computing Accreditation Commission of ABET, http://www.abet.org.

New engineering and computer science students enroll in ECS 101 Introduction to Engineering and Computer Science. ECS 101 Introduction to Engineering and Computer Science provides a broad introduction to each of our degree programs, allowing students an opportunity to explore areas outside their initial majors. ECS 101 Introduction to Engineering and Computer Science is also open to students at other Syracuse University colleges who are interested in exploring the areas of engineering or computer science. In fact, this course serves as a unique launchpad to integrating six institutional learning goals that enhance undergraduate education broadly at Syracuse University. These six goals are Syracuse University's "Shared Competencies (https://coursecatalog.syracuse.edu/shared-competencies/)," and include ethics, integrity, and commitment to diversity and inclusion; creative thinking; research skills; civic and global responsibility; communication skills; and technological agility.

ECS students may choose from a variety of study options, including technical and non-technical minors, combined B.S./M.S. degree programs, and a combined undergraduate degree program between ECS and the College of Arts and Sciences. The college also offers its students opportunities for study abroad, internships, co-ops, and undergraduate research.

Accreditation

Bachelor of science programs in aerospace engineering, biomedical engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, environmental engineering, and mechanical engineering accredited by the Engineering Accreditation Commission of ABET (www.abet.org (http://www.abet.org)), and the bachelor of science program in computer science accredited by the Computing Accreditation Commission of ABET.

Student Outcomes

Graduates of the engineering programs will have the ability to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. Communicate effectively with a range of audiences.
4. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.

Graduates of the computer science program will have an ability to:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions

Educational Mission and Vision

The College Mission

The mission of the college is to promote learning in engineering and computer science through integrated activities in teaching, research, scholarship, creative accomplishments, and service.

The College Vision

The vision of the college is to earn recognition among universities for engineering and computer science programs that prepare leaders for a high-technology, knowledge-based, global community. The vision for E&CS is a distinct student-centered research university model for

engineering and computer science education. Features of this model include the following:

- the commitment that all programs relate directly to students and their learning experiences;
- the commitment that research is an integral element of the learning environment;
- the flexibility for students to pursue the diversity of learning opportunities available in a broad university setting; and
- the commitment to world-class quality in courses and programs.

Undergraduate Program Overview

The college offers ten undergraduate programs: The bachelor of science programs in aerospace engineering, bioengineering, chemical engineering, civil engineering, computer engineering, electrical engineering, environmental engineering, and mechanical engineering are accredited by the Engineering Accreditation Commission of ABET, and bachelor science program in computer science is accredited by the Computing Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

College of Engineering and Computer Science Bachelor of Science Degree Requirements

The B.S. degree, in any of the 10 areas available, requires from 120 to 131 credits, distributed among university-wide requirements, liberal arts requirements and major specific requirements.

University-wide Requirements

All incoming and transfer students are required to take a 1-credit FYS 101 First Year Seminar course designed to facilitate students' transition to campus like at Syracuse University.

All undergraduate students at Syracuse University are also required to complete a a 3-credit IDEA course that can be selected from an approved list (https://coursecatalog.syracuse.edu/undergraduate/idea-course-requirement/), which may also satisfy another requirement of the program of study.

General Regulations

Academic rules and regulations that apply to all University students, as well as specific rules and regulations that apply to students matriculated into the College of Engineering and Computer Science can be found in the Academic Rules (https://coursecatalog.syracuse.edu/undergraduate/academic-rules/) section of this catalog.

Engineering and computer science students enrolled at Syracuse University must maintain at least a 2.0 grade point average in all engineering, mathematics, and science courses taken at SU. Furthermore, all students must satisfactorily complete at least 24 credits, including summer courses taken here or transferred to Syracuse University from another institution, within any 12-month period to maintain satisfactory progress, with at least a 2.0 semester and cumulative grade point average.

For graduation, students must have a minimum cumulative GPA of 2.0 and at least a 2.0 GPA in all engineering and computer science, mathematics, and science courses taken at Syracuse University, with no missing or incomplete grades. In addition, students must meet all degree requirements specific to their chosen major.

Arts and Sciences/Engineering and Computer Science (Combined Degrees)

Arts and Sciences/Maxwell contact the Advising and Academic Support Office, 329 Hall of Languages, 315-443-3150.

Engineering and Computer Science contact the Undergraduate Student Records Office at undergradrecords@syr.edu.
Engineering Faculty, See individual departments listed in the "College of Engineering and Computer Science (https://ecs.syracuse.edu/)."

The College of Arts and Sciences (https://coursecatalog.syracuse.edu/undergraduate/arts-sciences/), in cooperation with the College of Engineering and Computer Science, offers a five-year combined curriculum. Students complete the requirements for and receive two degrees-one degree in a major in The College of Engineering and Computer Science and one degree in a major in the College of Arts and Sciences. Students who enter this program are urged to talk with advisors in both academic departments in which they plan to major as soon as possible. It is important that they understand the curricular requirements of each academic major to understand how best to complete the two sets of requirements.

Students register with the College of Arts and Sciences as the home college for the first three years. They receive a basic education in mathematics and science along with a liberal education in the social sciences and humanities. While most of the coursework taken during that time is in the liberal arts, approximately one quarter of the program consists of first- and second-year courses in the engineering field chosen by the students.

After completing the third year, students transfer the home college designation to the College of Engineering and Computer Science while maintaining a connection with the College of Arts and Sciences. The fourth and fifth years of the program focus on engineering subjects. The B.A. or B.S. degree in the Arts and Sciences major may be awarded upon completion of the fourth year, but increased scheduling options are possible by completing both degrees at the end of the fifth year.

While some flexibility is possible in the program, it is a formalized curriculum. Students often major in complementary fields, such as mathematics, biology, physics, or chemistry in the College of Arts and Sciences, although many other majors are permissable upon approval by both colleges. The completion of the combined degree program requires a minimum of 150 total credits earned.

Admission requirements are the same as those for students entering the College of Engineering and Computer Science. Students who are already enrolled in the College of Engineering and Computer Science or the College of Arts and Sciences may transfer into the combined program provided all requirements can be met within the defined timeframe. Such transfers must be approved by both colleges.

Intra-University Transfer

Students who wish to transfer into any program within the College of Engineering and Computer Science from another school or college within the University must have a strong record of achievement, with a cumulative grade point average of 3.0 or better, and demonstrated success in key technical courses. Specifically, it is critical for the applicant to have proven their ability to excel in college-level calculus

(by completing at least one of MAT 295 Calculus I, MAT 296 Calculus II, or MAT 397 Calculus III with a grade of B- or better) and science (by completing at least one set of PHY 211 General Physics I/PHY 221 General Physics Laboratory I or CHE 106 General Chemistry Lecture I/CHE 107 General Chemistry Laboratory I with a grade of B- or better). Students who wish to major in computer science must also complete CIS 252 Elements of Computer Science with a grade of at least a B.

Advising in ECS

We want to see every student succeed in the College of Engineering and Computer Science. Starting in the first semester each undergraduate student is assigned a support network consisting of a Faculty Advisor, Success Advisor, and Career Advisor to guide them on academic, professional, and social matters from their transition to college through degree completion.

Through engagement with the College of Engineering and Computer Science and the Student Success Center, upon graduation, an ECS undergraduate student:

- Will have established a personal, academic, and professional support network
- Will have developed a peer network through involvement in college activities, mentoring opportunities, and leadership experiences
- Will be able to develop and model an accurate sense of self; cultivate a profound understanding of personal motivation; and practice personal, academic, & professional responsibility
- Will proactively make every effort to increase their skill sets and remain abreast of the latest technology so as to maintain a competitive advantage
- Will be encouraged to take the initiative to develop the skills necessary to position themselves as a competitive candidate in academic and professional markets
- Will have utilized the available internal and external resources and engage with a variety of career-related services so that they can successfully obtain co-op/internship/research opportunities and ultimately achieve successful post-graduation goals
- Will be able to articulate the connection between their degree program and their professional aspirations

Faculty Advising

All students are assigned to a faculty member in their chosen Department who they will meet with each semester to discuss their curriculum, progress toward degree, course selection and registration for the following semester, and professional mentoring in their field.

Student Success Advising

Success Advisors focus on the students' overall experience and success. Through individual meetings, small group workshops, and large-scale events, Success Advisors assist students in goal setting, time management, campus involvement, stress management, wellness, and other strategies to overcome challenges.

Success Advisors work collaboratively with students' Faculty and Career Advisors, as well as various campus partners, to provide holistic support in reaching their goals.

First and second year students, as well as students on academic probation, meet regularly with their Success Advisor to build a strong foundation for their experience in ECS. Success Advisors monitor all students' progress through Orange Success and provide timely and effective outreach in addressing challenges that arise.

Career Services

Recognizing that career development is an ongoing process, students are encouraged to engage with Career Services early and often so that we can empower them to get the most of their college experience. Undergraduates in ECS will be introduced to their Career Advisor during ECS 101 and encouraged to connect individually during their first year to discuss post-graduation goals and to strategize how to achieve them during their undergraduate career.

Highlights of our services include, but are not limited to:

Career Preparation: Resume preparation, Interview skills, Job search strategies, Cover letter writing, Negotiating the offer, Mock interviewing, Career fair preparation sessions.

Campus Fairs: College Career Fairs each semester, campus-wide career fairs, Employer networking and information events.

Internships and Co-Ops: Undergraduate students are empowered to take advantage of experiential learning opportunities that have proven to aid them in successfully reaching their post-graduate goals. Students can participate in internships and co-op experiences, either just for the summer or for the summer and an academic term. This allows students the opportunity to gain 3 to 6 months of paid work experience in their field of study and often times still graduate on time. Students interested in either of these opportunities should connect with their Career Advisor early to ensure they are fully prepared and informed. To be eligible, students must be enrolled full time in the College of Engineering and Computer Science.

Office of Inclusive Excellence

The Office of Inclusive Excellence is committed to breaking barriers and building bridges in our community. We augment and integrate diversity, equity, and inclusion within the college through education, research, dialogue, policy, and assessment. The Office leads high-impact student retention programs, and hosts training and education for faculty, staff, and students.

Inclusive Excellence Programs are designed to foster a sense of community, collaboration, support and individual growth. Highlights of some support opportunities available through the Office of inclusive excellence include:

- Academic Excellence Workshops (**AEW**) are peer-facilitated, one-credit, pass/fail courses designed to support academic excellence by supplementing instruction in many first and second year courses. Students can register for these classes during the course add period via MySlice.
- In addition to AEW, the College is committed to offering a number of different resources to ensure academic success. **Tutoring** support, including Sponsorship Vouchers for fee-based tutoring in eligible courses, is available each semester.
- We use our **Leadership Dialogue Circle** program to develop inclusive excellence leadership skills-crucial for enhancing campus climate and skills cited by employers as essential for leadership in today's global, diverse, and multicultural workforce. The dialogue circles bring people together in small groups to foster mutual understanding and trust, uncovering new ways to work together and solve problems. Each circle is led by diverse, trained facilitators to address and

encourage understanding across identity differences. Dialogue Circles are available to faculty, staff, and students.

- The ECS **Inclusive Excellence Council** is led by the Assistant Dean and comprised of faculty, staff and students. Driven by work in various sub-committees, the council is an action-based group focused on representation, expanding opportunities for underrepresented minorities and females and supporting the ECS Leadership Dialogue Circle program.
- Support and development of ECS **Student Organizations, Pre-College Initiatives**, and various **targeted events**, are additional opportunities to engage and integrate diversity, equity, and inclusion.

Students interested in further information on services provided by the ECS Office of Inclusive Excellence can email ecsieoffice@syr.edu.

Undergraduate Minors

Engineering and computer science students can incorporate a broad range of available minors into their major program of study offered by other departments within Engineering and Computer Science or from other Schools and Colleges at Syracuse University or SUNY College of Environmental Science and Forestry. Non-ECS students may pursue one of the several minors offered through the College of Engineering and Computer Science.

Study Abroad

In a time of rapidly growing global complexity and opportunity, international study is an increasingly important and relevant component of undergraduate study, especially for students preparing for careers in engineering or computer science. Of all the major professions, engineering and computer science are the most likely to involve international activity. In addition to strong technical skills, employers are increasingly looking for international experience, cross-cultural skills by developing a "global mindset" and perspectives, and an understanding of the world's diversity.

For over 20 years, ECS in a partnership with Syracuse Abroad, has been a national leader in providing distinctive international study opportunities. These opportunities include:

- Study at Signature Engineering programs at the SU Centers in Florence, London, and Strasbourg, during Fall or Spring Semesters
- Study at World Partner Programs at affiliated universities across the globe.
- Summer Research program in Strasbourg, France

The College of Engineering and Computer Science's international study programs give students the opportunity to gain global experience, develop new ways of viewing the world, form lasting friendships abroad, and deepen their connection to other countries, languages and cultures. Students with these experiences gain a competitive edge in today's multinational, multicultural environment.

To participate, students must be in good academic and judicial standing with a cumulative GPA of 3.0 and enrolled in one of Syracuse University's engineering or computer science programs. Participants must also meet any language requirements of the host country.

For further information, contact the ECS Undergraduate Student Records Office in Link Hall or by email at undergradrecords@syr.edu or Syracuse University Study Abroad, 106 Walnut Place (suabroad.syr.edu (http://suabroad.syr.edu)).

Facilities and Research

Undergraduate

Facilities

The College of Engineering and Computer Science has facilities in three buildings on the SU Main Campus: Link Hall, Bowne Hall and the Center for Science and Technology.

More than 200 computers are available around the clock for the exclusive use of students in ECS. These computers are housed in Windows, Mac and UNIX computer labs networked by up-to-date servers offering a range of software appropriate to the disciplines offered by the college.

Students in the college can readily access campus-wide resources operated by the University's central Information Technology Services (ITS) organization. Wireless network access is available in all campus buildings and across the Quad. Detailed information about IT resources campus-wide is available at its.syr.edu (http://its.syr.edu).

Programs

Major

- Aerospace Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/aerospace-engineering-bs/)
- Biomedical Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/biomedical-engineering-bs/)
- Chemical Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/chemical-engineering-bs/)
- Civil Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/civil-engineering-bs/)
- Computer Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-engineering-bs/)
- Computer Science, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-science-bs/)
- Electrical Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/electrical-engineering-bs/)
- Environmental Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/environmental-engineering-bs/)
- Mechanical Engineering, BS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/mechanical-engineering-bs/)

Minor

- Civil Engineering Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/civil-engineering-minor/)
- Computer Engineering Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-engineering-minor/)
- Computer Science Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-science-minor/)

- Electrical Engineering Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/electrical-engineering-minor/)
- Energy Systems Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/energy-systems-minor/)
- Engineering and Computer Science Management Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/engineering-computer-science-management-minor/)
- Environmental Engineering Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/environmental-engineering-minor/)
- Humanitarian Engineering Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/humanitarian-engineering-minor/)
- Infrastructure, Cities, and the Future Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/infrastructure-cities-future-minor/)
- Materials Science and Engineering Minor (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/materials-science-engineering-minor/)

Combined Degree

- Aerospace Engineering, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/aerospace-engineering-bs-engineering-management-ms/)
- Aerospace Engineering, BS/Mechanical and Aerospace Engineering, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/aerospace-engineering-bs-mechanical-aerospace-engineering-ms/)
- Aerospace Engineering/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/aerospace-engineering-business-administration-bs-mba/)
- Biomedical Engineering, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/biomedical-engineering-bs-engineering-management-ms/)
- Biomedical Engineering, BS/MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/biomedical-engineering-bs-ms/)
- Biomedical Engineering/Business Administration, BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/biomedical-engineering-business-administration-bs-mba/)
- Chemical Engineering, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/chemical-engineering-bs-engineering-management-ms/)
- Chemical Engineering, BS/MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/chemical-engineering-bs-ms/)
- Chemical Engineering/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/chemical-engineering-business-administration-bs-mba/)
- Civil Engineering, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/civil-engineering-bs-engineering-management-ms/)
- Civil Engineering, BS/MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/civil-engineering-bs-ms/)
- Civil Engineering/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/civil-engineering-business-administration-bs-mba/)
- Computer Engineering, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-engineering-bs-engineering-management-ms/)
- Computer Engineering, BS/MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-engineering-bs-ms/)
- Computer Engineering/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-engineering-business-administration-bs-mba/)
- Computer Science, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-science-bs-engineering-management-ms/)
- Computer Science, BS/MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-science-bs-ms/)
- Computer Science/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/computer-science-business-administration-bs-mba/)
- Electrical Engineering, BS/ Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/electrical-engineering-bs-engineering-management-ms/)
- Electrical Engineering, BS/MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/electrical-engineering-bs-ms/)
- Electrical Engineering/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/electrical-engineering-business-administration-bs-mba/)
- Environmental Engineering, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/environmental-engineering-bs-engineering-management-ms/)
- Environmental Engineering, BS/Environmental Engineering, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/environmental-engineering-bs-ms/)
- Environmental Engineering/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/environmental-engineering-business-administration-bs-mba/)
- Mechanical Engineering, BS/Engineering Management, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/mechanical-engineering-bs-engineering-management-ms/)
- Mechanical Engineering, BS/Mechanical and Aerospace Engineering, MS (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/mechanical-engineering-bsmechanical-aerospace-engineering-ms/)
- Mechanical Engineering/Business Administration (3+2 Program), BS/MBA (https://coursecatalog.syracuse.edu/undergraduate/engineering-computer-science/mechanical-engineering-business-administration-bs-mba/)

Faculty

Mo Abdallah, Assistant Teaching Professor
Ph.D., 2010
Computer Engineering

Riyad S. Aboutaha, Associate Professor and Senior Associate Dean
Ph.D., University of Texas at Austin, 1994
Structural design, evaluation, and rehabilitation; structural concrete and composites; infrastructure renewal

Jeongmin Ahn, Full Professor
Ph.D., University of Southern California 2006
Energy Conversion, Combustion, Thermal Management, PowerMEMS

Benjamin Akih-Kumgeh, Associate Professor
Program Director of Aerospace Engineering
Ph.D., McGill University, Canada, 2011
Combustion Physics & Chemistry; Fuel Technology

Jackie Anderson, Associate Teaching Professor
Program Director of Engineering Management
Ph.D., Syracuse University, 2011
Air Management Systems, HVAC, Engineering Management

Ethan Arnault, Assistant Professor
Ph.D., Duke University, 2022
Intersection of quantum materials, nanoscale devices, and light-matter interactions

Ercument Arvas, Emeritus Professor
Ph.D., Syracuse University, 1983
RF/Microwave devices and circuits, electromagnetic scattering

Shobha K. Bhatia, Professor Emertia, Laura J. and L. Douglas Meredith Professor
Ph.D., University of British Columbia, 1980
Geosynthetic applications, image processing, soil dynamics, geo-environmental

Michael Blatchley, Assistant Professor
PhD, Johns Hopkins University, August 2019
4D Biomaterials, Organoids, Vascularization, Extracellular Matrix, Tissue Morphogenesis

Howard A. Blair, Emeritus Associate Professor
Ph.D., Syracuse University, 1980
Knowledge Representation and Automated, hybrid systems, formal methods and verification

Michelle Blum, Associate Teaching Professor
Program Director of Mechanical Engineering
Ph.D., University of Notre Dame, May 2012
Orthopedic implant development, polymer characterization and simulation of tribological contacts

Edward A. Bogucz Jr., Associate Professor
Ph.D., Lehigh University, 1985
Fluid mechanics, heat transfer, numerical methods

Jesse Q. Bond, Professor, Gustav A. Mezger Professor and Graduate Chemical Engineering Program Director
Ph.D., University of Wisconsin, Madison 2009
Heterogeneous catalysis, Kinetics, Reaction engineering, and Alternative resource utilization

Katie D. Cadwell, Associate Professor, Undergraduate Chemical Engineering Program Director
Ph.D., University of Wisconsin, Madison 2007
Development of engineering faculty attitudes and pedagogy; Development of engineering student professional skills, K-12 engineering outreach

Yue Cao, Assistant Teaching Faculty
Ph.D., Purdue University, 2024, Electrical and Computer Engineering
Robotics and AI

Elizabeth K. Carter, Assistant Professor
Ph.D., Cornell University
Disaster response and mitigation; Hydrometerology and hydroclimatology; Space/time statistics; Machine learning/artificial intelligence; High-performance computing

Joseph Chaiken, Professor, Chemistry
Ph.D., University of Illinois 1982
Spectroscopy

David G. Chandler, Associate Professor
Ph.D., Cornell University, 1998
Hydrology, soil physics, environmental monitoring

Biao Chen, John E. and Patricia A. Breyer Professor in Electrical Engineering
Ph.D., University of Connecticut, 1999
Signal processing, Communication and Information Theory

C.Y. Roger Chen, Professor
Ph.D., University of Illinois, 1987
CAD for VLSI physical synthesis and multimedia information technologies

Ruth Chen, Professor of Practice
Ph.D., MPH, University of Michigan
Risk assessment; Environmental regulation; Injurious effect of environmental chemicals; Aerosol delivery of chemo-preventive agents; Alternative energy; Environmental education; Metabolism of hepatotoxic aliphatic halogenated hydrocarbons

Shiu-Kai Chin, Research Professor
Ph.D., Syracuse University, 1986
Formal verification, security, access control

Samuel P. Clemence, Professor Emeritus, Laura J. and L. Douglas Meredith Professor
Ph.D., Georgia Institute of Technology, 1973
Soil mechanics, geotechnical engineering, foundation engineering

Andria Costello Staniec, Associate Professor, Civil and Environmental Department Chair
Ph.D., California Institute of Technology, 1999
Engineering education, access and retention in STEM, applied environmental microbiology

Viktor J. Cybulskis, Assistant Professor
Ph.D., Purdue University 2016
Heterogeneous Catalysis, Zeolites, Molecular Sieves, Kinetics

Thong Dang, Professor

Ph.D., Massachusetts Institute of Technology, 1985
Theoretical/ computational fluid dynamics of internal/external flows

John F. Dannenhoffer, Associate Professor
Sc.D., Massachusetts Institute of Technology, 1987
Computational fluid dynamics, modeling and analysis in industry, collaborative education

Cliff I. Davidson, Research Professor
Ph.D., California Institute of Technology
Sustainability in Engineering, air quality, green infrastructure for stormwater management, environmental policy

R. Leland Davis, Research Faculty
M.S., University of Michigan
Indoor environmental quality

Rodrick Kuate Defo, Assistant Professor
Ph.D. Harvard University, 2020
Development of ab-initio solid-state materials theory for improved accuracy of first-principles material-property predictions

Alexander Deyhim, Kenneth and Mary Ann Shaw Professor of Practice in Entrepreneurial Leadership
MBA, Cornell University, 1998
MEng, Cornell University, 1993
Entrepreneurship, Engineering Design, Innovation

Bing Dong, Associate Professor
Ph.D., Carnegie Mellon University, 2010
Urban scale building energy modeling, modeling and simulation of occupant behavior in smart buildings and connected communities, control and optimization of smart building system, buildings-to-grid integration, building information modeling (BIM) and its application to smart building operation

Kimberley M. Driscoll, Research Faculty
M.S.E.G., Syracuse University, 1991
Environmental systems engineering

Charles T. Driscoll Jr., University Professor
Ph.D., Cornell University, 1979
Aquatic chemistry, biogeochemistry, environmental modeling

Victor H. Duenas, Assistant Professor
Ph.D., University of Florida, 2018
Nonlinear Control and Adaptive Control, Robotics and Cyber-physical Systems, Rehabilitation Engineering, Machine Learning Techniques in Biomedical Applications

Charles E. Ebbing, Adjunct Professor
M.S.E.E., SUNY, University at Buffalo, 1966
Acoustic consulting, sound quality, community noise, noise criteria, sound measurements, test facilities, creative problem solving

Sara Eftekharnejad, Associate Professor
Ph.D., Arizona State University, 2012
Power system operations planning; State estimation; Transmission expansion planning

Omar El Masri, Adjunct Professor

Gustav A. Engbretson, Professor Emeritus
Ph.D., Zoology, University of Oklahoma, 1976

Ehat Ercanli, Associate Teaching Professor, Associate Chair for Education and Operations
Ph.D., Case Western Reserve University, 1997
Design automation for embedded systems, computer architecture, database systems, system verification and testing

Matthew Erdman, Assistant Teaching Professor
P.h.D Florida State University, 2020
High speed flows

Makan Fardad, Associate Professor
Ph.D., University of California, Santa Barbara, 2006
Comvex optimization; Design and optimal control of complex networks; Synchronization and consensus multi-agent systems

James W. Fawcett, Emeritus Teaching Professor
Ph.D., Syracuse University, 1981
Software, software complexity, re-use, salvage

Eric B. Finkelstein, Research Assistant Professor of Biomedical & Chemical Engineering & Lab Manager, Syracuse BioInspired Institute
Ph.D., Anatomy and Cell Biology, SUNY Upstate Medical University, 2002
Vascular cell biology; Biomaterials, Tissue engineering, Cell-material interactions, Bioreplication, Engineered vascular networks

Zhenyu Gan, Assistant Professor
Ph.D., University of Michigan, 2018
Computational multibody dynamics, design and control of legged systems

Venkata Gandikota, Assistant Professor
Ph.D., Purdue University, 2017
Coding Theory, Sublinear algorithms, Foundations of data science

Natarajan Gautam, Professor
Ph.D., The University of North Carolina at Chapel Hill, 1997
Performacne modeling, analytics, control and optimization, queues and networks, applied probability

Nadeem Ghani, Assistant Teaching Professor, Program Coordinator, Computer Science MS
Ph.D., The Ohio State University, 1995
Software Engineering and design
Prasanta Ghosh, Professor
Ph.D., Pennsylvania State University, 1986
Microelectronics, solid state devices, optoelectronics, thin film processes, power engineering

Mark N. Glauser, Emeritus Professor
Ph.D., University at Buffalo, SUNY, 1987
Turbulence, flow control, fluid mechanics of built environments, dynamical systems, unsteady aerodynamics, heat transfer, acoustics, applied mathematics, signal processing and instrumentation

Amrit L. Goel, Emeritus Professor
Ph.D., University of Wisconsin, 1968
Software engineering: data mining applications, radial basis function models

Jennifer Graham, Associate Teaching Professor
Ph.D., Syracuse University, 2012
Electromagnetic wave behavior in complex media; Antenna design and characterization; RF and microwave design; Radar systems engineering.

Mustafa Cenk Gursoy, Professor

Ph.D., Princeton University, 2004
Wireless Communications, Information Theory, Communication Networks, and Signal Processing.

Moamer (Mo) Hasanovic, Assistant Teaching Professor
Ph.D., Syracuse University, 2006
Electromagnetics and RF

Julie M. Hasenwinkel, Professor, Laura J. and L. Douglas Meredith Professor, Biomedical and Chemical Engineering Department Chair
Ph.D., Biomedical Engineering, Northwestern University, 1999
Biomaterials, nerve regeneration, spinal cord injury

James H. Henderson, Full Professor; Associate Director, BioInspired Institute
Ph.D., Mechanical Engineering, Stanford University, 2004
Biomaterials/Tissue engineering, Mechanobiology, Biomechanics

John C. Heydweiller, Professor Emeritus
Ph.D., Chemical Engineering, Kansas State University 1977

Endadul Hoque, Assistant Professor
Ph.D. Computer Science, Purdue University, 2015
Security of computer networks and systems, IoT systems security, program analysis, software testing and verification, and vulnerability detection

Ian Hosein, Associate Professor
Ph.D., Materials Science & Engineering, Cornell University, 2009
Sustainable energy, Materials synthesis and processing, Spontaneous process in materials, Device fabrication and measurements

Can Isik, Professor
Ph.D., University of Florida, 1985
Applications of Artificial Intelligence; Controls; Medical Instrumentation; Environmental Control Systems

Era Jain, Assistant Professor
Ph.D. Indian Institute of Technology, India, 2011
Drug Delivery, Biomaterials, Translational animal models, Musculoskeletal Tissue engineering

Pankaj K. Jha, Assistant Professor
Ph.D., Texas A&M University, 2012
Quantum information science, quantum sensing and metrology, quantum nano- and meta-photonics, bio-inspired materials, bio-nano interfaces, and machine learning

Chris E. Johnson, Professor
Ph.D., University of Pennsylvania, 1989
Environmental geochemistry, soil chemistry, statistical modeling

Alex K. Jones, Klaus Schroder Professor of Engineering; Department Chair, Electrical Engineering and Computer Science
Ph.D., Northwestern University, 2002
Computer architecture and compilers

Dennis Joyce, Adjunct Professor

Garret Ethan Katz, Associate Professor
Ph.D., Computer Science, University of Maryland, 2017
Artificial Intelligence, neural networks, robotics

Lance S. Ketcham, Adjunct Faculty
M.S., Syracuse University, 1990 P.E.
Engineering design, construction, site investigation, construction materials, geotechnical engineering, engineering ethics and technical communications

Bryan S. Kim, Assistant Professor
Ph.D. Computer Science and Engineering, Seoul National University, 2018

Data storage systems, devices, and technologies, data-intensive applications and systems, and file systems and database management systems

Philipp Kornreich, Emeritus Professor
Ph.D., University of Pennsylvania, 1967
Fiber light amplifiers,lasers, optical fibers, image propagation through fibers

Saman Priyantha Kumarawadu, Associate Teaching Professor, Program Director, Computer Science Undergraduate Programs in EECS
Ph.D., Saga University, Japan, 1998
Software engineering and implementation, systems programming, machine learning and data mining

Kasey Laurent, Assistant Professor
Ph.D., Cornell University, 2022 (in progress)
Atmospheric turbulence on flight, flight performance of eagles and unmanned aerial vehicles

Andrew Chung-Yeung Lee, Assistant Teaching Professor; Program Coordinator, Systems and Information Science BS
Ph.D., University of Maryland, College Park, 1998
Algorithms and data structures; artificial intelligence; computer science education; cryptography; history of computing; theory of computing

Jay Kyoon Lee, Emeritus Professor
Ph.D., Massachusetts Institute of Technology, 1985
Electromagnetic fields and waves, microwave remote sensing, antennas and propagation, waves in complex media

Alan J. Levy, Professor
Ph.D., Columbia University, 1982
Theoretical and applied mechanics, applied mathematics

Min Liu, Professor and Abdallah H. Yabroudi Endowed Professor in Sustainable Civil Infrastructure
Ph.D. in Engineering Project Management, University of California Berkeley, 2007
Lean Construction; Work module development for Digital Twin design; data mining and machine learning approaches for intelligent construction planning

Xiyuan Liu, Associate Teaching Professor
Ph.D., Michigan State University, 2017
Point-of-Care Diagnostics, Electrochemistry, Wearable Biosensor, Computational Simulation

Yizhi Liu, Assistant Professor
Ph.D., Pennsylvania State University, 2023
AI and construction robotics, smart infrastructure, data-driven risk analysis, construction safety, and project management and control.

Eric M. Lui, Associate Professor, Laura J. and L. Douglas Meredith Professor
Ph.D., Purdue University, Structural Engineering, 1985

Numerical modeling, steel design, structural stability, structural dynamics, earthquake engineering

Aoyi Luo, Assistant Professor
Ph.D. University of Pennsylvania, 2020
Mechanics, materials and computational methods for design, manufacturing and robotics.

Juntao Luo, Affiliate Professor
PhD, NanKai University, 2003
Drug Delivery, Nanomedicine, Biomaterials in Tissue Engineering, Gene Delivery and Gene Therapy

Zhen Ma, Associate Professor, Samuel & Carol Nappi Research Scholar
Ph.D., Clemson University
Developmental biology and tissue morphogenesis, cardiac tissue engineering
and regenerative medicine, stem cell engineering

Sinead Mac Namara, Assistant Professor
Ph.D., Princeton University 2007
Innovation and creativity in structural engineering education; structural art; community engaged design-build; and the structural performance of shell structures

Shalabh Maroo, Full Professor, Chair of MAE Graduate Affairs Committee
Ph.D., University of Florida, 2009
Multi-scale transport phenomenon, Thermal Management and Bio-mechanical Systems

George C. Martin, Professor Emeritus
Ph.D., Chemical Engineering, University of Minnesota, 1976
Complex fluids, soft condensed matter, rheology

Jean-Daniel Medio Me Biomo, Assistant Teaching Professor, Program Director, Electrical Engineering and Computer Engineering Undergraduate Programs in EECS
Ph.D., Carleton University, 2019
Mobile ad hoc networks, Satellite networks, Artificial intelligence, and 5G-and-beyond networks

Kishan G. Mehrotra, Professor Emeritus, Research Professor
Ph.D., University of Wisconsin, 1971
Multisensor scene analysis, algorithms, neural networks and genetic algorithms; earlier work in statistical inference includes reliability theory, coding theory, time series analysis

Kristopher Micinski, Assistant Professor
Ph.D., Computer Science, Univeristy of Maryland at College Park
Programming Languages, static analysis, formal methods, foundations of computer security and privacy

Aaron Mohammed, Assistant Professor
Ph.D., University of Calgary, 2019
Hydrogeology, cold region hydrology

Chilukuri K. Mohan, Professor
Ph.D., State University of New York at Stony Brook, 1988
Machine learning, neural networks, evolutionary algorithms, bioinformatics, anomaly detection

Mary Beth Monroe, Assistant Professor
Ph.D., Texas A&M University, 2013
Biomaterials, Wound Healing, and Tissue Engineering

Young Bai Moon, William J. Smith Professor in Manufacturing Enterprises; Mechanical and Aerospace Engineering Department Chair
Ph.D., Purdue University, 1988
Cyber-manufacturing systems, manufacturing security, machine learning applications, system simulation

Shikha Nangia, Full Professor; Graduate Biomedical Engineering Program Director
Ph.D., Chemistry, University of Minnesota, 2006
Multiscale computational modeling of nanomaterials and targeted cancer drug delivery

Dawit Negussey, Professor and Graduate Dean's Faculty Fellow for Diversity and Inclusion
Ph.D., University of British Columbia, 1985
Geotechnical and transportation engineering, sustainable and adaptive infrastructures, innovative sensors and forensic investigations, properties and applications of geofoam, diversity and inclusion in STEM

Kent Ogden, Adjunct Associate Professor
Ph.D., Medical College of Wisconsin, 1999
Biomedical Imaging

Jae C. Oh, David G. Edelstein Professor for Broadening Participation; Senior Associate Dean for Faculty Affairs and Academic Initiatives, College of Engineering and Computer Science
Ph.D., University of Pittsburgh, 2000
Cooperation in multi-agent systems, application of game theory and artificial intelligence techniques to the Internet and distributed computer systems, evolutionary algorithms, game theory, search and optimization algorithms, machine learning algorithms

Susan Older, Associate Professor
Ph.D., Carnegie Mellon University, 1996
Semantics of programming languages, concurrency, fairness, logics of programs, formal methods

Gabriel Silva de Oliveira, Assistant Teaching Professor
Ph.D., North Carolina State University, 2024, Computer Science
Computer Science Education

Joan Paulo Oliveira Marum, Assistant Teaching Professor
Ph.D., University of Mississippi, 2021
Reactive Programming, Self-adjusting Computation, Augmented & Virtual Reality, Software Engineering, Multi-paradigm programming, Programming Patters, Data Structures

Anupam Pandey, Assistant Professor
Ph.D., University of Twente, 2018
Programmable soft surfaces, flexible metamaterials, elasto-fluidic composites, ultra-soft gels

Daniel J. Pease, Emeritus Professor
Ph.D., Syracuse University, 1981
Design and development of shared and distributed parallel systems, software and tools; performance optimization for multi-thread client/server application in C, C++, Ada, Java, and .NET applications on different parallel architectures, including mobile wireless systems and cyber security on mobile systems

Vir V. Phoha, Professor
Ph.D., Texas Tech University, 1992
Cyber Security - Cyber offense and defense; Machine Learning; Smart phones and tablets security; Biometrics - network based and standalone

Peter W. Plumley, Research Associate Professor
Ph.D., University of California, Santa Cruz, 1984
Paleomagnetism and Displacement of Tectonic Terranes, Engineering Materials, Structures and Materials, Mechanics of solids

Jason Pollack, Assistant Professor
Ph.D., California Institute of Technology, 2017
Quantum Information, thermalization and decoherence, quantum gravity

Quinn Qiao, Professor
Ph.D., Virginia Commonwealth University, 2006
Solar cells, batteries, biomedical sensors, precision agriculture, micro/nano fabrication

Zhao Qin, Assistant Professor
Ph.D., Massachusetts Institute of Technology 2013
Multiscale Material Modeling and Simulations; Engineering Materials; Structures and Materials; Mechanics of Solids

Qinru Qiu, Professor
Ph.D., University of Southern California 2001
Neuromorphic Computing; Cyber Physical Systems; Dynamic Power; Thermal and Performance Management; Real-time Embedded Machine Intelligence; Computer Aided Design Automation

David E. Quinn, Adjunct-Instructor
B.S., Rochester Institute of Technology, 2008
Analytical algorithm, Embedded system development, biomedical instrumentation

Younes Ra'di, Assistant Professor
Sc.D., Aalto University, 2015
Theoretical and Applied Electromagnetics, RF and Microwave Engineering, Antennas and Propagation, Electromagnetics of Artificial Materials and Surfaces

Dana Radcliffe, Adjunct Professor
Ph.D., Syracuse University, 1996
Ethical issues in engineering and research, Business ethics

Farzana Rahman, Associate Teaching Professor
Ph.D., Computer Science, Marquette University, 2013
Mobile and pervasive heath technologies, internet-of-things, computer science education, impact of active learning pedagogy in CS course, and broadening participation of women and underrepresented students in CS

Dacheng Ren, Professor, Milton and Ann Stevenson Professor of Biomedical & Chemical Engineering, Associate Dean for Research and Graduate Programs
Ph.D., Chemical Engineering, University of Connecticut, 2003
Biomaterials/Tissue engineering, Corrosion and electrochemistry, Indoor air
quality/environmental engineering, Molecular biotechnology, Sustainable

energy production, Systems biology

Philip A. Rice, Professor Emeritus
Ph.D., Chemical Engineering, University of Michigan, 1963

Utpal Roy, Professor
Ph.D., Purdue University, 1989
Computer-integrated design and manufacturing, development and application of operations research, finite-element methods, geometric modeling, computational geometry, artificial intelligence techniques

James S. Royer, Emeritus Professor
Ph.D., State University of New York at Buffalo, 1984
Theory of the computational complexity of higher-type functionals, structural computational complexity theory, computational learning theory, biological computing

Baris Salman, Assistant Professor
Ph.D., University of Cincinnati, 2010
Infrastructure Asset Management, Construction Engineering and Project Management, Sustainable Development, Information Technology and Visualization

Ashok Sangani, Professor
Ph.D., Chemical Engineering, Stanford University, 1982
Complex fluids, soft condensed matter, rheology; Molecular biotechnology; Multiple phase systems; Mathematical and numerical analysis

Amit K. Sanyal, Associate Professor
Ph.D., University of Michigan, 2004
Dynamics, robotics and control

Mehmet Sarimurat, Associate Teaching Professor
Ph.D., Syracuse University, 2008
Multi-physics Simulation, Computational Fluid Dynamics, Design

Fred Schlereth, Research Associate Professor
Ph.D., Syracuse University, 1969
Past research interests include: Quadrupole Mass Spectrometer, Fourier Transform Ion Cyclotron Resonance Mass Spectrometer, Quartz Crystal Vacuum Deposition Monitor, Halogen Gas Leak Detector; Analog and Digital Signal Processing and Circuit Design, VLSI Circuit Design; Architecture, Algorithms and Hardware for Parallel Computation; VLSI Cellular Array Computer; Distribution-free Detection Theory, Imaging in Dispersive Media; Neural Networks for Financial Applications. Current research interests include: design of VLSI Signal Processing Circuits for Software Defined Radio.

Roger Schmidt, Traugott Distinguished Professor
Energy Sources, conversion, and conservation

Paulo Shakarian, K.G. Tan Endowed Chair, Professor
Ph.D., University of Maryland College Park, 2011
Fusion of symbolic AI and machine learning

Wanliang Shan, Assistant Professor
Ph.D., Princeton University, 2012
Solid mechanics, materials engineering, thermophysics, machine learning, soft robotics

Andrea Shen, Assistant Teaching Professor
Ph.D.,University of Wisconsin, 2024
Greenhouse gases, novel alternative fuels, gasoline surrogate compositions

Ian Shapiro, Professor of Practice
M.S. Columbia University 1983
Heat pumps, decarbonization, green building design.

Yilei Shi, Associate Teaching Professor and Undergraduate Civil Engineering Program Director
Ph.D. in Civil Engineering, Florida International University; Concentration: Structural Engineering, 2009

Transportation resilience; Sustainable construction materials, Structural behavior under extreme loading conditions

Yilei Shi, Associate Teaching Professor and Undergraduate Civil Engineering Program Director
Ph.D. in Civil Engineering, Florida International University; Concentration: Structural Engineering, 2009
Transportation resilience; Sustainable construction materials, Structural behavior under extreme loading conditions

Walter H. Short, Adjunct, Biomedical and Chemical Engineering Research Professor; Department of Orthopedic Surgery, SUNY Upstate Medical University
M.D., SUNY Upstate Medical University, 1975
Orthopedic biomechanics

Ernest Sibert, Professor Emeritus
Ph.D., Rice University, 1967
Computational logic, logic programming, and parallel computation

Cynthia Smith, Assistant Professor
Ph.D., University of Arizona, 2005
Bioinstrumentation, Sports Engineeing

J. Cole Smith, Professor and Dean
Ph.D., Virginia Tech, 2000
Operations research; combinatorial optimization; non-convex programming

Robert L. Smith, Emeritus Professor and Director of the Institute for Sensory Research
Ph.D., Syracuse University, 1973

Pranav Soman, Associate Professor
Ph.D., Pennsylvania State University, 2009
Bioprinting, Biomaterials, Tissue Engineering and Additive manufacturing (3D printing)

Q. Wang Song, Professor
Ph.D., Pennsylvania State University, 1989
Photonic switching, fiber communications, electro-optics, guided-wave optical devices, optical sensors

Martinez Soto, Assistant Teaching Professor
Ph.D., Virginia Tech, 2024
Teaching and assessment for conceptual understanding, curriculum development, student cultural competencies

Sucheta Soundarajan, Associate Professor, Program Director, Graduate Programs in EECS
Ph.D., Cornell University, 2013
Developing algorithms for large scale complex and social network analysis, including algorithms for network data collectionand exploration, measuring and improving fairness in network structure and network analysis, and characterizing hierarchy and resilience in network structure

Shelley K. Stevens, Adjunct Assistant Professor
Ph.D., SUNY Upstate Medical University, 2007
Tissue Engineering

Yiyang Sun, Assistant Professor
Ph.D., Florida State University, 2017
Computational fluid dynamics, flow control. Unsteady aerodynamics, modal/non-modal analysis, data science

Radhakrishna Sureshkumar, Distinguished Professor
Ph.D., Chemical Engineering, University of Delaware, 1996
Complex fluids, Soft condensed matter, Rheology, Multiple phase systems, Nanotechnology, Sustainable energy production, Systems biology/metabolic engineering, Mathematical and numerical analysis

Robert Tanchak, Adjunct Professor

Jian Tang, Research Professor
Ph.D., Arizona State University, 2006
Wireless Networking and Mobile Computing, Green Computing and Networking, Cloud Computing, Data Centers, Algorithm Design and Analysis

Yuzhe Tang, Associate Professor, Electrical Engineering and Computer Science
Ph.D., Computer Science, Georgia Tech
Cyber-security; Distributed systems; Measurement; Blockchain; Security education

Lawrence L. Tavlarides, Professor Emeritus
Ph.D., Chemical Engineering, University of Pittsburgh, 1968
Indoor air quality/environmental engineering; Multiple phase systems; Sustainable energy production, Nuclear engineering

Svetoslava Todorova, Professor of Practice, Program Director, Environmental Engineering
MPA, Syracuse University, 2011; Ph.D., Syracuse University, 2012
Nutrients and Metals in Freshwater Ecosystems; Smart Water Monitoring; Sustainable Urban Infrastructure

John Trimmer, Assistant Teaching Professor
Ph.D., University of Illinois at Urbana-Champaign, 2019
Water and sanitation in resource-constrained communities; Sustainability analysis of water, sanitation, and resource systems

Katherine Tsokas, Adjunct Professor
J.D., Widener University School of Law, 2004
Regulatory Affairs

Pramod K. Varshney, Distinguished Professor; Research Director, NY State Center for Advanced Technology in Computer Applications and Software Engineering (CASE)
Ph.D., University of Illinois, 1976
Data/information fusion; Wireless communications; Signal processing; Statistical inference; Cybersecurity; Machine learning and Human-machine teaming

Senem Velipasalar, Professor
Ph.D., Princeton University, 2007
Computer Vision, Machine Learning, Video/Image Processing, Mobile Camera Applications, Embedded Smart Cameras, Distributed Multi-Camera Systems, Pattern Recognition, Signal Processing and Information Theory

Joseph J. Waclawski, Assistant Teaching Professor
MS, Syracuse University, 1994, Computer Engineering
GC, Stevens Institute of Technology, 2021, Systems Engineering of Embedded Cyber-Physical Systems

Theodore Walker, Assistant Professor
Ph.D., University of Wisconsin, 2019
Catalytic technologies for upcycling solid waste resources

Li Wang, Assistant Teaching Professor

M.S., Computer Science, Louisiana Tech University

Yeqing Wang, Assistant Professor
Ph.D., University of Iowa, 2016
Mechanics of composite materials, modeling of laser/plasma material processing, uncertainty quantification and design optimization, finite element analysis, model verification and validation

David S. Wazenkewitz, Adjunct
B.S., Syracuse University
Environmental engineering and solid waste management

Volker Weiss, Professor Emeritus & Research Professor, Mechanical and Aerospace Engineering, Physics
Ph.D., Syracuse University, 1957
Mechanical behavior of solids, materials science and engineering; computer applications

Yaoying Wu, Assistant Professor
Ph.D., University of Minnesota, 2014
Immunoengineering, polymer engineering, biomaterials

Eric Wing, Adjunct Professor

William E. Young, Jr., Research Associate Professor
Ph.D., Engineering Systems, Massachusetts Instititute of Technology

Edmund Yu, Associate Teaching Professor
Ph.D., Computer Science, Syracuse University
Text Mining, Social Networks, Social Media Miniing, Information Retrieval, Multi-Agent Systems

Pun To (Douglas) Yung, Associate Professor
Ph.D., California Institute of Technology, 2008
MEMS and microfluidics, biosensor development, microbial engineering, astrobiology

Reza Zafarani, Associate Professor
Ph.D., Arizona State University, 2014
Big data, mainly in the order of billions, analyzing human behavior at scale using social media, and mining large-scale social media sites

Teng Zeng, Assistant Professor
Ph.D., Civil Engineering, University of Minnesota, 2012
Occurrence and fate of organic contaminants, Formation and control of disinfection byproducts, Public health implications of water reuse, Environmental impacts of energy production

Jianshun S. Zhang, Professor
Ph.D., University of Illinois, Urbana-Champaign, 1991
Building environmental and mechanical systems, materials emissions and indoor air quality, room air and contaminant distributions, multizone air and air contaminant transports in buildings, building energy efficiency, integrated computer simulation tools for building environmental and mechanical system design, system analysis and optimization

Junzhe Zhang, Assistant Professor
Ph.D., Columbia University, 2023, Computer Science
Causal Reinforcement Learning

Teng Zhang, Associate Professor
Ph.D., Brown University, 2015
Solid Mechanics and materials

Yi Zheng, Assistant Professor
Ph.D., University of Toronto, 2014
Stem cell-based microengineered systems

Fernando Zigunov, Assistant Professor
Ph.D. Florida State University 2020
High-speed flows

Courses

Aerospace Engineering

AEE 100 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

AEE 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports, or an examination. Limited to those in good academic standing.
Repeatable

AEE 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

AEE 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

AEE 342 Aerodynamics (4 Credits)
Engineering & Comp Sci
Vorticity, circulation, potential flow and superposition of flows. Lift, drag, moments of two- and three-dimensional wings. Thin airfoil theories. Panel methods. Lifting-line theory. Flow separation and stall. Viscous drag reduction.
Prereq: MAE 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

AEE 343 Compressible Flow (3 Credits)
Engineering & Comp Sci
Isentropic flow, normal and oblique shock waves, expansion fans. Compressible flow in converging and diverging nozzles. Course includes lab component with written report.
Prereq: MAE 251 and 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

AEE 371 Analysis of Aerospace Structures (3 Credits)
Engineering & Comp Sci
Structural configuration of modern aircraft and spacecraft; symmetric and unsymmetric beams; single and multicell thin-walled tubes; skin-stringer construction; shear flow; ring, frame and fuselage analysis.
Prereq: ECS 325
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/)

AEE 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

AEE 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

AEE 427 Aircraft Performance and Dynamics (4 Credits)
Engineering & Comp Sci
Wing aerodynamic, thrust and drag. Performance analysis of aircraft: take-off, landing, climbing, gliding, turns, range and load factors. Control surfaces. Longitudinal and lateral static stability. Dynamic stability. Introduction to autopilot.
Prereq: MAE 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

AEE 435 Aerospace Structures (0 Credits)
Engineering & Comp Sci

AEE 446 Air-breathing and Rocket Propulsion (3 Credits)
Engineering & Comp Sci
Fluid dynamics and thermodynamics of airbreathing engines, including gas turbine, ramjet and scramjet. Engine component analysis, including inlets, combustors, nozzles, and turbomachines. Introduction to rocket propulsion.
Prereq: AEE 343
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

AEE 461 Design of Aerospace Systems I (3 Credits)
Engineering & Comp Sci
Conceptual design of aerospace systems. Methodologies for aerospace vehicle synthesis and sizing. Modeling and simulations in design. Integration of aerospace technologies. Preliminary analysis of an assigned aerospace component, system, or vehicle. Oral and written reports.
Prereq: AEE 342 and AEE 371

AEE 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

AEE 472 Design of Aerospace Systems II (3 Credits)
Engineering & Comp Sci
Design of an aerospace component, system, or vehicle to meet specified performance and cost criteria. Vehicle options include subsonic, supersonic, or VTOL aircraft; a missile system; or a spacecraft. Oral and written preliminary and final reports.
Prereq: AEE 461 and (AEE 427 or AEE 577)
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

AEE 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable 1 times for 12 credits maximum

AEE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

AEE 491 Hypersonics Research Project I (1-3 Credits)
Engineering & Comp Sci
In depth exploration of a problem in the field of hypersonics under the supervision of a faculty member. Projects may be experimental or computational research on hypersonic phenomena, or a conceptual study of hypersonic vehicles.

AEE 492 HypHypersonics Research Project II (1-3 Credits)
Engineering & Comp Sci
Advanced research on a problem in the field of hypersonics under the supervision of a faculty member. Projects may be experimental or computational research on hypersonics phenomena, or a conceptual study of hypersonic vehicles.

AEE 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

AEE 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

AEE 527 Helicopter Dynamics (3 Credits)
Engineering & Comp Sci
Introduction to the helicopter; hover- and vertical-flight analysis; autorotation and vertical descent; blade motion and rotor control; aerodynamics of forward flight.
Prereq: AEE 342 and 427

AEE 542 Hypersonic/High Temperature Gas Dynamics (3 Credits)
Engineering & Comp Sci
Inviscid and viscous hypersonic fluid dynamics with and without high temperature effects. Approximate and exact methods for analyzing hypersonic flows. Elements of statistical thermodynamics, kinetic theory, and nonequilibrium gas dynamics. Experimental methods.
Prereq: MAE 251 and AEE 343

AEE 577 Introduction to Space Flight (3 Credits)
Engineering & Comp Sci
Two-body orbital mechanics, orbits and trajectories, interplanetary transfers, vehicle and booster performance.
Prereq: ECS 222
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

Bioengineering

BEN 101 Computing for Bioengineers (3 Credits)
Engineering & Comp Sci
Introduction to desktop computing applications: word processing; statistical analysis; bitmap, object-oriented, and engineering graphics; circuit analysis; image processing; spread sheets. Introduction to programming, general principles of program organization, bioengineering applications, verification, reliability.

BEN 105 Bioengineering Seminar I (1 Credit)
Engineering & Comp Sci

BEN 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BEN 201 Biological Principles for Engineers (4 Credits)
Engineering & Comp Sci
Introduction to cell types and structure, nucleic acids, proteins and enzyme kinetics. Gene expression including transcription, translation and post-translational modification. Introduction to genomics, proteomics and bioinformatics. Genetic engineering and tissue engineering. Applications to biotechnology.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 212 Experimental Methods in Chemical Engineering and Bioengineering (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 212
Statistical analysis and presentation of experimental data. Parameter estimation. Design of experiments. Hardware and software for computer interfacing. Collection, analysis, and reporting of laboratory data.
Prereq: MAT 296 and ECS 104.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 231 Bioengineering Fundamentals (3 Credits)
Engineering & Comp Sci
Introduction to material, energy, charge, and momentum balances in biological systems. Overview of the field of bioengineering. Technological bases for established and emerging subfields.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

BEN 271 Clinical Immersion (3 Credits)
Engineering & Comp Sci
Clinical experiences via in-person shadowing and/or technology-enhanced simulation. Application of bioengineering to clinical practices, healthcare technology, medical device design and application, and electronic medical record. Team-based design project on clinical needs identification, ideation and prototyping.

BEN 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BEN 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

BEN 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BEN 310 Bioenrgtcs & Transprt Phenomna (4 Credits)
Engineering & Comp Sci
Introduction to equilibrium and nonequilibrium thermodynamics. Basic equations of momentum, mass and energy transfer. Applications in physiology and medicine.
Repeatable
Prereq: (PHY 211 or 215) and (211 or 216) and MAT 397

BEN 333 Fluid Transport (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 333
Fluid statics. Shear stress and viscosity. Energy and momentum balances for flow systems. Dimensional analysis. Friction and drag coefficients. Turbulent flow of compressible and incompressible fluids. Non-Newtonian fluids.
Prereq: MAT 397 and (PHY 212 or 216)
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 338 Biocontrol Systems (4 Credits)
Engineering & Comp Sci

BEN 341 Fundamentals of Heat and Mass Transfer (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 341
Principles of heat and mass transfer. Conduction, convection, and radiation. Thermal properties of materials. Solutions of steady state and transient heat and mass transfer problems. Diffusion with chemical reaction. Convective mass transfer.
Prereq: CEN 333 or BEN 333
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 355 Fundamntls Bioinstrumentation (0 Credits)
Engineering & Comp Sci

BEN 364 Quantitative Physiology (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 664
Introduction to mammalian physiology from an engineering perspective. Each of the major systems of the body will be addressed, with an emphasis on electrical, mechanical, and thermodynamic principles Lecture and laboratory. Additional work required of graduate students.
Prereq: BEN 201
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 375 Biomedical Systems, Signals, & Control (3 Credits)
Engineering & Comp Sci
Basic analysis and design techniques for signals and linear systems in bioengineering. Laplace and Fourier Transforms, time-frequency analysis. PID and fuzzy to optimal control. Applications include signals and noise, ECG processing, mathematics of imaging.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BEN 385 Bioengineering Laboratory I (3 Credits)
Engineering & Comp Sci
Practical experience in the design, execution and analysis of experiments related to biomechanics and bioinstrumentation. Technical writing skills will also be emphasized.
Advisory recommendation Coreq: BEN 364
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BEN 412 BioMEMS, Biosensors & Biophotonics (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 612
Building blocks, fabrication techniques, sensing and actuation principles of biomedical microelectromechanical systems (bioMEMS). Case studies on biosensors, biophotonics and microsystem technologies that enhance biomedical research and healthcare. Additional work required of graduate students.
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 421 Biochemical Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 421
Double-numbered with BEN 621, CEN 621
Introduction to microbiology, biochemical kinetics. Biochemical-reactor design, including methods for oxygen transfer and control. Introduction to separation processes in biochemical engineering. Additional work for graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 422 Immunoengineering (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 622
Strategies and technologies to modulate and deconvolute the immune process for therapeutic purposes. Fundamentals of immunology, tools and methods, engineering strategies for vaccination, immunotherapy, and immunomodulation. Additional work required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 423 Wave Phenomena (3 Credits)
Engineering & Comp Sci
Derivation of the wave equation for electromagnetic and mechanical waves. Wave phenomena; standing waves, reflections, resonance, impedance transformations, surface waves.

BEN 430 Sports Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 630
Study of engineering principles involved in sports: body systems in human motion, analysis of gait, basic performance patterns in athletic movements, performance improvements, and design of sports equipment. Additional work required of graduate students.

BEN 431 Introduction to Global Regulatory Affairs (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 631
An introduction to Global Regulatory Affairs. Providing a foundational understanding of how regulatory and health authorities regulate products to bring safe and effective solutions to patients and consumers. Additional work required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

BEN 433 Drug Delivery (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 433
Double-numbered with BEN 633, CEN 633
Integration of biology, chemistry, and engineering to understand how pharmaceuticals are delivered to, and behave within, the body. Includes drug formulation, pharmacokinetics, pharmacodynamics, controlled release, and targeted delivery. Additional work is required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 438 Biocontrol Systems (4 Credits)
Engineering & Comp Sci

BEN 441 Mobile Health (mHealth) Device Design and Application (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 641
This course will introduce students to the rapidly growing field of Mobile Health (mHealth), including concepts of mHealth design, hardware, software, wireless integration, and mobile apps, with application of those concepts to problems faced by different patient and user populations. Additional work required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

BEN 450 Environmental Risk Assessment & Toxicology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 450, CEE 450
Double-numbered with BEN 650, CEE 650, CEN 650
Students will analyze the human health impact of exposure to toxic chemicals in air, water, and soil according to USEPA Risk Assessment Guidance for Superfund. Additional work required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 455 Bioinstrumentation Design (0 Credits)
Engineering & Comp Sci

BEN 458 Biomedical Imaging (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 658
Basics of imaging techniques useful for biological and medical applications. Microscopy, electron microscopy, acoustic microscopy, atomic force microscopy, magnetic resonance imaging. Discussion of images and literature. MRI laboratory exercises.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 462 Biofuels, Bioproducts, and Biorefining (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 462
Double-numbered with CEN 662, BEN 662
Survey of modern technologies available for the production of transportation fuels from abundant natural resources. Additional work required of graduate students.

BEN 466 Advanced Biomechanics (3-4 Credits)
Engineering & Comp Sci
Double-numbered with BEN 666
Introduction to kinesiology and kinematics; finite element method; joint force analysis and the properties of bone cartilage and tendon as related to functional analysis of bone-joint systems.
Prereq: BEN 465

BEN 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

BEN 473 Biomanufacturing (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 473
Double-numbered with BEN 673, CEN 673
Students learn the governing principles of conventional and advanced manufacturing techniques, which are adapted/modified to engineer living tissues/organs, biomedical products and test-platforms for investigating fundamental cell biology. Additional work required for grad students.
Prereq: BEN 364 or BEN 664
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 474 Medical Image Processing & Analysis (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 674
Introductory medical image processing and analysis. An open source software that has been developed for this purpose will be used. Additional work required of graduate students.

BEN 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BEN 481 Bioinstrumentation (3 Credits)
Engineering & Comp Sci
Measurement and analysis of biological signals in the time and frequency domain. Operational amplifiers, analog, and digital signal processing; sensors and sources of biopotentials; biopotential electrodes. Matlab, Labview and C programming.
Prereq: ELE 231
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 485 Bioengineering Laboratory II (3 Credits)
Engineering & Comp Sci
Practical experience in the design, execution and analysis of experiments related to biomechanics and bioinstrumentation. Technical writing skills will also be emphasized. One four-hour laboratory a week.
Prereq: BEN 385 Coreq: BEN 465 and 481
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 486 Bioengineering Capstone Design I (1 Credit)
Engineering & Comp Sci
Bioengineering design experience. Lecture, discussion, active learning components. Team design of biomedical system, device, or process from concept through prototype production. Includes design strategy, reliability, FDA regulations, patents, oral, and written presentations.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/)

BEN 487 Bioengineering Capstone Design II (3 Credits)
Engineering & Comp Sci
Bioengineering design experience. Lecture, discussion, active learning components. Team design of biomedical system, device, or process from concept through prototype production. Includes design strategy, reliability, FDA regulations, patents, oral, and written presentations.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/)

BEN 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study based on a plan submitted by the student.
Repeatable

BEN 498 Senior Thesis (3 Credits)
Engineering & Comp Sci
Mentored investigation of an approved topic under the supervision of a member of the faculty. A written report and oral presentation are required in accordance with program guidelines.

BEN 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

BEN 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BEN 521 Stem Cell Engineering (3 Credits)
Engineering & Comp Sci
Covers wide-ranging topics related to stem cell and regenerative biology, including: introduction of cell and developmental biology, stem cell biology, tissue engineering, regenerative medicine, and the political and ethical issues surrounding the stem cell debate.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

BEN 522 Biomedical-Device Infections (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 522
Discussion of the complex issues related to biomedical-device infections. Investigation of the impact of biomaterials, microbiology, detection, and device regulation to reduce biomedical-device infections.
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 541 Principles of Tissue Engineering (3 Credits)
Engineering & Comp Sci
Cellular and biomaterials principles relevant to tissue engineering, focusing on cellular and tissue organization; regulation of cell behavior; biomaterials for tissue regenerations; tissue engineering applications in cardiovascular, neurological, and musculoskeletal and other organ systems.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 561 Polymer Science & Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 561
Polymer structure, physical properties, and applications of polymers. Polymer synthesis, characterization of molecular structure, and copolymerization and blending. Unique physical properties of polymeric materials. Processing and applications of polymers.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 565 Biomechanics (3 Credits)
Engineering & Comp Sci
Functions and mechanical properties of cells and tissues, how those cells and tissues combine to form structures, the properties and behaviors of those structures, and biomechanical techniques to analyze the structures and individual components.
Prereq: ECS 221 and MAT 485 and BEN 364
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 568 Biomaterials & Medical Devices (3 Credits)
Engineering & Comp Sci
Materials science and biological issues associated with medical devices and biomaterials are discussed. Bulk and surface materials science, tissue engineering, degradation and biocompatibility are addressed and related to medical device design and regulatory issues.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 580 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

Civil and Environmental Engineering

CEE 198 Computer-aided Drafting, Design, and Modeling (3 Credits)
Engineering & Comp Sci
An introductory course in computer-aided drafting, design, and modeling in 2D and 3D. Basic commands, tools, multi-view drawing and dimensioning techniques. Review of software architecture, capabilities, application, and output formats.

CEE 271 Environmental Chemistry and Analysis (3 Credits)
Engineering & Comp Sci
Introduction to chemical principles in natural and engineered environmental systems. Thermodynamics and kinetics of reactions; acid-base chemistry; environmental organic chemistry; treatment process design applications.
Prereq: CHE 116 or CHE 150 Coreq: MAT 296
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEE 273 Introduction to Geomatics and GIS (3 Credits)
Engineering & Comp Sci
Map reading, surveying, and theory of Geomatics. Application of 2D and 3D computer software for Geomatics. Application of Geographic Information Systems (GIS) in civil and environmental engineering.
Prereq: MAT 295; Coreq; MAT 296
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEE 274 Sustainability in Civil and Environmental Systems (3 Credits)
Engineering & Comp Sci
Introduction to systems theory and concepts applied to natural and built environments. Sustainability, ecosystems, mass and energy balances, chemical transformation and reactions. Basic principles for sustainable civil and environmental engineering design and decision making.
Prereq: CHE 106 or 109 and MAT 296
Shared Competencies: Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 275 Infrastructure and Society (3 Credits)
Engineering & Comp Sci
Cross-listed with BUA 275
Interdisciplinary view of urban infrastructure. Resilience, sustainability, economic and community impacts, finance, infrastructure development in the global economy, and smart cities.
Shared Competencies: Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Ethics and Integrity (https://coursecatalog.syracuse.edu/shared-competencies/ethics-and-integrity/)

CEE 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CEE 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable 6 times for 6 credits maximum

CEE 325 Mechanics of Materials (3 Credits)
Engineering & Comp Sci
Theory of deformation, stress, stress resultants, transformation. Elastic and inelastic constitutive behavior. Equilibrium. Tension and torsion of bars; flexure and shear of beams; pressure vessels. Thermoelasticity. Elastic and inelastic stability. Credit cannot be given for both ECS 325 and CEE 325.
Prereq: ECS 221 and MAT 296 Coreq: MAT 397
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 326 Engineering Materials (3 Credits)
Engineering & Comp Sci
Atomic, molecular, and crystalline structures of solid engineering materials. Explanation and interpretation of physical, mechanical, and electrical properties of materials based on these structures. Two one-hour lectures and one two-hour laboratory a week.
Prereq: CEE 325 or ECS 325
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 327 Prin of Fluid Mechanics (4 Credits)
Engineering & Comp Sci
Dimensional analysis. Hydrostatics. Equations of motion. Bernoulli's equation. Euler's momentum theorem. One-dimensional analysis. Velocity potential. Stream function. Laminar viscous flow. Potential flow applications.
Prereq: MAT 296 and ECS 221

CEE 329 Probability, Statistics and Risk for Civil and Environmental Engineering (4 Credits)
Engineering & Comp Sci
Summary statistics and graphical representations of data. Elements of probability theory. Normal distribution. Simple regression. One- and two-sample inference. Elementary stochastic processes. Risk and reliability. Bayesian decision analysis. Applications in civil and environmental engineering.
Prereq: MAT 397
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEE 331 Analysis of Structures and Materials (3 Credits)
Engineering & Comp Sci
Analysis of statically determinate and indeterminate trusses, beams, and frames by traditional and computer-based methods. Physical, mechanical, and thermal properties of conventional and environmental friendly construction materials.
Prereq: CEE 325 or ECS 325
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEE 332 Design of Concrete Structures (3 Credits)
Engineering & Comp Sci
Analysis and design of environmentally friendly reinforced concrete structures subjected to flexural, shear, and axial loads. Analysis of stresses and deformations and their relation to codes and specifications.
Prereq: CEE 331
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 337 Introduction to Geotechnical Engineering (4 Credits)
Engineering & Comp Sci
Nature and composition of soils. Formation and classification of natural soils and man-made construction materials. Compaction, permeability and seepage, consolidation and settlement, shear behavior and strength.
Prereq: CEE 325 or ECS 325
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEE 338 Foundation Engineering (3 Credits)
Engineering & Comp Sci
Subsurface investigation, bearing capacity, lateral earth pressures. Design of retaining structures, shallow and deep foundations. Slope stability, foundations on difficult soils, and soil-improvement methods.
Prereq: CEE 337
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 341 Introduction to Environmental Engineering (3 Credits)
Engineering & Comp Sci
Fundamental principles of environmental processes, pollution, and pollution control, including mass transfer, water chemistry and microbiology, water and air pollution, and solid- and hazardous-waste management.
Prereq: CHE 106 and CHE 107
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

CEE 352 Water Resources Engineering (4 Credits)
Engineering & Comp Sci
Analysis and design of hydraulic facilities including pipe systems, open channels, pumps and turbines, and ground water wells. Analysis of rainfall and riverflow; surface and subsurface water storage. Laboratory experiments and problem solving.
Prereq: CEE 327 or MAE 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEE 361 Evolution of an Infrastructure Project (3 Credits)
Engineering & Comp Sci
Cross-listed with BUA 361
Lifecycle stages of infrastructure projects. Needs assessment, feasibility analysis, project delivery, public budgeting, project financing, risk allocation, urban design, permitting and zoning, sustainability criteria, project detailed design, construction management and troubleshooting, asset management, and disaster-response infrastructure.
Prereq: BUA 275 or CEE 275

CEE 362 Infrastructure Design Capstone (3 Credits)
Engineering & Comp Sci
Cross-listed with BUA 362
Review and integration of fundamental principles of infrastructure systems including smart city applications. Hands-on infrastructure design projects allow student teams to demonstrate competency in applying concepts and tools introduced in prerequisite courses.
Prereq: (CEE 275 and CEE 361) OR (BUA 275 and BUA 361)

CEE 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CEE 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable 6 times for 6 credits maximum

CEE 401 Construction Engineering and Project Management (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 601
Overview of various aspects of construction engineering and project management. Construction contracts, resource management, scheduling, equipment, quality control, productivity, construction safety, cash flow concepts, legal and management structures. Additional coursework required of graduate students.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEE 405 Construction Estimating and Scheduling (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 605
Cost and schedule estimations based on project specifications. Construction drawings and specifications, quantity take-off, cost estimation, scheduling through deterministic and probabilistic methods, resource management, accelerated construction, and schedule updating. Additional work (research presentation and report) required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 413 Physical Hydrology (3 Credits)
Engineering & Comp Sci
Cross-listed with EAR 413
Double-numbered with CEE 613, EAR 613
Fundamentals of watershed hydrology presented from a physical hydrology perspective; course topics include: the water cycle, hydrologic processes, streamflow generation, groundwater-surface water interactions, and introduction to hydrologic modeling concepts. Additional work required of graduate students.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 415 Timber Design (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 615
Structural design using timber. Topics covered include dimensional features, structural properties, and behavior under loads using current NDS and ASCE 7 in both ASD and LRFD. Additional work is required of graduate students.
Prereq: CEE 331
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEE 430 Environmental Organic Chemistry (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 630
Movement and fate of organic chemicals in aquatic systems. Thermodynamic principles and molecular descriptors for predicting the partitioning in environmental phases. Mechanisms and kinetics of chemical transformation processes including hydrolysis, reduction, oxidation, and photolysis. Additional work required for graduate students.
Prereq: CHE 116 and CEE 271

CEE 433 Intermediate Structural Analysis (3 Credits)
Engineering & Comp Sci
Analysis of cables and arches. Classical and matrix methods of truss, beam, and frame analysis. Computer and numerical methods of structural analysis. Relation of analysis to design.
Prereq: CEE 331

CEE 442 Treatment Processes in Environmental Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 642
Fundamental engineering concepts and principles used for the design and operation of water and wastewater treatment systems. Estimating water demand and wastewater flows in the urban water use cycle. Significance of government regulations and standards.
Coreq: CEE 327 and CEE 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEE 443 Transportation Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 643
Transportation systems, modes and significance. Traffic engineering fundamental relationships and field studies. Intersection design and control. Geometric design of road alignments. Introduction to transportation planning. Additional work required of graduate students. A research report is required for CEE 643.
Prereq: CEE 273

CEE 450 Environmental Risk Assessment & Toxicology (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 450, CEN 450
Double-numbered with BEN 650, CEE 650, CEN 650
Students will analyze the human health impact of exposure to toxic chemicals in air, water, and soil according to USEPA Risk Assessment Guidance for Superfund. Additional work required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 457 Biogeochemistry (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 657
Biogeochemical relationships as a unifying concept for ecological systems, including importance of biogeochemical relationships in ecosystems and global cycles. The interface between abiotic and biotic components of ecosystems is explained. Additional work required of graduate students.
Prereq: CHE 106 and 107
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 463 Introduction to Sustainable Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 663
Introduction to principles underlying engineering decisions to improve our quality of life without jeopardizing quality of life for future generations. Application of these principles to qualitative and quantitative engineering problems. Additional coursework required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Ethics and Integrity (https://coursecatalog.syracuse.edu/shared-competencies/ethics-and-integrity/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 465 Modern Urban Infrastructure (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 665
Interdisciplinary view of urban infrastructure (transportation, water supply, electric power, etc.). Considerations of resilience, sustainability, design objectives, politics, economic/community impacts, finance, and smart cities. Challenges and possibilities inherent in modern infrastructures. Additional work required of graduate students.

CEE 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CEE 471 Environmental Chemistry and Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 461
Double-numbered with CEE 671, CEN 661
An introduction to chemical principles in natural and engineered environmental systems. Thermodynamics and kinetics of reactions; acid-base chemistry; environmental organic chemistry; treatment process design applications. Includes selected laboratory exercises. Additional work is required of graduate students.
MAT 296 and CHE 106 and CHE 107
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 472 Applied Env Microbiology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 472
Double-numbered with CEE 672, CEN 672
General Principles and application of environmental microbiology and microbial processes. Role of microbes in water pollution control, environmental health, and element cycling in the environment. Additional work is required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 473 Transp Procss/Env Engrng (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 673
Fundamentals and applications of mass and heat transport in environmental engineering. Molecular and turbulent diffusion, advection, dispersion, settling, and surface transfer in air and water. Quantitative applications in treatment systems and the natural environment. Additional work is required of graduate students.
Prereq: (CEE 327 OR MAE 341) and CEE 341

CEE 475 Civil and Environmental Engineering Design (4 Credits)
Engineering & Comp Sci
Capstone design experience. Fundamental principles in various areas of civil and environmental engineering applied to open-ended design projects. Economics, safety, reliability, environmental, sustainability, ethical and social considerations.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 478 Rehabilitation of Civil Infrastructure (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 678
Deterioration of construction materials. Evaluation, non-destructive testing, and rehabilitation of existing structures. Properties and applications of repair materials. Seismic retrofit of bridges. Analysis and design of structural members retrofitted with carbon fiber reinforced polymer composites.
Prereq: CEE 332 and (CEE 325 or ECS 325)
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CEE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

CEE 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

CEE 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable 6 times for 6 credits maximum

CEE 501 FE Exam Preparation (1 Credit)
Engineering & Comp Sci
Discussion of content, administration, and implementation of the Fundamentals of Engineering (FE) Exam, a comprehensive review of FE-type problems, and a targeted review of specific topics on the FE Exam.

CEE 520 Building Information Modeling (3 Credits)
Engineering & Comp Sci
Generating three-dimensional architectural/structural models. Dimensioning and Annotating. Modeling various components of a building, including floors, roofs, structure, ceilings, stairs, ramps, railings. Generating schedules, views and detailing views.

CEE 529 Risk Anlys in Civ Engin (3 Credits)
Engineering & Comp Sci
Probability, statistics, and decision theory applied to a variety of civil-engineering disciplines, such as structural design and analysis, geotechnical, water quality, water resources, and transportation.
Prereq: MAT 397

CEE 535 Strctrl Steel Design (3 Credits)
Engineering & Comp Sci
Design of structures using load- and resistance-factor design concept. Limit states design of columns, beams, beam-columns, frames, connections, plate girders, and composite sections. Computer applications to design.
Prereq: CEE 331
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 536 Prestrssd Concrete Design (3 Credits)
Engineering & Comp Sci
Analysis and design of prestressed concrete members for flexure, shear, torsion, and compression. Basic concept of prestressing. Stress computation and prestress loss estimation. Deflection and crack control.
Prereq: CEE 331
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEE 538 Dynamics of Structures (3 Credits)
Engineering & Comp Sci
Response of single and multiple degree of freedom systems to dynamic loadings (harmonic, blast, wind, earthquake); design of buildings, bridges, and pipelines for dynamic loading (with particular emphasis on earthquakes); building and bridge codes.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 545 Pavement Design (3 Credits)
Engineering & Comp Sci
Pavement types and stress analysis, traffic assessment, subgrade and pavement materials evaluation, design of flexible and rigid pavements for highways and airports, pavement distress and rehabilitation, introduction to pavement management systems and SuperPave mix design.
Prereq: CEE 338 Coreq: CEE 443

CEE 548 Engineering Economics and Technology Valuation (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 548
Value-based assessment and management of engineering/technology projects: equivalence; discounted cash flow; taxes/depreciation; financial statements. Risk-adjusted valuation: risk/uncertainty in staged projects; Monte Carlo simulations; decision trees; real options; project portfolio management.
Prereq: MAT 296
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEE 549 Designing with Geofoam (3 Credits)
Engineering & Comp Sci
Introduction to geofoam production, physical properties, evaluation of engineering parameters, specification and quality assurance, analyses and design of selected applications, comparison with conventional methods, field monitoring, and case histories.
Prereq: CEE 338

CEE 551 Energy Conversion (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 551
Energy demand and resources. Fundamentals of combustion. Power plants, refrigeration systems. Turbines and engines. Advanced systems. Direct energy conversion. Alternate energy sources. Energy storage. Costs and environmental impact.

CEE 552 Building Environmental Measurements and Controls (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 552
Fundamentals of building ventilating methods for measuring and controlling indoor environmental conditioning, thermal comfort, and indoor air quality.
Prereq: MAE 341 and MAE 355

CEE 553 HVAC Systems Analysis and Design (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 553
Fundamentals of moist air properties, basic air conditioning processes, heat transfer in building structures, heating and cooling load calculations, and air distribution systems.
Prereq: MAE 251
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEE 554 Principles of Environmental Toxicology (3 Credits)
Engineering & Comp Sci
Factors that make chemicals environmental hazards and techniques used in their evaluation. Topics include chemical, physiological, and molecular aspects of toxicology; transport and fate of chemicals in the environment; and current legislation.
Prereq: (BIO 121 and 122 and 123) or (CHE 106 and 107 and 275) or (CHE 109 and 129)

CEE 555 Hazardous Waste Mgmt (3 Credits)
Engineering & Comp Sci
Regulations that address management of hazardous wastes. Practices and technologies commonly used in meeting regulations. Investigative and diagnostic techniques.

CEE 558 Solid Wastes: Collection and Disposal (3 Credits)
Engineering & Comp Sci
Composition of refuse. Quantities produced by individuals and industries. Collection equipment, methods, and associated costs. Disposal problems and solutions, such as landfills, incineration, and composting.

CEE 562 Air Resources (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 562
Occurrence, nature and properties, major sources and quantities of contaminants. Ambient air concentration levels, community distribution patterns, and control of air pollution.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 570 Water&Wastewtr Trtmnt Des (3 Credits)
Engineering & Comp Sci
Design of water and wastewater treatment plants; design capacity, process size and configuration, and overall treatment system performance for specific use needs and regulatory requirements. Groups prepare designs and cost estimates with written and oral reports. Repeatable
Prereq: CEE 327 and CEE 342

CEE 571 Water Quality Modeling (3 Credits)
Engineering & Comp Sci
Conceptual and mathematical models of water quality in surface waters. Application of mass and energy balances to aquatic systems. Numerical methods for solution of governing equations. Students will build simple models and use existing water quality modeling software.
Prereq: MAT 296 and CEE 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 573 Water, Sanitation, and Sustainability in Low-Resource Settings (3 Credits)
Engineering & Comp Sci
Overview of water and sanitation technologies and systems, including design and operational principles, commonly found in low-resource settings around the world. Emphasis on sustainable design considering environmental, economic, and social dimensions, with inclusion of stakeholder perspectives.

CEE 577 Urban Stormwater Management (3 Credits)
Engineering & Comp Sci
Theory and practice of urban stormwater management systems. Selecting and sizing stormwater quality and quantity control devices and systems. Sustainability aspects of urban stormwater design and regulatory compliance requirements. ENVISION rating system. Final design project.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 581 Lean Construction Principles and Methods (3 Credits)
Engineering & Comp Sci
Principles and methods of lean construction. History and evolution of lean production and lean construction paradigms. Production control and contracting. Applications to construction processes and operations to improve project performance.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 582 Construction Productivity (3 Credits)
Engineering & Comp Sci
Discussion of construction productivity measurement techniques, productivity improvement methods, and how to measure productivity loss. Examine factors that affect construction productivity such as human behavior, overtime, shift work, overmanning, change orders, and weather.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 584 Designing W/Geosynthetics (3 Credits)
Engineering & Comp Sci
Engineering properties of geosynthetics (geotextiles, geogrids, geonets, geomembranes, and geocomposites). Design of filters using geotextiles, retaining structures using geosynthetics, design of liquid impoundment, and solid waste containment facilities.
Prereq: CEE 337
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 588 Principles of Wind Turbines (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 588, ECS 588
Aerodynamics, performance, control, and electrical aspects wind turbines.
Prereq: MAE 341

Chemical Engineering

CEN 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CEN 212 Experimental Methods in Chemical Engineering and Bioengineering (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 212
Statistical analysis and presentation of experimental data. Parameter estimation. Design of experiments. Hardware and software for computer interfacing. Collection, analysis, and reporting of laboratory data.
Prereq: MAT 296 and ECS 104
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 231 Mass and Energy Balances (3 Credits)
Engineering & Comp Sci
Material balances for single units and multistage processes. Recycle and bypass streams. Introduction to phase equilibrium. Energy balances including latent and sensible heat effects, heats of reaction.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 252 Chemical Engineering Thermodynamics I (3 Credits)
Engineering & Comp Sci
Review of first law. Second law and thermodynamic analysis of processes. Power and refrigeration cycles. Thermodynamic properties of pure substances and homogeneous mixtures. Phase behavior of ideal solutions.
Prereq: CEN 231
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEN 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CEN 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable 1 times for 12 credits maximum

CEN 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

CEN 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CEN 311 Chemical Engineering Laboratory I (2 Credits)
Engineering & Comp Sci
Introduction to report writing and laboratory safety. Experiments on fluid mechanics and heat transfer. Analysis of experimental data. Engineering reports, summary reports, and oral presentations required.
Coreq: CEN 341
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

CEN 313 Chemical Process Safety (3 Credits)
Engineering & Comp Sci
Best practices for recognizing and managing chemical process safety hazards, preventing accidents and chemical exposures, and promoting safe work culture. Process safety administration, risk assessment, hazard analysis, case studies and safe process design methodologies.
Coreq: CEN 311

CEN 333 Fluid Transport (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 333
Fluid statics. Shear stress and viscosity. Energy and momentum balances for flow systems. Dimensional analysis. Friction and drag coefficients. Turbulent flow of compressible and incompressible fluids. Non-Newtonian fluids.
Prereq: MAT 397 and (PHY 212 or 216)
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 341 Fundamentals of Heat and Mass Transfer (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 341
Principles of heat and mass transfer. Conduction, convection, and radiation. Thermal properties of materials. Solutions of steady state and transient heat and mass transfer problems. Diffusion with chemical reaction. Convective mass transfer.
Prereq: CEN 333 or BEN 333
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 353 Chemical Engineering Thermodynamics II (3 Credits)
Engineering & Comp Sci
Thermodynamics of homogeneous mixtures and mixing processes. Phase equilibrium for nonideal solutions. Equilibrium stage separations with applications including distillation and extraction. Chemical reaction equilibria.
Prereq: CEN 252
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEN 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CEN 390 Research In CEN (1-6 Credits)
Engineering & Comp Sci
Repeatable

CEN 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CEN 412 Chemical Engineering Laboratory II (2 Credits)
Engineering & Comp Sci
Report writing and laboratory safety. Statistical analysis and experimental design. Experiments on reaction kinetics, separations, and mass transfer. Engineering reports, summary reports, and oral presentations required.
Prereq: CEN 341 and CEN 311
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 421 Biochemical Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 421
Double-numbered with BEN 621, CEN 621
Introduction to microbiology, biochemical kinetics. Biochemical-reactor design, including methods for oxygen transfer and control. Introduction to separation processes in biochemical engineering. Additional work for graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 429 Methods in Materials Characterization (3 Credits)
Engineering & Comp Sci
Double-numbered with CEN 629
Establish working knowledge of experimental tools to characterize solid materials (catalysts, metals, semiconductors). Theory for each technique, information provided for various research topics, experimental parameters, and data interpretation will be discussed. Additional work required of graduate students.

CEN 433 Drug Delivery (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 433
Double-numbered with BEN 633, CEN 633
Integration of biology, chemistry, and engineering to understand how pharmaceuticals are delivered to, and behave within, the body. Includes drug formulation, pharmacokinetics, pharmacodynamics, controlled release, and targeted delivery. Additional work is required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 442 Heat and Mass Transfer Operations (3 Credits)
Engineering & Comp Sci
Selected topics in heat and mass transfer. Application of transport principles to analysis & design of unit operations.
Prereq: CEN 341
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEN 450 Environmental Risk Assessment & Toxicology (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 450, CEE 450
Double-numbered with BEN 650, CEE 650, CEN 650
Students will analyze the human health impact of exposure to toxic chemicals in air, water, and soil according to USEPA Risk Assessment Guidance for Superfund. Additional work required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 451 Molecular and Statistical Thermodynamics (3 Credits)
Engineering & Comp Sci
Double-numbered with CEN 651
Classical and molecular thermodynamics in chemical equilibrium, with applications. Emphasis on concepts of statistical mechanics and correlation with properties of gases and condensed matter. Additional work required of graduate students.
Prereq: CEN 353
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 455 Materials for Energy Systems (3 Credits)
Engineering & Comp Sci
Double-numbered with CEN 655
Materials related to energy technologies and existing energy resources. Topics include: geologic fuels; photovoltaics; wind energy; thermoelectrics; electrical energy storage; hydrogen production, storage, and use; solid-state lighting; nuclear energy. Additional work required of graduate students
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEN 461 Environmental Chemistry and Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 471
Double-numbered with CEE 671, CEN 661
An introduction to chemical principles in natural and engineered environmental systems. Thermodynamics and kinetics of reactions; acid-base chemistry; environmental organic chemistry; treatment process design applications. Includes selected laboratory exercises. Additional work is required of graduate students.
MAT 296 and CHE 106 and CHE 107
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 462 Biofuels, Bioproducts, and Biorefining (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 462
Double-numbered with CEN 662, BEN 662
Survey of modern technologies available for the production of transportation fuels from abundant natural resources. Additional work required of graduate students.

CEN 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CEN 472 Applied Env Microbiology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 472
Double-numbered with CEE 672, CEN 672
General Principles and application of environmental microbiology and microbial processes. Role of microbes in water pollution control, environmental health, and element cycling in the environment. Additional work is required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 473 Biomanufacturing (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 473
Double-numbered with BEN 673, CEN 673
Students learn the governing principles of conventional and advanced manufacturing techniques, which are adapted/modified to engineer living tissues/organs, biomedical products and test-platforms for investigating fundamental cell biology. Additional work required for grad students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 474 Process Design (4 Credits)
Engineering & Comp Sci
Chemical engineering principles for plant design and optimal process operation. Cost estimation and profitability analysis. Shortcut and computer-aided process design techniques. Environmental impact and health and safety concerns.
Prereq: CEN 353 and 587
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CEN 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

CEN 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

CEN 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CEN 520 Radiochemistry, Nuclear Fuel Reprocessing and Nonproliferation (3 Credits)
Engineering & Comp Sci
Cross-listed with NUC 520
Radiochemistry for nuclear reactors and nuclear fuel reprocessing; nonproliferation issues through detection and monitoring, nuclear fuel reprocessing and design, waste vitrification and storage facilities, safety issues in nuclear fuel reprocessing.
Prereq: NUC 301

CEN 522 Biomedical-Device Infections (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 522
Discussion of the complex issues related to biomedical-device infections. Investigation of the impact of biomaterials, microbiology, detection, and device regulation to reduce biomedical-device infections.
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 540 Experiential Studies in Nuclear Technology (3 Credits)
Engineering & Comp Sci
Cross-listed with NUC 540
Introduction to experimental methods, procedures and research techniques through projects at participating government facilities, industrial entities or Syracuse University.
Prereq: NUC 301 and (NUC 510 or NUC 520)

CEN 545 Physuichem/Mthds/Waste Tr (3 Credits)
Engineering & Comp Sci
Applicability of chemical-engineering unit operations and unit processes in fluid-waste treatment. Membrane process, including electrodialysis and reverse osmosis, IPC (independent physical and chemical) process of waste treatment, coagulation, deep-bed filtration, and carbon-column operation.

CEN 561 Polymer Science & Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 561
Polymer structure, physical properties, and applications of polymers. Polymer synthesis, characterization of molecular structure, and copolymerization and blending. Unique physical properties of polymeric materials. Processing and applications of polymers.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 562 Air Resources (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 562
Occurrence, nature and properties, major sources and quantities of contaminants. Ambient air concentration levels, community distribution patterns, and control of air pollution.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 573 Principles and Design in Air Pollution Control (3 Credits)
Engineering & Comp Sci
Fundamental principles of pollution control, design of control processes and equipment. Criteria for selection of control processes and equipment for gaseous and particulate pollutants.

CEN 575 Process Control (3 Credits)
Engineering & Comp Sci
Modeling and linearization of process dynamics. Transfer functions. Performance and stability of feedback control loops. Introduction to multivariable and digital controls.
Prereq: MAT 485
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CEN 576 Green Engineering (3 Credits)
Engineering & Comp Sci
Review of environmental regulations. Evaluating the environmental fate of chemicals. Techniques for improving environmental performance of processes. Methods for evaluating environmental performance, design of unit operations, and flowsheets for pollution prevention. Environmental cost accounting.
Prereq: CEN 341 and 353

CEN 580 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CEN 587 Chemical Reaction Engineering (4 Credits)
Engineering & Comp Sci
Conversion and reactor sizing, isothermal reactor design for flow and batch systems, rate laws and stoichiometry, analysis of rate data, multiple reactions, introduction to heterogeneous reactor design.
Prereq: CEN 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEN 590 Recent Advances In CEN (3 Credits)
Engineering & Comp Sci
Selected topics in research and new areas of competence in chemical engineering.
Repeatable

Computer and Information Science

CIS 100 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CIS 151 Fundamentals of Computing and Programming (3 Credits)
Engineering & Comp Sci
Principles and practice of programming. Computing fundamentals: variables, types, scope, objects, classes, functions, parameter passing, input/output, conditionals, and iteration. Defensive programming techniques, including exceptions. Program testing and debugging. Includes programming laboratory.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 180 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CIS 182 Intro to Comput Prog:Apl (1-2 Credits)
Engineering & Comp Sci

CIS 183 Intr to Comp Prog:Fortran (1 Credit)
Engineering & Comp Sci

CIS 187 Intro to Comp Prog:Pascal (1 Credit)
Engineering & Comp Sci

CIS 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CIS 205 Survey of Comp & Info Sci (0-3 Credits)
Engineering & Comp Sci

CIS 223 Statistical Reasoning and Practice (3 Credits)
Engineering & Comp Sci
Methods for exploratory data analysis. Graphical and numerical summaries of numerical and categorical data. Drawing conclusions from data. Basic probability, correlation, estimation and testing. Concepts of study design.
Prereq: MAT 194

CIS 252 Elements of Computer Science (4 Credits)
Engineering & Comp Sci
Introduction to key computer-science concepts through functional programming. Recursion, data representation, data abstraction, and computational patterns. Algebraic data types and higher-order functions. Models of computation. Three hours of lecture and one hour of computer laboratory.
Prereq: CIS 151 or CPS 196
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CIS 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CIS 285 Computer Applications (0 Credits)
Engineering & Comp Sci

CIS 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

CIS 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CIS 321 Introduction to Probability and Statistics (4 Credits)
Engineering & Comp Sci
Double-numbered with CPS 621
Programming-oriented introduction to fundamentals in statistics and probability; elementary statistics, graphical and numerical representation; probability distributions; tests and confidence intervals; regression, and correlation. CPS 621 adds Journalism applications of statistical methods.
Prereq: MAT 295
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 341 Computer Organization & Programming Systems (3 Credits)
Engineering & Comp Sci
Digital logic, data types and their representations, instruction set architecture, assembly language, program construction, processors, memory hierarchy, traps and interrupts, privilege and security, input-output subsystems.
Prereq: CIS 351
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 342 Introduction to Systems Programming (1 Credit)
Engineering & Comp Sci
Input and output, including error handling, file descriptors and interface to OS. Pointers and pointer arithmetic. Structures. Memory functions and storage allocation. Makefiles, header files, libraries, compilation, and linking.
Prereq: CIS 351; Coreq: CIS 341

CIS 351 Data Structures (3 Credits)
Engineering & Comp Sci
Abstract data structures including arrays, lists, trees, binary search trees, priority queues, graphs. Algorithm analysis. Examples include data structures used for security-related applications.
Prereq: CIS 252 or CSE 283
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 352 Programming Language: Theory & Practice (3 Credits)
Engineering & Comp Sci
Environments, stores, scoping, functional and imperative languages, modules, classes, data encapsulation, types, and polymorphism. Implementation of these constructs in a definitional interpreter.
Prereq: CIS 252, 375, and 351

CIS 355 Intrm Prog/High Levl Lang (0 Credits)
Engineering & Comp Sci

CIS 370 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CIS 375 Introduction to Discrete Mathematics (3 Credits)
Engineering & Comp Sci
Basic set theory and symbolic logic. Methods of proof, including mathematical induction. Relations, partitions, partial orders, functions, and graphs. Credit cannot be given for both MAT 375 and CIS 375.
Prereq: PHI 251
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CIS 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CIS 381 Programming Systems (3 Credits)
Engineering & Comp Sci

CIS 383 Cmp Appl & Prog/Soc Rsrch (3 Credits)
Engineering & Comp Sci

CIS 386 Principles of Computer System Design (3 Credits)
Engineering & Comp Sci
Fundamental design principles for computer and information systems. Concurrency, race conditions, complexity, modularity, abstraction, layering, hierarchy, iteration, emergent properties, organization, virtualization, performance, atomicity, fault tolerance, consistency, and security.
Prereq: ECS 102 and CIS 351

CIS 390 Honors Seminar in Computer & Information Science (3 Credits)
Engineering & Comp Sci
Specific topics in computer and information science suitable for honors-thesis research.
Repeatable

CIS 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CIS 415 Intro Comp Linguistics (0 Credits)
Engineering & Comp Sci

CIS 425 Introduction to Computer Graphics (3 Credits)
Engineering & Comp Sci
Graphics programming. User interfaces. Modeling and viewing transformations. Shading techniques. Representations of three-dimensional models. Curves and non-planar surfaces. Ray tracing and radiosity. Antialiasing.
Prereq: CIS 351 or CSE 382
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 428 Introduction to Cryptography (3 Credits)
Engineering & Comp Sci
Classical cryptosystems and their cryptanalysis, RSA and other public-key cryptosystems, pseudo-random sequences, zero-knowledge protocols, related ethical and social concerns.
Prereq: CIS 477 or MAT 534 or 541
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 437 Multiagent Systems: Concepts and Programming (3 Credits)
Engineering & Comp Sci
Double-numbered with CIS 637
Algorithms for multiagent systems. Environment types for agent systems. Communications, game theoretical models, automatic auctions, utility and decision theory for multiagent systems, relationships between distributed systems and multiagent systems, Belief-Desire-Intention architecture, logic-based agent models, and agent simulations. Additional work required for graduate students.
Prereq: CIS 375 and CIS 351
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 440 Topics in Mobile Programming (3 Credits)
Engineering & Comp Sci
Double-numbered with CIS 640, CSE 640
A variety of subjects surveyed or a particular subject in depth. Additional coursework required of graduate students.
Repeatable 3 times for 9 credits maximum
Prereq: CIS 351

CIS 442 Introduction to Virtual Reality (3 Credits)
Engineering & Comp Sci
Fundamental aspects of virtual environments: applications, methods, and technologies. Development of 3D applications such as games, animations, and immersive virtual worlds. Aspects of 3D graphics (3D transformations and physics) and interactive systems (human perception and motion tracking).
Advisory recommendation Prereq: CIS 351 or CSE 283

CIS 444 Mobile Application Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 444
Double-numbered with CIS 651, CSE 651
Development of applications for different mobile devices. Creating effective user interfaces, efficient use of persistent storage, network services, GPS, maps and sensors. Additional work required of graduate students.
Prereq: CIS 351 or CSE 382

CIS 445 Finite Mathematics (3 Credits)
Engineering & Comp Sci

CIS 451 Modern Programming in Java (3 Credits)
Engineering & Comp Sci
Programming in Java with generic classes. Defining generic classes. Specifying types and inheritance. Verifying correctness of Java methods and classes. Managing concurrency, remote method invocation, and performance considerations.

CIS 453 Software Specification and Design (3 Credits)
Engineering & Comp Sci
Software engineering process models. Software requirements analysis, including object-oriented methodology. Behavioral and nonbehavioral requirements. Development of specification documents. Unified Modeling Language. High-level design and software architecture. Team projects.
Prereq: CIS 351 or CSE 382
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 454 Software Implementation (3 Credits)
Engineering & Comp Sci
Detailed design of software. Implementation and software testing. Developing software implementations from UML specifications and design documents. Software development methodologies, including agile development. Ethics and social responsibility. Team projects.
Prereq: CIS 453
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 458 Data Networks: Basic Principles (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 458, CSE 458
Data communication networks, multilayer network architecture, data transmission fundamentals, network protocols, local and wide area networks, transport and application protocols.
Prereq: CIS 321 or MAT 521

CIS 467 Introduction to Artificial Intelligence (3 Credits)
Engineering & Comp Sci
Double-numbered with CIS 667, CSE 684
Knowledge representation, production systems, search algorithms, game playing, uncertainty handling, learning, automated reasoning, computer vision, and natural language processing. Programming project or term paper required for CIS 667, not for CIS 467.
Prereq: CIS 375 and 321 and (CIS 351 or CSE 382)
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CIS 468 Natural Language Processing (3 Credits)
Engineering & Comp Sci
Double-numbered with CIS 668
Linguistic and computational aspect of natural language processing technologies. Lectures, readings, and projects in the computational techniques required to perform all levels of linguistic processing of text. Additional work required of graduate students.

CIS 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

CIS 471 Optimization Methods (3 Credits)
Engineering & Comp Sci
Classical methods of minimum and maximum, gradient methods, conjugate direction methods, linear programming and simplex algorithm, integer programming, non-linear optimization, random search algorithms.

CIS 473 Automata and Computability (3 Credits)
Engineering & Comp Sci
Countable and uncountable sets; diagonalization proofs; finite state automata; regular, context-free, context-sensitive, recursive, and r. e. languages; Turing machines; relationships between classes of languages and machines; the halting problem; proof methods for decidability and undecidabilty.
Prereq: CIS 375 or MAT 375
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 477 Introduction to Analysis of Algorithms (3 Credits)
Engineering & Comp Sci
Mathematical modeling of computational problems; searching and sorting algorithms; search trees, heaps, and hash tables; divide-and-conquer, dynamic programming, and greedy choice design techniques; graph algorithms; cryptographic algorithms; NP-completeness; and selected topics.
Prereq: CIS 375 and 351
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 478 Introduction to Quantum Computing (3 Credits)
Engineering & Comp Sci
Purpose of QC; simple Markov processes; quantum registers; quantum state transitions; classical vs quantum models of computation; measurement and superposition; no-cloning theorem; quantum teleportation; quantum logic.
Prereq: CIS 375 and (MAT 397 or 331)

CIS 480 International Course (1-6 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable 1 times for 6 credits maximum

CIS 487 Access Control, Security and Trust (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 487
Analytical/logical basis for trusting systems. Access requests, authorizations, certificates, credentials, jurisdiction, and delegation. Applications include distributed access control, process isolation and sharing, and access policies.
Prereq: CIS 375
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 489 Mobile Systems Security (3 Credits)
Engineering & Comp Sci
Double-numbered with CIS 689
Components in Mobile OS; basic mobile app development; sandbox mechanism; permission enforcement; vulnerabilities; malware attacks. Additional work required of graduate students.
Prereq: CIS 486 or CSE 486

CIS 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

CIS 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

CIS 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CIS 531 Compiler Construction (3 Credits)
Engineering & Comp Sci
Programming a small compiler. Lexical analysis, tokens, finite automata, hashing. Syntax analysis, grammars, syntax trees, error recovery. Scope and type analysis, symbol tables. Run-time stack, variable addressing, expression evaluation, procedure activation, recursion. Code generation, 0ptimization, portability.
Prereq: CIS 351

CIS 535 Assembly Language (3 Credits)
Engineering & Comp Sci

CIS 536 Comp Prog Tech (3 Credits)
Engineering & Comp Sci

CIS 543 Control of Robots (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 516
Kinematics, dynamics, and control of mobile and/or manipulator robots. Path planning, actuators, sensors, human/machine interface. Two hours lecture and two hours laboratory weekly. Design project.

CIS 545 Introduction to Combinatorics (3 Credits)
Engineering & Comp Sci
Cross-listed with MAT 545
Permutations, combinations, recurrence relations, generating functions, inclusion-exclusion and applications, introductory graph theory.
Prereq: CIS 375 or MAT 375
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CIS 553 Software Systems Implementation (3 Credits)
Engineering & Comp Sci
Organization, analysis, and documentation of a sophisticated implementation project in a prominent high-level language, such as ADA, C, or Modular-2. Substantial programming assignments and analytical documentation. Language and project may vary from year to year.
Prereq: CIS 453

CIS 554 Object Oriented Programming in C++ (3 Credits)
Engineering & Comp Sci
Pointers, dynamic memory management, data abstraction, classes, derived classes, inheritance, types, structures and templates. Threaded programming, standard template library, interfaces. Substantial programming assignments.
Prereq: CIS 351 or CSE 382
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 563 Introduction to Data Science (3 Credits)
Engineering & Comp Sci
Fundamentals of the knowledge discovery and data mining process. Basics of supervised and unsupervised learning. Applications (recommendation and collaborative filtering) and computational tools for carrying out predictive/descriptive modeling. Additional work required for graduate students.
Prereq: MAT 503
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CIS 565 Introduction to Artificial Neural Networks (3 Credits)
Engineering & Comp Sci
Perceptrons and the Perceptron Convergence Theorem; non-linear optimization, gradient descent methods; neural net architecture, conjugate-gradient and recurrent networks; Hopfield networks, Kohonen's feature maps; non-neural clustering algorithms.

CIS 567 Knowledge Representation and Reasoning (3 Credits)
Engineering & Comp Sci
Applications of mathematical methods to knowledge bases. Methods include nonclassical, fuzzy logic and statistical inference. Application topics include planning, temporal and physical reasoning, attitudes, the frame problem, preference, constraints, qualitative differential equations, situation theory.

CIS 570 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CIS 573 Computability Theory (3 Credits)
Engineering & Comp Sci

CIS 580 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CIS 581 Concurrent Programming (3 Credits)
Engineering & Comp Sci
Processes, events, alphabets, and trace sets. Process equivalence. Divergence, dead-lock, fairness, and termination. Message channels, buffers, pipelines, trees, rings, grids, recursive nets. Mutual exclusion, semaphores, conditional critical regions, monitors, remote procedures. Programming exercises in Joyce.

CIS 590 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

Computational Science

CPS 100 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CPS 155 Introduction to Cyber Security (3 Credits)
Engineering & Comp Sci
Introductory concepts of: network organization and operation security. Differentiate among physical, organizational and personal security. Introduce mechanisms and history of software, hardware and OS security. Significant hands-on laboratory component with demonstrations and projects.

CPS 180 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable 1 times for 999.99 credits maximum

CPS 181 Introduction to Computing (3 Credits)
Engineering & Comp Sci
Organization of computers, elementary programming, and problem solving. Applications in such areas as calculation and visualization, communication, databases, graphics, and artificial intelligence. Origins of the modern digital computer, future trends, social impact, abuses. Includes lab.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CPS 185 Introduction to Animation and Game Development (3 Credits)
Engineering & Comp Sci
This course provides a visual introduction to computer programming. Students will learn the basics of programming and high-level 3-dimensional animation together, while programming animations and games for assignments and an integrative final project.

CPS 196 Introduction to Computer Programming (3 Credits)
Engineering & Comp Sci
Basic computing concepts, data representation, problem definition, algorithms and flow charts, programming exercises. Students may not receive credit for both CPS 196 and ECS 102.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CPS 234 Introduction to Computational Thinking (3 Credits)
Engineering & Comp Sci
Computational-thinking skills developed through team-based problem solving. Fundamental concepts of computation, including algorithms, data organization, and computational strategies. Application of those concepts to solve problems from multiple settings and disciplines.

CPS 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
Repeatable

CPS 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.

CPS 312 Intro/Cmputnl Sci II (3 Credits)
Engineering & Comp Sci

CPS 333 UNIX Operating System and Internet (3 Credits)
Engineering & Comp Sci
UNIX operating system: commands, hierarchical file systems, editors, windowing, networking, security, administration. Emphasis on shell programming, awk scripts, sed, e-mail, newsgroups, Internet, telnet/ftp, search tools (Archie, Gopher, WAIS, Mosaic). For non-majors in computer science.

CPS 335 JAVA programming for the Internet (3 Credits)
Engineering & Comp Sci
Introduction to JAVA, object-oriented programming concepts and windows programming. Variables and data types, expression evaluation, control, stand-alone programs, inheritance, polymorphism, applets, graphics classes, arrays and strings, interfaces, threads, windows, widgets, animation, sound, libraries.

CPS 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CPS 430 Topics in Computational Science (3 Credits)
Engineering & Comp Sci
A variety of subjects surveyed or a particular subject in depth.
Repeatable 4 times for 12 credits maximum

CPS 451 Sr Comptnl Sci Project (3 Credits)
Engineering & Comp Sci

CPS 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor and the department.
Repeatable

CPS 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CPS 501 Selected Topics (0 Credits)
Engineering & Comp Sci

CPS 504 Introduction to C++ (3 Credits)
Engineering & Comp Sci
Object oriented programming in C++: classes, derived classes, data abstraction, inheritance, and access control. Substantial programming assignments. For students not majoring in computer science.
Prereq: CPS 196

CPS 506 Introduction to C (3 Credits)
Engineering & Comp Sci
Programming in C: data types, control structures; the preprocessor; arrays and pointers. Substantial programming assignments. For students in computer science.

CPS 551 Computer Organization & Operating System Design (3 Credits)
Engineering & Comp Sci
Fundamentals of computer organization and operating systems design. Computer organization topics: CPU & pipeline architecture, data representation and memory hierarchies, assembly language and instruction sets. Operating system concepts: system calls, processes, threads, synchronization, memory management, input-output, traps, and file systems.

Computer Engineering

CSE 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CSE 261 Digital Logic Design (3 Credits)
Engineering & Comp Sci
Number representations, Boolean Algebra, logic minimization, memory circuits, counters, state diagrams, state machine design, arithmetic circuits, and asynchronous circuits. Logic simulators will be used to demonstrate and provide students with design activities.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 262 Digital Logic Design Laboratory (1 Credit)
Engineering & Comp Sci
Basic digital logic circuit design and implementation. Logic-circuit design and testing using a Hardware Description Language and FPGAs. Digital system design, including coding, testing, synthesis, troubleshooting and documentation.
Coreq; CSE 261
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CSE 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CSE 283 Introduction to Object-Oriented Design (3 Credits)
Engineering & Comp Sci
Present fundamental software design concepts of functional decomposition and object-oriented design. Use both C++ and Java to implement design projects which will be completed to demonstrate the design concepts.
Prereq: CIS 151
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

CSE 370 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

CSE 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CSE 381 Computer Architecture (3 Credits)
Engineering & Comp Sci
Data representation, memory hierarchies, protection, specialized processors, multiple computers, performance evaluation, and reliability.
Prereq: CSE 261
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 382 Algorithms & Data Structures (3 Credits)
Engineering & Comp Sci
Data structures and algorithms implemented in high-level language. Nonnumeric processing, including database management. Types, structures, pointers, linked lists, recursion, iteration, retrieval, pattern recognition, and context processing.
Prereq: CSE 283

CSE 384 Systems and Network Programming (3 Credits)
Engineering & Comp Sci
Unix programming and shell scripting for systems and network software. Makefiles, compilers, linkers, debuggers, software with multiple source files. Dynamic memory allocation, system calls, C programming, pointers, concurrent/parallel programming, defensive programming techniques, network programming.
Prereq: CSE 283 or CIS 351
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 389 Web System Architecture and Programming (3 Credits)
Engineering & Comp Sci
Issues involved in architecting and programming Web servers and clients. Topics include Java Socket Programming; Java Thread Programming; HTTP; Apache HTTP Server; PHP/Python scripting; Java Servlets; JSP.
Prereq: CIS 351 OR CSE 283
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 390 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

CSE 397 Microcontroller Laboratory (3 Credits)
Engineering & Comp Sci
Fundamentals of microcontrollers. Concepts include architecture, programming, interfacing, and communication with analog and digital components.
Prereq: CSE 262
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 398 Embedded and Mobile Systems Laboratory (3 Credits)
Engineering & Comp Sci
Design and testing of embedded systems with an operating system. Rapid prototyping and design methods. Interfacing and network communication with mobile devices.
Coreq: CSE 384
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

CSE 418 Deep Learning (3 Credits)
Engineering & Comp Sci
Basic classification models,deep neural networks, recurrent neural networks,their software implementations and state-of-art deep learning frameworks on CPU and GPU.

CSE 444 Mobile Application Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 444
Double-numbered with CIS 651, CSE 651
Development of applications for different mobile devices. Creating effective user interfaces, efficient use of persistent storage, network services, GPS, maps and sensors. Additional work required of graduate students.

CSE 458 Data Networks: Basic Principles (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 458, CIS 458
Data communication networks, multilayer network architecture, data transmission fundamentals, network protocols, local and wide area networks, transport and application protocols.

CSE 461 Electronic Computers (3-4 Credits)
Engineering & Comp Sci

CSE 464 Introduction to VLSI Design (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 464
MOS VLSI technologies. CMOS digital circuits. Layout design. Simulation. Realization of digital subsystems-adders, memory, etc. Opportunities for chip fabrication and testing.
Prereq: CSE 261
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

CSE 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CSE 483 C# and Windows Programming (3 Credits)
Engineering & Comp Sci
Design and implementation of Windows 32-bit applications. Windows API techniques and Windows MFC techniques will be presented. This is a projects course.
Prereq: CSE 382 or CIS 351
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 484 Introduction to Computer and Network Security (3 Credits)
Engineering & Comp Sci
Operating system security. Authentication. Access control. Program vulnerabilities. Malicious code. Secure programming principles. TCP/IP protocols, vulnerabilities, attacks, and countermeasures. Firewalls. Intrusion detection. Secret-key and Public-key cryptography. One-way has function. Digital Signature.
Prereq: CSE 486 or CSE 384
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 486 Design of Operating Systems (3 Credits)
Engineering & Comp Sci
Design, implementation, and security aspects of modern operating system components. Resource management and protection of CPU, memory, file systems, and input/output devices. Concurrent and parallel process implementation. Process synchronization. Networking. Distributed systems.
Prereq: (CIS 341 or CSE 381) and (CSE 384 and CIS 351)
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 487 Access Control, Security and Trust (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 487
Analytical/logical basis for trusting systems. Access requests, authorizations, certificates, credentials, jurisdiction, and delegation. Applications include distributed access control, process isolation and sharing, and access policies.
Prereq: CIS 375
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 488 Introduction to Internet Security (3 Credits)
Engineering & Comp Sci
Network attack techniques and methods to defend them. Topics include vulnerabilities of TCP/IP protocols, denial of service attacks, intrusion detection, firewalls, tracing the source of attacks, anonymous communication, IPsec, virtual private network, and PKI.
Prereq: CSE 486
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

CSE 491 Senior Design Project I (3 Credits)
Engineering & Comp Sci
Design methodology and presentation techniques for one extensive team project to be completed in the follow-up course. Focus on design processes and associated technical documentation. Must be taken in sequence with CSE 492.
Prereq: CSE 398 or ELE 392
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 492 Senior Design Project II (3 Credits)
Engineering & Comp Sci
Prototyping, construction, and demonstration skills for one extensive project created by a team of students. Must be taken in sequence with CSE 491.
Prereq: CSE 491
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

CSE 500 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

CSE 561 Digital Machine Design (3 Credits)
Engineering & Comp Sci
Behavioral and structural design methods and examples using a hardware description language (VHDL). Control, arithmetic, bus systems, memory systems. Logic synthesis from hardware language descriptions.
Prereq: CSE 261

CSE 564 Vlsi Design Methods (3 Credits)
Engineering & Comp Sci

CSE 581 Introduction to Database Management Systems (3 Credits)
Engineering & Comp Sci
DBMS building blocks; entity-relationship and relational models; SQL/Oracle; integrity constraints; database design; file structures; indexing; query processing; transactions and recovery; overview of object relational DBMS, data warehouses, data mining.
Prereq: CSE 382 or CIS 351
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

CSE 590 Independent Studies (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

CSE 591 Special Problems in Computer Systems Engineering (1-4 Credits)
Engineering & Comp Sci
Students work on special projects. Instructors present new or special material.
Repeatable 30 times for 30 credits maximum

Electrical & Computer Engineering

ECE 161 Digital Logic Design (0 Credits)
Engineering & Comp Sci

ECE 181 Computer Programming (0 Credits)
Engineering & Comp Sci

ECE 182 Computer Applications (0 Credits)
Engineering & Comp Sci

ECE 221 Electrical Science I (0 Credits)
Engineering & Comp Sci

ECE 231 Active Resistive Networks (0 Credits)
Engineering & Comp Sci

ECE 232 Dynamic Networks (0 Credits)
Engineering & Comp Sci

ECE 281 Cmptr Org & Assembly Lang (0 Credits)
Engineering & Comp Sci

ECE 282 System Software Design (0 Credits)
Engineering & Comp Sci

ECE 290 Independent Study (0 Credits)
Engineering & Comp Sci
Repeatable

ECE 291 Electrical Lab I (0 Credits)
Engineering & Comp Sci

ECE 292 Electrical Lab II (0 Credits)
Engineering & Comp Sci

ECE 305 Engineering Analysis (0 Credits)
Engineering & Comp Sci

ECE 322 Electrical Mach & Devices (0 Credits)
Engineering & Comp Sci

ECE 324 Electromagnetics (0 Credits)
Engineering & Comp Sci

ECE 331 Digital Circuits/Systems (0 Credits)
Engineering & Comp Sci

ECE 347 Electronic Materials (0 Credits)
Engineering & Comp Sci

ECE 348 Electronic Devices (0 Credits)
Engineering & Comp Sci

ECE 351 System & Signal Analysis (0 Credits)
Engineering & Comp Sci

ECE 381 Computer Architecture (0 Credits)
Engineering & Comp Sci

ECE 382 Algorithms & Data Structr (0 Credits)
Engineering & Comp Sci

ECE 383 Comparative Prog Lang (0 Credits)
Engineering & Comp Sci

ECE 390 Independent Study (0 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

ECE 391 Electrical Engr Lab I (0 Credits)
Engineering & Comp Sci

ECE 392 Electricl Engineer Lab II (0 Credits)
Engineering & Comp Sci

ECE 393 Egr Ethics & Prof Resp (0 Credits)
Engineering & Comp Sci

ECE 394 Elect Lab/Non-Elect Stdt (0 Credits)
Engineering & Comp Sci

ECE 397 Computer Lab I (0 Credits)
Engineering & Comp Sci

ECE 398 Computer Laboratory II (0 Credits)
Engineering & Comp Sci

ECE 400 Selected Topics (0 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ECE 412 Control Systems (0 Credits)
Engineering & Comp Sci

ECE 416 Electromechanical Devices (0 Credits)
Engineering & Comp Sci

ECE 424 Electromag Transmissn Sys (0 Credits)
Engineering & Comp Sci

ECE 431 Analog Circuits & Systems (0 Credits)
Engineering & Comp Sci

ECE 452 Communication Systems (0 Credits)
Engineering & Comp Sci

ECE 461 Electronic Computers (0 Credits)
Engineering & Comp Sci

ECE 470 Experience Credit (0 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

ECE 482 Principles/Software Engr (0 Credits)
Engineering & Comp Sci

ECE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

ECE 492 Sel Top Electromag Engr (0 Credits)
Engineering & Comp Sci

ECE 493 St:Circuits/Netwks/Systms (0 Credits)
Engineering & Comp Sci

ECE 494 Sel Tpcs /Phys Elec&Devcs (0 Credits)
Engineering & Comp Sci

ECE 496 Select Top/Control&Power (0 Credits)
Engineering & Comp Sci

ECE 498 Selected Topics/Computers (0 Credits)
Engineering & Comp Sci

ECE 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

ECE 513 Powr Semicondctr Electron (0 Credits)
Engineering & Comp Sci

ECE 514 Electric Power Systems (0 Credits)
Engineering & Comp Sci

ECE 516 Fund Servomechanism (0 Credits)
Engineering & Comp Sci

ECE 517 Systems Analysis (0 Credits)
Engineering & Comp Sci

ECE 541 Integrated Circuits (0 Credits)
Engineering & Comp Sci

ECE 542 Integrated Circuit Design (0 Credits)
Engineering & Comp Sci

ECE 555 Microwave Engineering (0 Credits)
Engineering & Comp Sci

ECE 561 Digital Machine Design (0 Credits)
Engineering & Comp Sci

ECE 564 Vlsi Design Methods (0 Credits)
Engineering & Comp Sci

ECE 565 Microprcssr & Microcomptr (0 Credits)
Engineering & Comp Sci

ECE 566 Info Display Devices&Tech (0 Credits)
Engineering & Comp Sci

ECE 571 Switching Theory (0 Credits)
Engineering & Comp Sci

ECE 572 Switch Thry & Seq Mch Des (0 Credits)
Engineering & Comp Sci

ECE 585 Engr Des/Operating System (0 Credits)
Engineering & Comp Sci

ECE 588 Translator Design (0 Credits)
Engineering & Comp Sci

ECE 590 Independent Study (0 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

ECE 591 Spec Prob Elec Eng (0 Credits)
Engineering & Comp Sci

ECE 599 Elec Engineer Lab IV (0 Credits)
Engineering & Comp Sci

Engineering and Computer Science

ECS 100 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable 12 times for 36 credits maximum

ECS 101 Introduction to Engineering and Computer Science (3 Credits)
Engineering & Comp Sci
Gateway course: Discussion of disciplines within the college, technical communication, presentation of technical results, professional behavior, ethics, problem solving, modeling, and data analysis. Laboratory topics: computers, computer language, and software packages.
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

ECS 102 Introduction to Computing (3 Credits)
Engineering & Comp Sci
Computing concepts. Principles of programming. Applications of computing concepts to problem solving in engineering and computer science. Laboratory topics will include problem solving projects from various disciplines within the college.

ECS 103 First Year Student Success Forum (1 Credit)
Engineering & Comp Sci
Gives new LCS students tools for success including study and time management skills, leadership; transition issues; academic policies and university resources; through lecture, small group meetings with their peer mentor, and hands-on activities.

ECS 104 Engineering Computational Tools (3 Credits)
Engineering & Comp Sci
Elementary numerical techniques for root finding, sets of equations, curve fitting, differentiation, integration. Programming concepts: conditional branching, loops, etc. Examples of engineering calculations. Use of spreadsheets and interpreted programming languages.
Coreq: MAT 295
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ECS 105 ECS SummerStart Supplemental Math Workshop (1 Credit)
Engineering & Comp Sci
Workshop designed to supplement the theory taught in math courses. Design problems will incorporate course work. Limited enrollment/special permission.
Repeatable 8 times for 8 credits maximum

ECS 109 ECS SummerStart Seminar (1 Credit)
Engineering & Comp Sci
Designed to assist first-year students with their transition from high school to the University setting. Introduction of resources that will assist in the student's academic, social, cultural, and personal development through interactions with various representatives.

ECS 110 Introduction to Engineering Mathematics (3 Credits)
Engineering & Comp Sci
This course brings together mathematics and engineering by quantifying and interpreting rates of change through the analysis of linear and non-linear phenomena and how these phenomena change with respect to time.

ECS 114 Academic Excellence Workshop for Pre-Calculus (1 Credit)
Engineering & Comp Sci
Designed to supplement the theory taught in pre-calculus. Problems will incorporate course work. The computational component is designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: MAT 193 or MAT 194

ECS 115 Academic Excellence Workshop for Calculus I (1 Credit)
Engineering & Comp Sci
Designed to supplement the theory taught in Calculus I. problems will incorporate course work. The computational component is designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: MAT 295

ECS 116 Academic Excellence Workshop for Calculus II (1 Credit)
Engineering & Comp Sci
Designed to supplement the theory taught in Calculus II. Problems will incorporate course work. The computational component is designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: MAT 296

ECS 117 Academic Excellence Workshop for Calculus III (1 Credit)
Engineering & Comp Sci
Designed to supplement the theory taught in Calculus III. Problems will incorporate course work. The computational component is designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: MAT 397

ECS 122 Academic Excellence Workshop for Intro. to Computing (1 Credit)
Engineering & Comp Sci
Designed to supplement the material taught in Introduction to Computing. Problems will incorporate course work and are designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: CIS 151 or ECS 102

ECS 125 Survey of Engineering Problems (2-3 Credits)
Engineering & Comp Sci
Current design and research problems in engineering presented by faculty members actively working on these problems. Opportunities for student participation and individual project.

ECS 180 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

ECS 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of topics not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable 12 times for 36 credits maximum

ECS 201 Academic Excellence Workshop for Statics (1 Credit)
Engineering & Comp Sci
Designed to supplement the theory taught in the static (ECS 221) course. Design problems will incorporate course work. Limited enrollment/special permission.
Repeatable 3 times for 3 credits maximum
Coreq: ECS 221

ECS 202 Academic Excellence Workshop for Dynamics (1 Credit)
Engineering & Comp Sci
Designed to supplement the theory taught in the dynamics course (ECS 222). Design problems will incorporate course work. Limited enrollment/special permission.
Repeatable 3 times for 3 credits maximum
Coreq: ECS 222

ECS 203 Introduction to Technology (3 Credits)
Engineering & Comp Sci
Cross-listed with STS 203
Basic engineering principles behind some of today's rapidly changing technologies. The capabilities, limitations, and application of these technologies to audio and TV systems, CD players, communications' satellites, radar, computers, and the electric power system. For nonspecialists.

ECS 204 Mathematical Programming for Engineers (1 Credit)
Engineering & Comp Sci
Technical computing environment such as MATLAB; trigonometry and complex numbers; arrays and array operations; mathematical functions and applications; data analysis; selection programming; vectors; matrices and linear algebra; curve fitting and interpolation; integration and differentiation; symbolic processing.

ECS 205 Academic Excellence Workshop for Thermodynamics (1 Credit)
Engineering & Comp Sci
Designed to supplement the material taught in Thermodynamics. Problems will incorporate course work and are designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: MAE 251

ECS 206 Academic Excellence Workshop for Mass & Energy Balances (1 Credit)
Engineering & Comp Sci
Designed to supplement the material taught in Mass & Energy Balances. Problems will incorporate course work and are designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: CEN 231

ECS 207 AEW for CEN Thermodynamics (1 Credit)
Engineering & Comp Sci
Designed to supplement the theory taught in CEN Thermodynamics. Problems will incorporate course work and are designed to reinforce the understanding of concepts through a series of repetitive exercises.
Repeatable 3 times for 3 credits maximum
Coreq: CEN 252

ECS 221 Statics (3 Credits)
Engineering & Comp Sci
Fundamentals of static equilibrium. Vector algebra. Forces, moments, equivalent force systems. Free body diagrams and equilibrium problems in two and three dimensions. Analysis of structures and machines. Centroids and moments of inertia.
Prereq: PHY 211 or 215; Coreq: MAT 296
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ECS 222 Dynamics (3 Credits)
Engineering & Comp Sci
Dynamics of a particle. Newton's law and D'Alembert's principle. Plane motion. Cartesian, polar, and local coordinates. Energy and momentum methods. Motion of a rigid body. Review of vector algebra and moments of inertia.
Prereq: MAT 296 and ECS 221
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ECS 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

ECS 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
In depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

ECS 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ECS 301 Understanding Contemporary Technology (3 Credits)
Engineering & Comp Sci
Survey of significant areas of technology: scientific bases, operating principles, physical capabilities and performance, economic limitations, social impact. Areas include: fuel, energy, materials, pollution control, environmental modification. May be taken in either order with 302.

ECS 302 Understanding Contemporary Technology (3 Credits)
Engineering & Comp Sci
Survey of significant areas of technology: scientific bases, operating principles, physical capabilities and performance, economic limitations, social impact. Areas include: fuel, energy, materials, pollution control, environmental modification.

ECS 311 Introduction to Humanitarian Engineering (3 Credits)
Engineering & Comp Sci
Introduction to the role of engineers in humanitarian and low-resource settings. Overview of challenges commonly encountered, along with solutions relevant to various engineering fields. Consideration of sustainability, stakeholder engagement, humanitarian ethics, humility, and reflection.

ECS 325 Mechanics of Solids (3 Credits)
Engineering & Comp Sci
Theory of deformation, stress, stress resultants, transformation. Elastic and inelastic constitutive behavior. Equilibrium. Tension and torsion of bars; flexure and shear of beams; pressure vessels. Thermoelasticity. Elastic and inelastic stability. Energy methods.
Prereq: ECS 221; Coreq: MAT 397
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ECS 326 Engineering Materials, Properties, and Processing (3 Credits)
Engineering & Comp Sci
Introduction to the properties and applications of engineering materials with emphasis on structure-property-processing relationships; fundamentals of structure, properties, and processing; materials selection for design; case studies of specific engineering applications.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ECS 353 Automotive Technology for Non-Engineers (3 Credits)
Engineering & Comp Sci
A study of the modern automobile, using a recent model car as a laboratory example. Description and demonstration of engines, transmissions, body, suspension, brakes, steering, safety equipment, and fuel systems. Federal Motor Vehicle Standards.

ECS 354 Green Technology and Sustainability (3 Credits)
Engineering & Comp Sci
Energy consumption, climate change and global warming. The green movement. Current and alternative energy sources. Technologies for energy generation, conversion and storage. Sustainable development. Green economy. Political, economic and social aspects of green practices. Permission of instructor.

ECS 365 Engineering Peer Mentor Forum (1 Credit)
Engineering & Comp Sci
Designed to give Peer Mentors the opportunity to discuss issues and concerns within their weekly group meetings. Peer Mentors will work as a group to discuss, analyze, and problem solve advising and first year transition issues.
Repeatable 3 times for 3 credits maximum

ECS 370 Professional Practice (0 Credits)
Engineering & Comp Sci
Full-time practical engineering or computer science work experience, with a participating employer, that is directly related to the student's field of study and is of a semester's duration. Student must be in good standing in the College of Engineering and Computer Science Cooperative Education Program.
Repeatable

ECS 371 International Professional Practice (0 Credits)
Engineering & Comp Sci
A supervised work experience in a laboratory at one of several European universities near an SU Abroad center. Offered only overseas through Syracuse University Abroad.

ECS 375 Academic Excellence Facilitator Forum (1 Credit)
Engineering & Comp Sci
Designed to give facilitators the opportunity to discuss issues and concerns within their weekly workshop. Facilitators will work as a group to discuss, analyze, and problem solve participant issues.
Repeatable 8 times for 8 credits maximum

ECS 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

ECS 391 Legal Aspects of Engineering and Computer Science (3 Credits)
Engineering & Comp Sci
Legal issues related to engineering and computer science are investigated using case studies, research projects, and term papers. Topics include patents, copyright, licenses, trade secrets, technology transfer, computer crime, contracts, and product liability.
Shared Competencies: Ethics and Integrity (https://coursecatalog.syracuse.edu/shared-competencies/ethics-and-integrity/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ECS 392 Ethical Aspects of Engineering and Computer Science (3 Credits)
Engineering & Comp Sci
Ethical issues related to engineering and computer science, including professionalism, collective and individual moral responsibility, codes of ethics, whistle blowing, conflicts of interest, product liability, employer-employee expectations, oppression/injustice, inclusion/accessibility, and ethics issues related to cyberspace.
University Requirement Course: IDEA Requirement Eligible
Shared Competencies: Ethics and Integrity (https://coursecatalog.syracuse.edu/shared-competencies/ethics-and-integrity/)

ECS 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of engineering and computer science topics not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ECS 401 Spec. Projects-Soling Program (3 Credits)
Engineering & Comp Sci
Projects sponsored by the greater University community are completed by interdisciplinary teams in consultation with a faculty advisor. Open to juniors and seniors.

ECS 441 Leonardo da Vinci: Artist and Engineer (4 Credits)
Engineering & Comp Sci
Cross-listed with HOA 425
Interdisciplinary exploration of the life and work of Leonardo da Vinci (1452-1519). Supplemented by required field trip to Europe. Special application required.

ECS 470 Professional Practice (1-6 Credits)
Engineering & Comp Sci
Full-time practical engineering or computer science work experience, with a participating employer, that is directly related to the student's field of study and is of one semester's duration.
Repeatable

ECS 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

ECS 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

ECS 498 Concepts & Issues of Tech. (3 Credits)
Engineering & Comp Sci
Role of engineering in modern society. Selection of criteria. Methods of problem analysis and decision making. Case studies.

ECS 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

ECS 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ECS 511 Sustainable Manufacturing (3 Credits)
Engineering & Comp Sci
Visions of sustainable manufacturing, systems approach to sustainable product development and design, manufacturing processes and systems, alternative energy systems for manufacturing, innovation and entrepreneurship opportunities. Senior standing.
Prereq: MFE 331
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ECS 525 Probability for Engineers (3 Credits)
Engineering & Comp Sci
Sample spaces, events, and probabilities. Conditional probability and independence. Random variables, random vectors. Probability distributions and densities. Expectations. Moment-generating functions. Introduction to data analysis. Engineering applications.

ECS 526 Statistics for Engineers (3 Credits)
Engineering & Comp Sci
Point estimation, confidence intervals, simple hypothesis testing, nonparametric tests, curve fitting and regression, analysis of variance, factorial experiments, and engineering applications.
Prereq: ECS 525 or MAT 521

ECS 555 Virtual Design Studio for Green Building Systems (VDS-GBS) (3 Credits)
Engineering & Comp Sci
Integrative design methodology; Interactions between form, structure, and flows of energy & mass, and their impacts on building performance; Computer simulation tools for performance-based design. Exploration of green building design and technology through case studies

ECS 561 Data Centers: Infrastructure Design and Energy Efficiency (3 Credits)
Engineering & Comp Sci
Introduction to data centers and the infrastructure supporting the IT equipment. Focus on the energy efficiency aspects of various designs. Introduction of servers, storage and networking equipment that are housed in data centers. Power and cooling infrastructure that supports the IT equipment.
Repeatable 2 times for 6 credits maximum

ECS 570 Professional Practice (0 Credits)
Engineering & Comp Sci
Full-time practical engineering or computer work experience, with a participating employer, that is related to the student's field of study, and is of a semester's duration. May not be repeated.
Prereq: ECS graduate program

ECS 588 Principles of Wind Turbines (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 588, CEE 588
Aerodynamics, performance, control, and electrical aspects wind turbines.
Prereq: MAE 341

Electrical Engineering

ELE 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ELE 231 Electrical Engineering Fundamentals (3 Credits)
Engineering & Comp Sci
Analysis of electric circuits. Resistive, reactive circuits. Independent, dependent sources. Network theorems, circuit reduction, op amps. Elements of transient and steady state circuit analysis. Power and energy considerations.
Prereq: MAT 295
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ELE 251 Fundamentals of Linear Systems (3 Credits)
Engineering & Comp Sci
Linear time invariant analogous systems. Step, Impulse, response in both time and frequency domain using the Laplace transform. The s-plane. Steady state AC response. Discrete time sampling, Nyquist limits, z-transform, z-plane. Simple digital filters.
Advisory recommendation Prereq: MAT 295 Coreq: PHY 211 or PHY 215
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ELE 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

ELE 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

ELE 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

ELE 291 Electrical Engineering Laboratory I (1 Credit)
Engineering & Comp Sci
Electrical-instrumentation and measurement. Experimental methods in linear and nonlinear devices and circuits. One hour of recitation and one three hour laboratory a week.
Coreq: ELE 231
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ELE 292 Linear Systems Laboratory (1 Credit)
Engineering & Comp Sci
Electrical-instrumentation, measurement and data-logging. Experimental methods in linear systems. Computer computations for analysis and modelling. One three hour laboratory per week.
Coreq: ELE 251
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ELE 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ELE 314 Power Engineering (3 Credits)
Engineering & Comp Sci
Phasors; complex power; single phase systems; three-phase systems; electromagnetic fundamentals of power systems; transformers; transmission line parameters; power flow analysis.
Prereq: ELE 231
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 324 Electromagnetics I (3 Credits)
Engineering & Comp Sci
Vector analysis, electrostatics, LaPlace's equation, dielectrics, magnetostatics, magnetic materials.
Prereq: MAT 397 and (PHY 212 or PHY 216)
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 325 Electromagnetics II (3 Credits)
Engineering & Comp Sci
Faraday's Law, displacement current, Maxwell's equations, plane waves, power flow in waves, reflection and transmission of waves, wave-guides, radiation, and antennas.
Advisory recommendation Prereq: ELE 324

ELE 333 Analog Electronics (3 Credits)
Engineering & Comp Sci
Introductory semi-conductors; non-linear electronic circuits and devices including operational amplifiers, diodes and MOSFETs; Integrated electronics.
Prereq: ELE 231
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 346 Semiconductor Devices (3 Credits)
Engineering & Comp Sci
Physics of semiconductor devices. Energy bands. Electrons and holes. PN and metal semiconductor diodes. Characteristics, operation, properties and limitations of bipolar transistors, JFETS and MOSFETS. PNPN devices. Optoelectronic devices.
Prereq: PHY 212 or 216
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 351 System and Signal Analysis (3 Credits)
Engineering & Comp Sci
Signal and system analysis in continuous-time, discrete-time, and frequency domains. Fourier series, continuous and discrete Fourier transforms, z-transform, LaPlace transform. Engineering applications.
Prereq: ELE 251
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 352 Digital Signal Processing (3 Credits)
Engineering & Comp Sci
Discrete time sequences and systems. Sampling. Discrete Fourier transform. z-transform. Finite impulse response (FIR) filters. Infinite impulse response (IIR) filters.
Prereq: ELE 351
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 354 Communication Systems (3 Credits)
Engineering & Comp Sci
Time and frequency domain representation of signals, LTI systems, analog modulation and demodulation, random processes, digital modulation schemes, geometric representation of signal waveforms, optimal receiver design.
Prerequisite: ELE 351 and CIS 321
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ELE 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

ELE 392 Digital Signal Processing and Control Systems Laboratory (3 Credits)
Engineering & Comp Sci
A hands-on introduction to basics and applications of digital signal processing and feedback control. Simulations using MATLAB/Simulink and experiments using microcontrollers will cover structured lab exercises that lead to a final multi-week design project.
Prereq: ELE 251
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ELE 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ELE 412 Control Systems (3 Credits)
Engineering & Comp Sci
Review of Laplace transforms and z-transforms. System modeling, transfer functions, feedback, stability. Analysis and design using computer tools. Applications of controls to engineering systems.
Prerequisite: ELE 351
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

ELE 414 Power System Analysis and Control (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 614
Three phase power systems, Power flow analysis, Symmetrical components, Fault analysis, Power system stability, Power system controls, Fundamentals of economic dispatch. Additional work required for graduate students.
Prereq: ELE 314
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ELE 415 Microgrids (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 615
Challenges and opportunities in smart microgrids. Distributed energy resources in microgrids. Grid-connected and islanding mode of microgrid operation. Microgrid monitoring and protection. Control technology requirements and solutions. Additional work required for graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 416 Electromechanical Devices (3 Credits)
Engineering & Comp Sci
Principles of energy conversion that provide the basis of operation for electrical machinery, meters, and other transducers. Rotating DC and AC machines.
Prereq: ELE 232

ELE 417 Power Electronics (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 617
Semiconductor devices, switching power poles, switching analysis, topology selection and design, single phase and three phase rectifiers, inverters, and converters, feedback controllers and power supply. Additional work required of graduate students.
Prereq: ELE 314
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 418 Sensors & Measurements (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 618
Sensor signal domains, sensor classifications and architecture, sensor types, data acquisition methods, signal conversion methods, standards, introduction to metrology, measurement result processing, synchrophasor technology and applications. Additional work required of graduate students.

ELE 424 Applied Electromagnetics (3 Credits)
Engineering & Comp Sci
Electromagnetic Waves. Waveguides, coaxial cables, and optical fibers. Resonators, Transmission lines. Antennas and antenna systems.
Prereq: ELE 324
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 425 Microwave Engineering (3 Credits)
Engineering & Comp Sci
Microwave engineering including transmission line theory, impedance matching techniques, and microwave network analysis. Applications to coaxial, strip, microstrip, coupled lines and devices. Experimental illustration using network analyzers, spectrum analyzers, and computer based electromagnetic modeling tools.
Prereq: ELE 324

ELE 450 Independent Study (1-6 Credits)
Engineering & Comp Sci
Repeatable

ELE 452 Digital Audio Signal Processing (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 652
Course combines classroom theory with hands-on lab. Covers digital audio fundamentals, filter-design, DSP architecture, parallel assembly programming, circular buffers, processing music signals. Additional work required of graduate students.

ELE 453 Image and Video Processing (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 653
Concepts and applications of image and video processing. Principles of image formation, low-level image processing methods, noise filtering, histogram processing, feature detection, face recognition, moving object detection and tracking, multi-camera systems. Significant project for graduate students.
Prereq: CIS 321 AND (CIS 151 or ECS 102)

ELE 454 Introduction to Radar Systems (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 654
Foundations of radar systems including basic radar measurements and functionality, the radar range equation, and fundamentals of search and detection. Overview of major subsystems including antennas, transmitters, receivers and signal processors. Introduction to radar signal processing techniques. Additional work required for graduate students.
Prereq: ELE 324 and ELE 351

ELE 458 Data Networks: Basic Principles (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 458, CSE 458
Data communication networks, multilayer network architecture, data transmission fundamentals, network protocols, local and wide area networks, transport and application protocols.

ELE 464 Introduction to VLSI Design (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 464
MOS VLSI technologies. CMOS digital circuits. Layout design. Simulation. Realization of digital subsystems-adders, memory, etc. Opportunities for chip fabrication and testing.
Prereq: CSE 261
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

ELE 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

ELE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

ELE 491 Senior Design Project I (3 Credits)
Engineering & Comp Sci
Design methodology and presentation techniques for one extensive team project to be completed in the follow-up course. Focus on design processes and associated technical documentation. Must be taken in sequence with ELE 492.
Prerequisite: ELE 392 or CSE 398
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

ELE 492 Senior Design Project II (3 Credits)
Engineering & Comp Sci
Prototyping, construction, and demonstration skills for one extensive project created by a team of students. Must be taken in sequence with ELE 491
Prereq: ELE 491
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

ELE 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

ELE 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

ELE 516 Control of Robots (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 543
Kinematics, dynamics, and control of mobile and/or manipulator robots. Path planning, actuators, sensors, human/machine interface. Two hours lecture and two hours laboratory weekly. Design project.

ELE 524 Introduction to Applied Optics (3 Credits)
Engineering & Comp Sci
Geometrical optics, two-dimensional Fourier transforms and wave propagation, optical fibers, Fresnel and Fraunhofer diffraction, interferometry, imaging and Fourier transforming properties of lenses, image processing, complex filters and holography. Includes laboratory: design and experiment.
Prereq: ELE 324

ELE 551 Communication Systems (3 Credits)
Engineering & Comp Sci
Communications systems. Amplitude modulation techniques. Angle modulation or frequency modulation. Sampling and quantization of analog signals. Basic digital modulation techniques. Introduction to noise. System modeling evaluating performance using industry tools.
Prereq: ELE 351

ELE 580 International Course (1-6 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.

ELE 590 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

ELE 591 Special Problems in Electrical Engineering (1-4 Credits)
Engineering & Comp Sci
Students work on special projects. Instructors present new or special material.
Repeatable
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

Mechanical and Aerospace Engineering

MAE 180 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MAE 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable 6 times for 6 credits maximum

MAE 251 Thermodynamics (3 Credits)
Engineering & Comp Sci
Basic concepts in engineering thermodynamics. Thermodynamic properties of solids, liquids, and gases. First and second laws of thermodynamics. Reversible and irreversible processes. Entropy equation. Energy analysis of basic cycles.
Prereq: PHY 211 or 215
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable 6 times for 6 credits maximum

MAE 280 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MAE 284 Introduction to CAD (3 Credits)
Engineering & Comp Sci
Fundamentals of projections and intersections of surfaces. Dimensioning and tolerancing. Different solid and surface modeling techniques. Use of a computer-aided design system. Design problems.
Prereq: ECS 101
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

MAE 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

MAE 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MAE 312 Engineering Analysis (3 Credits)
Engineering & Comp Sci
Analytical and numerical methods of engineering problem solving. Linear algebra, ordinary and partial differential equations. Applications include vibration theory, column buckling, steady and unsteady heat transfer, subsonic and supersonic potential flows, wave propagation in rods.
Prereq: ECS 104 and MAT 485
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 315 Mechanical and Aerospace Engineering Laboratory (3 Credits)
Engineering & Comp Sci
Laboratory experiments in engineering and science topics. Introduction to statistical evaluation of data. Experiments will be selected from various topics including solid mechanics, fluid mechanics, digital signal processing and vibrations.
Prereq: ECS 325; Coreq: MAE 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

MAE 321 Dynamics of Mechanical Systems (3 Credits)
Engineering & Comp Sci
Formulation of dynamics problems using Newton's Laws with an introductory study of analytical dynamics. Vibration of linear systems. Computational techniques for predicting system response.
Prereq: ECS 222 and ECS 325 and MAT 485
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

MAE 322 Control Systems for MAE (3 Credits)
Engineering & Comp Sci
Review of Laplace transforms and z-transforms, system modeling, transfer functions, feedback, stability. Analysis and design using computer tools. Applications of controls to mechanical systems.
Prereq: MAT 485 Coreq: MAE 321
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 333 Data Analysis for Engineers (3 Credits)
Engineering & Comp Sci
Collecting and pre-processing engineering data. Analysis of engineering data. Probability distributions and inferences. Estimation. Engineering experimental design. Engineering applications such as curve fitting, error analysis, statistical process control and reliability. Computational tools for data analysis.
Prereq: MAT 397
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

MAE 341 Fluid Mechanics (4 Credits)
Engineering & Comp Sci
Dimensional analysis. Hydrostatics. Bernoulli's equation. Control volume analysis. Basic equations in differential form. Inviscid incompressible flows. Viscous flows in pipes and ducts. Estimation of head losses in fluid systems.
Prereq: ECS 221 and MAT 397 and (PHY 211 or 215)
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 355 Fundamentals of Heat Transfer (4 Credits)
Engineering & Comp Sci
Principles of heat transfer: conduction, convection, and radiation. Thermal properties of materials. Boiling and condensation. Solutions of steady state and transient heat transfer problems. Design of heat exchange systems.
Prereq: MAE 341; Coreq: MAE 251
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 373 Analysis and Design of Structures (4 Credits)
Engineering & Comp Sci
Elements of the plane theory of elasticity and strength of materials. Application to problems of mechanical and aerospace structures.

MAE 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MAE 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MAE 415 Mechanical and Aerospace Engineering laboratory III (2 Credits)
Engineering & Comp Sci
Experiments in composite structures and instrumentation performed in small groups. Written and oral reports.

MAE 433 Theory of Materials (3 Credits)
Engineering & Comp Sci
Double-numbered with MAE 633
Introduction to basic science, fundamentals and properties of materials. Processes and analysis techniques for fabricating nano, micro, and macro devices. Additional work required of graduate students.
Prereq: ECS 326 or CEE 326
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 457 Automotive Engineering for ECS Students (3 Credits)
Engineering & Comp Sci
An engineering study of the modern automobile, using a recent model car as a laboratory example. Analysis of engine, transmission, body, suspension, brakes, steering safety equipment, and fuel systems. FMVS Standards.
Prereq: MAE 251
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

MAE 473 Introduction to Finite Element Analysis (3 Credits)
Engineering & Comp Sci
Introduction to formulation of mechanics and heat transfer problems by finite element analysis. Applications of the finite element method for the static and dynamic analysis of mechanical components and use of commercial software.
Prereq: MAT 485 and ECS 325

MAE 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MAE 483 Applied Environmental Acoustics and Noise Control (3 Credits)
Engineering & Comp Sci
Double-numbered with MAE 683
Introductory to environmental acoustics, sound propagation, psychoacoustics, noise criteria for design, noise sources, absorption, noise isolation, design of critical spaces, sound measurement, vibration isolation, product noise ratings, sound quality.
Prereq: PHY 211
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 486 Fuel Cell Science and Technology (3 Credits)
Engineering & Comp Sci
Fuel cell thermodynamics; electrode kinetics; performance and efficiency; transport process; types of fuel cells; fueling issues, and fuel cell systems and applications will be covered.
Prereq: MAE 251

MAE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

MAE 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

MAE 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MAE 510 Nuclear Reactor Design, Operation and Safety (3 Credits)
Engineering & Comp Sci
Cross-listed with NUC 510
Principles of fission reactor analysis and design; reactor kinetics, operation and control; reactor thermo-fluid-dynamics; reactor safety; reactor accident case studies.
Prereq: NUC 301 and MAE 551

MAE 512 Technology Management (3 Credits)
Engineering & Comp Sci
This course develops a foundation for the concepts of ethics, technology life-cycles, product life cycles, concurrent engineering, managing people, project evaluation, leading technology teams, managing R&D and innovation and managing risks in order to support the planning, scheduling, and controlling activities required for successful completion of technologically innovative projects.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

MAE 525 Soft Robotics: Materials, Mechanics, and Machines (3 Credits)
Engineering & Comp Sci
Soft robotics offers many advantages over conventional robotics. This course explores relevant materials and mechanics for recent progress in soft robotics through lectures, literature surveys, and course projects where students work in teams to repeat part of recent soft robotics papers.
Advisory recommendation Prereq: ECS 325
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

MAE 530 Introduction to Design Optimization (3 Credits)
Engineering & Comp Sci
Theory and use of numerical design optimization methods. Problem formulation, practical application, and results analysis. Unconstrained nonlinear problems, constrained linear and nonlinear problems, and multi-objective optimization. Graduate students will do additional work in surrogate models and optimizing under uncertainty. Extensive use of Matlab functions and programming.
Prereq: MAT 485
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

MAE 536 Composite Materials (3 Credits)
Engineering & Comp Sci
Design, analysis, and manufacturing of fiber-reinforced composite materials. Emphasis is on polymeric composites for general aerospace and automotive applications, and on ceramic matrix composites for hypersonic applications.
Prereq: ECS 325
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 545 Applications of Fluid Mechanics (3 Credits)
Engineering & Comp Sci
Selected topics in applied fluid mechanics, to be determined by the instructor. Tools employed include control volume analysis, Bernoulli equation, exact and simplified solutions of the Navier-Stokes equations, and test correlations.
Prereq: MAE 341

MAE 548 Engineering Economics and Technology Valuation (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 548
Value-based assessment and management of engineering/technology projects: equivalence; discounted cash flow; taxes/depreciation; financial statements. Risk-adjusted valuation: risk/uncertainty in staged projects; Monte Carlo simulations; decision trees; real options; project portfolio management.
Prereq: MAT 296
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 551 Energy Conversion (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 551
Energy demand and resources. Fundamentals of combustion. Power plants, refrigeration systems. Turbines and engines. Advanced systems. Direct energy conversion. Alternate energy sources. Energy storage. Costs and environmental impact.
Prereq: MAE 251

MAE 552 Building Environmental Measurements and Controls (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 552
Fundamentals of building ventilating methods for measuring and controlling indoor environmental conditioning, thermal comfort, and indoor air quality.
Prereq: MAE 341 and 355

MAE 553 HVAC Systems Analysis and Design (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 553
Fundamentals of moist air properties, basic air conditioning processes, heat transfer in building structures, heating and cooling load calculations, and air distribution systems.
Prereq: MAE 251
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 554 Principles of Refrigeration (3 Credits)
Engineering & Comp Sci
Basic thermodynamic analysis of refrigeration cycles. Components selection. Environmental issues and recent developments in the refrigeration and the air conditioning industry.
Prereq: MAE 251

MAE 555 Fundamentals of Nano-Science & Nano-Engineering (3 Credits)
Engineering & Comp Sci
Definition of nano-, micro- and macro- scales. Overview of nanotechnology. Molecular and surface forces at the nanoscale. Atomistic definitions of continuum properties. Molecular Simulations. Principles of nanofabrication. Characterization of nanomaterials. Additional paper for graduate students.
Prereq: PHY 212 and MAT 485

MAE 571 Applications of Computational Fluid Dynamics (3 Credits)
Engineering & Comp Sci
Use of commercial Computational Fluid Dynamics (CFD) softwares to solve problems of practical interest. Modeling of fluid/thermal systems. Introduction to CFD algorithms. Simulation, evaluation, and interpretation of CFD results.
Prereq: MAE 341
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

MAE 573 Application of Finite Element Analysis (3 Credits)
Engineering & Comp Sci
Formulation of mechanics and heat transfer problems by finite element analysis. Application of the finite element method using commercial software in the static and dynamic analysis of mechanical components.
Prereq: ECS 325 and MAT 485
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

MAE 580 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MAE 585 Principles of Turbomachines (3 Credits)
Engineering & Comp Sci
Fluid dynamics and thermodynamics of turbomachines. Performance characteristics and analysis of axial and radial turbomachines. Cascade theory. Radial equilibrium equation. Meridional flow analysis. Three dimensional flow characteristics of turbomachines.
Prereq: MAE 251 and MAE 341
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 587 Design of Solar Energy System (3 Credits)
Engineering & Comp Sci
Fundamentals of solar radiation, collectors and storage. Design of solar space heating, cooling; water heating systems. Study of solar electric systems. Economics of solar design; application to heat pumps, energy conservation techniques.
Prereq: MAE 251

MAE 588 Principles of Wind Turbines (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 588, ECS 588
Aerodynamics, performance, control, and electrical aspects wind turbines.
Prereq: MAE 341

Mechanical Engineering

MEE 100 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MEE 200 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MEE 270 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

MEE 285 Intro/Computers in Design (3 Credits)
Engineering & Comp Sci

MEE 290 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by permission of supervising instructor or instructors and the department.
Repeatable

MEE 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MEE 332 Machine Design (4 Credits)
Engineering & Comp Sci
Introduction to the design process. Design and analysis of machine components such as springs, gears, shafts, keys, drive chains and belts.
Prereq: ECS 325 and ECS 222
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

MEE 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MEE 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MEE 416 Mechanical Engineering Laboratory (3 Credits)
Engineering & Comp Sci
Experiments in energy systems, air conditioning & refrigeration systems, turbomachine, heat transfer, fluid dynamics, solid mechanics, and control systems performed in small groups. Written reports and oral presentations required.
Prereq: MAE 251 and MAE 315 and MAE 341 and MAE 355
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

MEE 431 Manufacturing Processes (3 Credits)
Engineering & Comp Sci
Fundamentals of casting, forming, machining, assembly, and other manufacturing processes. Measurement and tolerancing. Design for manufacture and assembly.
Prereq: MAE 284 and ECS 326
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/)

MEE 453 Fund of Therodynamics II (3 Credits)
Engineering & Comp Sci

MEE 454 Air Conditioning (3 Credits)
Engineering & Comp Sci
sychro-metrics, air conditioning for human comfort and industrial processes, heating and cooling loads, air distribution, a/c systems, design project.
Prereq: MAE 251

MEE 456 Applications of Heat Transfer (3 Credits)
Engineering & Comp Sci
Applications of principles of heat transfer to analysis and design of heat-exchange and dissipation devices. Boiling and condensation heat transfer. Aspects of environmental heat transfer, such as thermal pollution and its control.
Prereq: MAE 355

MEE 470 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

MEE 471 Design Practice (3 Credits)
Engineering & Comp Sci
Topics in design methodology and development, professional practice, costing, intellectual property, use of modern engineering tools.
Prereq: MAE 251 and MAE 284 and MEE 332
Shared Competencies: Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Ethics and Integrity (https://coursecatalog.syracuse.edu/shared-competencies/ethics-and-integrity/)

MEE 472 Synthesis of Mechanical Systems (3 Credits)
Engineering & Comp Sci
Second course in the capstone design sequence. Development through completion of design projects. Elements of planning for production and manufacture, sustainability, intellectual property.
Prereq: MEE 471
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

MEE 473 Engineering Design Analysis (3 Credits)
Engineering & Comp Sci
Design problems that integrate the principles of diverse engineering courses. Use of ANSYS as a modeling and analysis tool.

MEE 475 Special Design Project (3 Credits)
Engineering & Comp Sci
Special design project carried out by student under supervision of staff member.

MEE 480 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MEE 483 Acoustics & Noise Control (3 Credits)
Engineering & Comp Sci

MEE 486 Introduction to Nuclear Power (3 Credits)
Engineering & Comp Sci
Application of engineering principles to nuclear power reactors. Relation of nuclear power to present and future world energy sources. Elements of reactor theory. Power removal, utilization, and economics. Design considerations and examinations of nuclear power plants.
Prereq: MAE 251

MEE 487 Design of Solar-Energy Systems (3 Credits)
Engineering & Comp Sci
Solar radiation, collectors, and storage. Design of solar space heating, cooling; water-heating systems. Solar electric systems. Economics of solar design. Applications of heat pumps, energy conservation techniques.
Prereq: MAE 251

MEE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

MEE 499 Honors Capstone Project (1-3 Credits)
Engineering & Comp Sci
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

MEE 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MEE 524 Microprocessors in Mechanical and Manufacturing Engineering (3 Credits)
Engineering & Comp Sci
Introduction to the microprocessor and its various configurations used in controlling machine operations, data acquisition, etc. Project-oriented work involving program development in machine, assembly, and basic languages. Micro-computers used for off-line program development. Not open to electrical and computer engineering students.

MEE 535 Matrls & Procs in Manuf (0 Credits)
Engineering & Comp Sci

MEE 571 Computer Aided Design (3 Credits)
Engineering & Comp Sci
Use CAD software and hardware in the solution of mechanical engineering problems. Computer graphics, computer aided geometry (space curves, splines, patches) design, solid modeling, optimization and an introduction to finite element method.
Prereq: MAE 284 and MAT 485

MEE 584 Noise from Industrial Flow Systems (3 Credits)
Engineering & Comp Sci
Basic fluid mechanics and acoustics. Noise generation by fluid flows and their interaction with solid bodies. Types of noise sources. Analysis and control of such flow noise sources in manufacturing, transportation, propulsion, power generation, and industrial control systems.
Prereq: MAE 341

MEE 585 Fuel & Energy Utilization (3 Credits)
Engineering & Comp Sci

Manufacturing Engineering

MFE 300 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MFE 326 Probability and Statistical Methods for Engineers (4 Credits)
Engineering & Comp Sci
Theory of probability, sampling, estimation, hypothesis testing, quality control techniques. Experimental design and analysis.

MFE 380 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

MFE 400 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MFE 429 System Modeling and Optimization (3 Credits)
Engineering & Comp Sci
Introduction to system modeling and optimization techniques and their applications. Topics include linear programming and its extensions, integer programming, dynamic programming, stochastic modeling, simulation and other system modeling techniques.
Prereq: MAT 397 and MAT 521

MFE 436 Robotics in Manufacturing (3 Credits)
Engineering & Comp Sci
Topics include requirements for robotic application, mechanical considerations, and effectors, sensors, software, applications, and optimization of robotic systems. Laboratory experiments included.

MFE 453 Production Planning and Control (3 Credits)
Engineering & Comp Sci
Problems in designing and controlling manufacturing facilities. Layout design, line balancing, production planning, sequencing, material-requirements planning, group technology, and quality control.
Prereq: MFE 326 and 429

MFE 470 Experience Credit (1-3 Credits)
Engineering & Comp Sci
Participation in a discipline or subject-related experience. Students will be evaluated by written and/or oral report.
Repeatable

MFE 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

MFE 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

MFE 534 Statistical Quality Control (3 Credits)
Engineering & Comp Sci
Controlling product quality through the control of the manufacturing process and acceptance sampling. Industrial project required.
Prereq: MFE 326

MFE 595 Multidisciplinary Analysis and Design (3 Credits)
Engineering & Comp Sci
Interdisciplinary subjects related to engineering, information technology, networking, AI and HTTP.//WWW-based tools. The objective is to use different MAD tools in the product realization process.
Prereq: MEE 571

Materials Science

MTS 421 Introduction to Ceramics (3 Credits)
Engineering & Comp Sci
Ceramics as a class of materials composed of inorganic, nonmetallic components. Development, utilization, and control of properties of ceramic materials.

MTS 431 Physical Metallurgy (3 Credits)
Engineering & Comp Sci
Properties of metals and alloys. Transformations and their consequences in practical systems.

MTS 471 Materials for Engineering Applications (3 Credits)
Engineering & Comp Sci
Deformation and fracture of metals, ceramics, and polymers. Materials for applications at high temperatures, corrosive environments, high strengths, and light weights. Prepares students to select materials for certain engineering functions.

MTS 490 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

MTS 533 Introduction to Theory of Materials (3 Credits)
Engineering & Comp Sci
Theoretical concepts that describe the electronic structure of crystals. Models of electron and ion interactions to correlate electronic, magnetic, and thermal properties of metals, alloys, and compounds.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MTS 537 Introduction to Diffusion in Solids (3 Credits)
Engineering & Comp Sci
Diffusion mechanisms, diffusion equations and their methods of solution.

MTS 570 Nondestructive Testing (3 Credits)
Engineering & Comp Sci
Determination of defects in structural materials. Nondestructive inspection methods include noise emission techniques, X-ray radiography, leak detectors, ultrasonics, magnetic and electrical methods.
Repeatable

MTS 581 X-Ray Diffraction (3 Credits)
Engineering & Comp Sci
Kinematic theory of X-ray diffraction and its applications in materials science. Experimental methods. Integrated intensity, line broadening, and peak shift analyses. Crystal structure. X-ray effects of imperfections in crystals.

Nuclear Energy Track

NUC 301 Introduction to Nuclear Engineering and Reactor Safety (3 Credits)
Engineering & Comp Sci
Importance of nuclear energy to society. Nuclear and radiological engineering. Nuclear energy production. Radioactive waste. Reactor safety
Prereq: PHY 212

NUC 510 Nuclear Reactor Design, Operation and Safety (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 510
Principles of fission reactor analysis and design; reactor kinetics, operation and control; reactor thermo-fluid-dynamics; reactor safety; reactor accident case studies.

NUC 520 Radiochemistry, Nuclear Fuel Reprocessing and Nonproliferation (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 520
Radiochemistry for nuclear reactors and nuclear fuel reprocessing; nonproliferation issues through detection and monitoring, nuclear fuel reprocessing and design, waste vitrification and storage facilities, safety issues in nuclear fuel reprocessing.
Prereq: NUC 301

NUC 530 Electric Power Generation and Distribution (3 Credits)
Engineering & Comp Sci
Fundamental principles governing the electro-mechanical power conversion; transformer; generators; introduction to power distribution systems; reliability and safety issues related to power generation and delivery, particularly in nuclear power plants.3

NUC 540 Experiential Studies in Nuclear Technology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 540
Introduction to experimental methods, procedures and research techniques through projects at participating government facilities, industrial entities or Syracuse University.
Prereq: NUC 301 and (NUC 510 or NUC 520)