COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

J. Cole Smith, Dean
223 Link Hall
eng-cs.syr.edu (https://coursecatalog.syracuse.edu/graduate/
engineering-computer-science/eng-cs.syr.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. 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.

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 ECS 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.

Graduate Program Overview

The College of Engineering and Computer Science was established in 1901, the fifth of the 11 schools and colleges within Syracuse University today. The college is dedicated to graduate as well as undergraduate education in engineering, computer science, systems and information science, and research. Its research efforts contribute significantly to student development as well as to the continued professional growth of the faculty. Graduate education and research, particularly at the Ph.D. level, are inseparable.

Distance Programs

The College of Engineering and Computer Science has a long and proud history of preparing students to produce practical and sustainable solutions for the most important technological, scientific, and social challenges impacting the future. Through our highly interactive online degree programs, students develop the skills to address critical issues ranging from national security threats to building energy efficient systems. Our online master's degree programs take education beyond theoretical learning with inclusive, interdisciplinary, and collaborative experiences that prepare graduates to solve real-world problems.

Through cutting-edge research, curricular innovations, and multidisciplinary collaboration, the **Master of Science in Cybersecurity** prepares students to identify, prevent, and counteract cybercrime. Students in the M.S. in Cybersecurity program develop the expertise to design and develop secure, assured systems. Curriculum focuses on: Design of new systems that are inherently secure; Protection of systems such as web, mobile, and critical infrastructures; Systems assurance through application of mathematical logic; Analysis and detection of malware and other cyberattacks; and Data mining and anomaly detection to identify suspicious cyber behavior.

The **Master of Science in Computer Science** program prepares students to discover groundbreaking solutions to the world's most complex technological challenges. Through a curriculum that places an emphasis on mathematical evaluation, the program prepares students to: Incorporate emerging technologies into new system designs; Develop expertise in areas such as security and assurance, artificial intelligence, computer architecture, and advanced programming; and build the analytical, critical-thinking, and mathematical skills necessary to take on advanced challenges.

The **Master of Science in Computer Engineering** program teaches students to create groundbreaking hardware, software, and assured solutions for new and emerging systems. The M.S. in Computer Engineering curriculum is crafted around our faculty's groundbreaking research in the areas of: Artificial intelligence; Application of data mining methodologies; Assured systems that degrade the face of attack and failure; and the Intersection of computational complexity, formal methods, and programing language semantics. Students learn innovative thinking strategies and solve computer engineering challenges in areas such as security and assurance, network systems, computer architecture, and advanced programming. Students in all of our online programs complete an academically rigorous curriculum and learn in an online environment that mirrors the close interactions of traditional residential degree programs. Courses are taught by many of the same faculty members who teach on campus and faculty are trained in the unique aspects of teaching online. In addition to theoretical learning, our online programs challenge students with inclusive, interdisciplinary experiences that prepare them for real-world applications that enhance their computational, analytical, critical-thinking, and problem-solving skills.

The **Master of Science in Engineering Management program** Master the next challenges in your career with a degree designed specifically for engineering professionals. Our rigorous 30-credit curriculum provides essential leadership, managerial, and technical skills taught by experienced Syracuse University faculty. Gain proficiency in engineering economics, technology management, and business solutions. Integrate technical and business skills to tackle complex problems and find sustainable solutions. Strengthen your knowledge of statistics, product development, simulation, and data analytics.

More information about Syracuse University's College of Engineering and Computer Science online graduate programs can be found at https://www.syracuse.edu/online/

For a complete listing of faculty affiliated with the College of Engineering and Computer Science, see the Faculty section.

Admission

Applicants must complete the application for admission found online at www.applyweb.com/cgi-bin/app?s=syr (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/www.applyweb.com/cgi-bin/app/?s=syr). Please see current guidance on taking standardized tests such as the Graduate Record Examination (GRE) and Test of English as a Foreign Language (TOEFL) as it pertains to your program of interest.

Please note that failure to see that transcripts, letters of recommendation, or standardized test scores may delay processing. It is advisable to apply as early as possible.

Nonmatriculated students may register through University College. Up to 12 credits of nonmatriculated graduate credit may be transferred toward a degree program if the applicant is subsequently admitted. Performance in courses taken for nonmatriculated credit carries considerable weight in evaluating the application.

Graduate Awards

Syracuse University fellowships are awarded competitively from applications received by January 1. Doctoral fellows receive a stipend, plus a tuition scholarship of 30 credits for the academic year. Fellows devote full time to their studies and dissertation research.

Graduate assistantships in the form of research assistantships and teaching assistantships are awarded on a competitive basis from among applications received by the due date corresponding to that program; assistantships are usually not available at any other time of the year. Research assistants are required to assist their sponsoring faculty to perform research. Teaching assistants are required to assist with teaching instruction, while conducting their own graduate study.

Recipients of these assistantships receive a stipend in addition to a tuition scholarship for up to 24 credits per year.

Information about programs to support graduate students from ethnic minority groups (African, Latino, and Native American) that are underrepresented in science and engineering fields can be found in the publication Graduate Study: College of Engineering and Computer Science.

To apply for fellowships or assistantships, check the proper place on the application for admission.

Programs

Master's

- Biomedical Engineering, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/biomedical-engineering-ms/)
- Chemical Engineering, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/chemical-engineering-ms/)
- Civil Engineering, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/civil-engineering-ms/)
- Computer Engineering (Online Program), MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/computer-engineering-online-ms/)
- Computer Engineering, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/computer-engineering-ms/)
- Computer Science (Online Program), MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/computer-science-online-ms/)
- Computer Science, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/computer-science-ms/)
- Cybersecurity (Online Format), MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/cybersecurity-online-ms/)
- Cybersecurity, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/cybersecurity-ms/)
- Electrical Engineering (Distance Format), MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/electrical-engineering-distance-ms/)
- Electrical Engineering, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/electrical-engineering-ms/)
- Engineering Management (Distance Format), MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/engineering-management-distance-ms/)
- Engineering Management, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/engineering-management-ms/)
- Environmental Engineering Science, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/environmental-engineering-science-ms/)
- Environmental Engineering, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/environmental-engineering-ms/)
- Mechanical and Aerospace Engineering, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/mechanical-aerospace-engineering-ms/)
- Operations Research and System Analytics, MS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/operations-research-system-analytics-ms/)

Doctorate

- Biomedical Engineering, PhD (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/biomedical-engineering-phd/)
- Chemical Engineering, PhD (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/chemical-engineering-phd/)
- Civil and Environmental Engineering, PhD (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/civil-environmental-engineering-phd/)
- Computer & Information Science & Engineering, PhD (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/computer-information-science-engineering-phd/)
- Electrical & Computer Engineering, PhD (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/electrical-computer-engineering-phd/)
- Mechanical and Aerospace Engineering, PhD (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/mechanical-aerospace-engineering-phd/)

Combined

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

Certificate of Advanced Study

- Public Infrastructure Management and Leadership, CAS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/public-infrastructure-management-leadership-cas/)
- Sustainable Enterprise (CASSE), CAS (https://coursecatalog.syracuse.edu/graduate/engineering-computer-science/sustainable-enterprise-casse-cas/)

Faculty

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

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

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

Benjamin Akih-Kumgeh, Associate Professor

Undergraduate Program Director of Aerospace Engineering
PhD, 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

Christian Aponte-Rivera, Assistant Professor
PhD, Cornell University, 2017
Polymer composites, disordered proteins, and materials for energy applications

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

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

Michelle Blum, Teaching Professor
Associate Dean for Student Affairs
PhD, 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
Ph.D. University of Wisconsin, Madison 2009
Heterogeneous catalysis, Kinetics, Reaction engineering, and Alternative resource utilization

Katie D. Cadwell, Teaching 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

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

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

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

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, 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

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

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

Ehat Ercanli, Associate Teaching Professor, Associate Chair of 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

Fabrizio Sabba, Assistant Professor
Ph.D., University of Notre Dame, 2017
Bioprocesses for Wastewater Engineering, Applied Environmental Microbiology, Environmental biotechnology, Microbial Ecology of Engineered and Impacted natural systems, Microbial nitrogen and phosphorus cycling, Sustainable biological wastewater treatment, Resource and Energy Recovery from Waste, Microbial Greenhouse Gas Emissions, Biofilms and Biofilm Reactors, Mathematical Modeling of Bioprocesses

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

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, Operations Research and Systems Analytics Master's Program Director
Ph.D., The University of North Carolina at Chapel Hill, 1997
Performance 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

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

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

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 System

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

Garrett 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 Kim, Assistant Professor
Ph.D. Computer Science and Engineering, Seoul National University
Data storage systems, devices, and technologies, data-intensive applications and systems, and file systems and database management systems

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
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

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, Biomedical and Chemical Engineering Graduate Program Director
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, MAE Graduate Program Director
Ph.D., University of Florida, 2009
Multi-scale transport phenomenon, Thermal Management and Bio-mechanical Systems

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

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

Chilukuri K. Mohan, Professor,

Ph.D., State University of New York at Stony Brook, 1988
Machine learning, neural networks, evolutionary algoriths, bioinformatics, anomaly detection

Mary Beth Monroe, Associate 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

Shikha Nangia, Professor; Biomedical and Chemical Engineering Department Chair
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

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

Joao 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 Patterns, Data Structures

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

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

Chae Woon Jeong-Potter, Assistant Professor
PhD, Columbia University, 2021
Carbon capture and utilization, direct air capture, carbon dioxide removal, decarbonization, heterogeneous catalysis, electrified processes (e.g., plasma, induction, joule-heating), energy justice, science and engineering education

Quinn Qiao, Professor, Interim Associate Dean for Research
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

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

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

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

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, Mechanical Engineering Undergraduate Program Director
Ph.D., Syracuse University, 2008
Multi-physics Simulations, 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, Associate 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

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

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

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

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 collection and exploration,

measuring and improving fairness in network structure and network analysis, and characterizing hierarchy and resilience in network structure

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

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

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

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

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

Kun-Hao Yu, Assistant Professor
Ph.D., University of Southern California, 2022
Engineering Materials, Mechanics of Materials, Solid Mechanics, Structural Design, Additive Manufacturing, Sustainable and Bio-Inspired Materials, Engineered Living Materials, Advanced Manufacturing and 3D Printing

Pun To (Douglas) Yung, Associate Professor, Biomedical Engineering Undergraduate Program Director
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, Associate 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 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/)

AEE 600 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 628 Adv Spacecraft Dyn (3 Credits)
Engineering & Comp Sci
Analytical techniques, including dyadic operators for rotational motion, Lambert's theorem and its use in spacecraft mission analysis computer programs, and Bierman's factorized estimation board.

AEE 630 Spacecraft Dynamics & Control (3 Credits)
Engineering & Comp Sci
Stability; spacecraft orbital dynamics and control; Lagrange points; attitude representations like rotation matrix, Euler angles, and Euler parameters; attitude kinematics; attitude determination (Wahba¿s problem); attitude dynamics; inertia tensor; gravity gradient torque; attitude stabilization and control.

AEE 636 Strctral Dynamics/Vehicle (3 Credits)
Engineering & Comp Sci
Static aeroelasticity, unsteady aerodynamics of airfoils and wings, lifting surface flutter, panel flutter, and dynamic response including modal techniques.
Advisory recommendation Prereq: MAE 627

AEE 637 Adv/Mech/Aerospce/Structr (3 Credits)
Engineering & Comp Sci
Structural problems not amenable to elementary analysis, such as swept and delta wings, stresses around cutouts, shear lag, torsion with restrained warping, general instability of stiffened shells, thermal stresses. Matrix and energy methods.

AEE 690 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

AEE 700 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 747 Hypersonic Gas Dyn (3 Credits)
Engineering & Comp Sci
Classification, physical properties of hypersonic flows. Thickness and structure of shock fronts. Real gas effects, relaxation phenomena. Compressible viscous boundary layer flows. Shock layer flows. Two-layer Newtonian flow models. Aerodynamic applications. Hypersonic flow generation, simulation.
Advisory recommendation Prereq: MAE 647

AEE 787 Plasma Dynamics (3 Credits)
Engineering & Comp Sci

AEE 800 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 863 Adv Aerodynamics (0 Credits)
Engineering & Comp Sci

AEE 990 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

AEE 996 Special Project (0-6 Credits)
Engineering & Comp Sci
Repeatable

AEE 997 Masters Thesis (0-9 Credits)
Engineering & Comp Sci
Repeatable

AEE 999 Dissertation (0-15 Credits)
Engineering & Comp Sci
Repeatable

Bioengineering
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

BEN 600 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 601 Graduate Bioengineering and Chemical Engineering Seminar (0-1 Credits)
Engineering & Comp Sci
Cross-listed with CEN 601
Selected topics in bioengineering. Presentations by internal and external speakers, discussions with students.
Repeatable

BEN 602 Ethical Issues in Engineering and Research (1-3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 602
Explores the application of professional norms to ethical decision making in engineering and scientific research. Includes examination of cases in light of the requirements of the Responsible Conduct of Research.

BEN 604 Cells, Tissues,and Systems (3 Credits)
Engineering & Comp Sci
Properties of biological systems from genes to behavior, clinical implications emphasized. Nervous and endocrine organization as control systems, cardiorespiratory system and fluid dynamics, renal system and ion transport, pH balance. Classic and contemporary literature.

BEN 612 BioMEMS, Biosensors & Biophotonics (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 412
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 613 Readings in Neuroscience (0-3 Credits)
Engineering & Comp Sci
Cross-listed with NEU 613, BIO 624, CSD 753, PSY 778
A literature-based team-taught course focusing on in depth discussions of classical or recent papers of exceptional import to neuroscience. Students will complete weekly readings assigned by faculty and participate in a 3-hr/wk group facilitated discussion

BEN 614 Interdisciplinary Methods of Neuroscience (0-3 Credits)
Engineering & Comp Sci
Cross-listed with NEU 614, BIO 625, CSD 754, PSY 779
A practical interdisciplinary survey course whereby neuroscience faculty introduce students to a wide array of methodologies, including molecular, cellular, developmental, systems, behavioral, and cognitive neuroscientific approaches to investigate basic, pre-clinical, translational, and clinical questions to unravel the relationship between brain and behavior.

BEN 621 Biochemical Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 621
Double-numbered with BEN 421, CEN 421
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 622 Immunoengineering (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 422
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 630 Sports Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 430
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 631 Introduction to Global Regulatory Affairs (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 431
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 633 Drug Delivery (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 633
Double-numbered with BEN 433, CEN 433
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 634 Polymer Physics (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 634
Exploration into the physical properties of polymers focusing on polymer theoretical physics, characterization of their physical properties, and the importance of their structure-property relationships in various applications.

BEN 635 Physical Cell Biology (3 Credits)
Engineering & Comp Sci
Cross-listed with PHY 635, CHE 635, BIO 635, CEN 635
This interdisciplinary class for science and engineering students provides an introduction to the quantitative description of biological systems and processes. The focus is on the biological and physical aspects of structure and function of cells and their subsystems.

BEN 638 Open Problems in Soft Interfaces (3 Credits)
Engineering & Comp Sci
Cross-listed with BIO 638, PHY 638, CHE 638, CEN 638
In this seminar course on soft and biological materials and interfaces, teams from science and engineering will identify, discuss and assess current articles from the literature. Writing skills related to publishing peer-reviewed research are introduced.

BEN 641 Mobile Health (mHealth) Device Design and Application (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 441
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 648 Biofluid Dynamics (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 648
Principles of momentum transfer in bioengineering systems. Flight and swimming in nature including flagellar propulsion. Newtonian and non-Newtonian fluid phenomena, including low-Reynolds-number flow, pulsatile and separated flows. Flow past bifurcations. Respiratory and blood circulatory flows.

BEN 650 Environmental Risk Assessment & Toxicology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 650, CEN 650
Double-numbered with BEN 450, CEN 450, CEE 450
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 658 Biomedical Imaging (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 458
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 659 Signal Processing & Analysis of Bioelectric Signals (3 Credits)
Engineering & Comp Sci
Origins and properties of bioelectric signals and noise. Digital signal processing. Theory of signal detection: applications to psychophysics. Noise reduction techniques: time averaging, spectral analysis and filtering, optimal filterings. Analysis of neural spike trains: point processes.
Advisory recommendation Prereq: ELE 251, 232, 351

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

BEN 664 Quantitative Physiology (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 364
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.
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 666 Advanced Biomechanics (3-4 Credits)
Engineering & Comp Sci
Double-numbered with BEN 466
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.
Advisory recommendation Prereq: BEN 665

BEN 670 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

BEN 673 Biomanufacturing (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 673
Double-numbered with BEN 473, CEN 473
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/)

BEN 674 Medical Image Processing & Analysis (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 474
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 687 Advanced Bioengineering Design (3 Credits)
Engineering & Comp Sci
Bioengineering solution development experience. Team development of a bioengineering innovation. Brainstorm, design, iterate and test hypotheses. Lecture and experiential learning. Hands on concept development and evaluation, bioengineering industry exposure, visual management, oral, and poster presentations.

BEN 690 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

BEN 706 Nonlinear Dynamics and Electrophysiology of the Heart (3 Credits)
Engineering & Comp Sci
The electrical activity of the heart, nonlinear dynamics theory and computer modeling of mechanisms of complex cardiac rhythms. Specific topics include electrical excitation and propagation in the heart, cell-to-cell communication, and cardiac arrhythmias.

BEN 741 Biopolymers (3 Credits)
Engineering & Comp Sci
Polymer structure, physical properties, and clinical applications of natural and synthetic biomedical polymers. Polymer synthesis, structural and molecular characterization, material properties, polymer processing, biocompatibility, and polymer degradation will be discussed.
Advisory recommendation Prereq: BEN 668

BEN 765 Orofacial Biomechanics (3 Credits)
Engineering & Comp Sci
Methods (instrumentation, data collection and reduction, modeling) for the analysis of structure and function of the orofacial complex and its constituent elements (jaws, teeth, muscles, tongue, pharynx) and their CNS control in feeding and speech.
Advisory recommendation Prereq: BEN 465 or 665

BEN 768 Surfaces of Biomaterials (3 Credits)
Engineering & Comp Sci
Metallic, ceramic, and polymeric surfaces used in biomaterials. Surface forces, structure, chemistry, electrochemical behavior of surfaces, and corrosion reactions related to material-body interactions will be discussed and surface-analytical techniques present.

BEN 991 Introduction to MS Research (3 Credits)
Engineering & Comp Sci
Preliminary research and investigation on a topic of interest under supervision of a member of the faculty.

BEN 996 Masters Project (0 Credits)
Engineering & Comp Sci
Investigation of a bioengineering problem. An oral defense is required in accordance with current departmental guidelines. Required of all students electing the non-thesis option for a master¿s degree.

BEN 997 Masters Thesis (3 Credits)
Engineering & Comp Sci
Independent investigation on a topic of interest under supervision of a member of the faculty.
Advisory recommendation Prereq: BEN 991

BEN 999 Dissertation (1-15 Credits)
Engineering & Comp Sci
Research work on a doctoral dissertation under the supervision of a member of the faculty.
Repeatable 15 times for 30 credits maximum

Chemical Engineering

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

CEN 600 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 601 Graduate Bioengineering and Chemical Engineering Seminar (0-1 Credits)
Engineering & Comp Sci
Cross-listed with BEN 601
Selected topics in bioengineering. Presentations by internal and external speakers, discussions with students.
Repeatable

CEN 602 Ethical Issues in Engineering and Research (1-3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 602
Explores the application of professional norms to ethical decision making in engineering and scientific research. Includes examination of cases in light of the requirements of the Responsible Conduct of Research.

CEN 621 Biochemical Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 621
Double-numbered with BEN 421, CEN 421
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 629 Methods in Materials Characterization (3 Credits)
Engineering & Comp Sci
Double-numbered with CEN 429
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 632 Behavior of Fluid-Particle Systems (3 Credits)
Engineering & Comp Sci
Mechanical, electrical, and physiochemical behavior of aerosol particles. Theories of deposition and filtration of particles from gases. Experimental methods for measuring particle size distributions.

CEN 633 Drug Delivery (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 633
Double-numbered with BEN 433, CEN 433
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 634 Polymer Physics (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 634
Exploration into the physical properties of polymers focusing on polymer theoretical physics, characterization of their physical properties, and the importance of their structure-property relationships in various applications.

CEN 635 Physical Cell Biology (3 Credits)
Engineering & Comp Sci
Cross-listed with PHY 635, CHE 635, BIO 635, BEN 635
This interdisciplinary class for science and engineering students provides an introduction to the quantitative description of biological systems and processes. The focus is on the biological and physical aspects of structure and function of cells and their subsystems.

CEN 638 Open Problems in Soft Interfaces (3 Credits)
Engineering & Comp Sci
Cross-listed with BIO 638, PHY 638, CHE 638, BEN 638
In this seminar course on soft and biological materials and interfaces, teams from science and engineering will identify, discuss and assess current articles from the literature. Writing skills related to publishing peer-reviewed research are introduced.

CEN 643 Fluid Dynamics (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 643
Review of undergraduate fluids; kinematics, vorticity; dynamics, stresses, Euler and Navier-Stokes equations; energy, Bernoulli's equation; potential flows; Stokes flows; boundary layers; flow separation; other applications.
Advisory recommendation Prereq: MAE 341 or CEN 333

CEN 645 Introduction to Transport Phenomena (3 Credits)
Engineering & Comp Sci
Parallel, systematic treatment of momentum, energy, and mass transfer processes. Problem formulation by "shell balances" and the use of general conservation equations. Applications include the description of velocity, temperature, and concentration profiles.

CEN 650 Environmental Risk Assessment & Toxicology (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 650, CEE 650
Double-numbered with BEN 450, CEN 450, CEE 450
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 651 Molecular and Statistical Thermodynamics (3 Credits)
Engineering & Comp Sci
Double-numbered with CEN 451
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.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEN 655 Materials for Energy Systems (3 Credits)
Engineering & Comp Sci
Double-numbered with CEN 455
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 661 Environmental Chemistry and Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 671
Double-numbered with CEE 471, CEN 461
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.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

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

CEN 666 Heterogeneous Catalysis (3 Credits)
Engineering & Comp Sci
Surface chemistry and modern methods in analysis of catalytic systems. Special consideration will be given to green chemistry and sustainability.

CEN 670 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 671 Chemical Engineering Methods I (3 Credits)
Engineering & Comp Sci
Use of fundamental physical, chemical and mathematical principles involving chemical engineering problems. Problems associated with transport theory and chemical kinetics requiring the solution of partial differential equations using orthogonal function expansions. Duhammel's theorem and other techniques.

CEN 672 Applied Env Microbiology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 672
Double-numbered with CEE 472, CEN 472
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 673 Biomanufacturing (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 673
Double-numbered with BEN 473, CEN 473
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 687 Advanced Chemical Engineering Design (3 Credits)
Engineering & Comp Sci
Chemical Engineering Masters Project, to be completed by each student as an individual advanced design project, involving a chemical process synthesis. Students are expected to apply mathematical and engineering concepts to complete the design calculations.

CEN 690 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 691 Chemical Engineer Problem (1-3 Credits)
Engineering & Comp Sci

CEN 700 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 741 Transport Phenomena I (3 Credits)
Engineering & Comp Sci
Tensor analysis. Reynold's transport theorem. Constitutive equations for stress. Momentum transport equations. Creeping flow, nonviscous flow, boundary layer flow. Flow through porous media. Turbulence. Energy transport equation. Conduction, natural and forced convection solutions. Boundary layer heat transfer.
Advisory recommendation Prereq: CEN 542, 671

CEN 742 Transport Phenomena II (3 Credits)
Engineering & Comp Sci
Multicomponent molecular and convective diffusion. Associated boundary value problems. Limitations of analogies for heat, mass, and momentum transfer. Boundary layer calculations. Eddy diffusion. Interphase energy and mass transport. Interfacial phenomena.
Advisory recommendation Prereq: CEN 741

CEN 743 Transport Phenomena III (3 Credits)
Engineering & Comp Sci
Selected topics, such as "Introduction to Statistical Theory of Turbulence." Probability theory, statistical mechanical concepts. Cartesian tensors. Correlation functions. Energy spectrum. Turbulent diffusion. Diffusion and reaction in boundary layers.
Advisory recommendation Prereq: CEN 742, 772

CEN 752 Chemical Engineering Thermodynamics II (3 Credits)
Engineering & Comp Sci
Foundations of chemical equilibrium computation. Mathematical structure of the chemical equilibrium problem. Methods based on optimization techniques. Methods based on the solution of non-linear equations. Consideration of nonideality and condensed phases. Industrial application.
Advisory recommendation Prereq: CEN 651, 671

CEN 761 Rheology &Polymer Process (3 Credits)
Engineering & Comp Sci
Introduction to flow phenomena in polymeric fluids; the non-Newtonian rheological behavior of polymer solutions and melts; constitutive relations for the flow properties; applications in polymer processing; characterization of polymer mechanical properties, morphology and structure.
Advisory recommendation Prereq: CEN 741

CEN 775 Separation Processes (3 Credits)
Engineering & Comp Sci
Diffusion as a kinetic-molecular phenomenon. Steady-state cascade theory. The ideal cascade. Squared-off and square cascades. Criteria of cascade optimization. Gaseous diffusion processes. Membrane separation processes, selective permeation of gases, vapors, and liquids; reverse osmosis and water desalination, electrodialysis.

CEN 776 Multicomponent Separation Processes (3 Credits)
Engineering & Comp Sci
Multicomponent distillation. Extractive and azeotropic distillation. Gas adsorption and stripping, cryogenic separation and purification processes. Fixed-bed gas and vapor adsorption. Unsteady-state behavior of cascades.

CEN 786 Kinetics (3 Credits)
Engineering & Comp Sci
Homogenous reactions: tubular and stirred reactors, axial and radial transport. Residence time distribution. Heterogenous reactions-catalytic: rates, pores, transport, in fixed and fluid beds, non-catalytic reaction and growth of new phases.
Advisory recommendation Prereq: CEN 587, 651, 671

CEN 787 Multiphase Reactive Systems (3 Credits)
Engineering & Comp Sci
Multicomponent mass transport with reaction in two-phase dispersions, particularly liquid extractions. Convective diffusion with reaction, turbulent mass transport, population balance and simulation models, two-phase flow models, reactor/extractor design. Application of models to design gas-liquid-solid slurry may also be covered.
Advisory recommendation Prereq: CEN 587, 742

CEN 790 Advanced Topics in Chemical Engineering (1-3 Credits)
Engineering & Comp Sci
Recent advances in chemical engineering science.
Repeatable

CEN 890 Advanced Topics In Chemical Engineering (3 Credits)
Engineering & Comp Sci
Recent advances in chemical engineering research, including experimental techniques.
Repeatable

CEN 990 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 991 Introduction to MS Research (3 Credits)
Engineering & Comp Sci
Preliminary research and investigation on a topic of interest under supervision of a member of the faculty.

CEN 996 Masters Project (0 Credits)
Engineering & Comp Sci
Investigation of a chemical engineering problem. An oral defense is required in accordance with current departmental guidelines. Required of all students electing the non-thesis option for a master¿s degree.

CEN 997 Masters Thesis (3 Credits)
Engineering & Comp Sci
Independent investigation on a topic of interest under supervision of a member of the faculty.
Advisory recommendation Prereq: CEN 991

Civil and Environmental Engineering

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

CEE 600 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

CEE 601 Construction Engineering and Project Management (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 401
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 605 Construction Estimating and Scheduling (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 405
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 609 Environmental Data Science (3 Credits)
Engineering & Comp Sci
Cross-listed with EAR 609
Introduction to data science methods for environmental analysis in the R and Python programming languages. Reproducible scientific computing; open geospatial data sources; common structures of environmental data; space/time applications of supervised machine learning; and high throughput computing.

CEE 613 Physical Hydrology (3 Credits)
Engineering & Comp Sci
Cross-listed with EAR 613
Double-numbered with CEE 413, EAR 413
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 615 Timber Design (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 415
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.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEE 629 Reliability of Civil Systems (3 Credits)
Engineering & Comp Sci
Probability-based risk assessment. Probability modeling of load and resistance processes. Probability distribution and cumulative density functions. Extreme value problems. First and second order reliability analyses of series and parallel civil engineering systems.

CEE 630 Environmental Organic Chemistry (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 430
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.

CEE 631 Classical and Matrix Structural Analysis (3 Credits)
Engineering & Comp Sci
Analysis of cables and arches using classical method. Linear and nonlinear analyses of trusses and frames using matrix method. Modeling and analysis of special structures.

CEE 632 Structural Dynamics and Earthquake Engineering (3 Credits)
Engineering & Comp Sci
Dynamic response of single- and multi-degree-of-freedom structures. Time domain and frequency domain analyses. Linear and nonlinear systems. Applications to earthquake engineering. Blast loading and soil-structure interaction effects.

CEE 633 Finite Element Analysis (3 Credits)
Engineering & Comp Sci
Fundamentals and techniques of modern finite analytical methods, including the finite element and finite difference methods. Application to elasticity, plate, shell seepage, torsion, and fracture mechanics problems.

CEE 634 Stability Analysis of Structural Systems (3 Credits)
Engineering & Comp Sci
Stability analysis of bars, arches, plates and shells. Stability criteria. Analytical and numerical solutions to stability problems. Effects of geometrical imperfections and material nonlinearity. Design considerations for stability.

CEE 635 Adv Reinforced Concrt Des (3 Credits)
Engineering & Comp Sci
Relation of straight line and ultimate theories to the analysis and design of reinforced an prestressed concrete structures.

CEE 636 Plstc Des/Steel Strctures (3 Credits)
Engineering & Comp Sci
Design of steel structures using plasticity theory. Concept of plastic hinge and collapse mechanism. Lower and upper bound theorems. Equilibrium and mechanism methods for the analysis and design of continuous beams and frames.

CEE 637 Adv Soil Mech Fndtns I (3 Credits)
Engineering & Comp Sci
Physiochemical studies of soils land soil behavior. Stress distribution in soil masses. Immediate and time-dependent compression of soils. Settlement analysis. Seepage through foundations and earth structures.

CEE 638 Adv Soil Mech&Foundtns II (3 Credits)
Engineering & Comp Sci
Shear strength of soils. Bearing capacity and slope stability analyses. Earth pressures and analysis of retaining structures. Soil dynamics.

CEE 639 Sustainable Development and Infrastructure Management (3 Credits)
Engineering & Comp Sci
Cross-listed with ECS 636
Introduction to public infrastructure systems. Management of infrastructure systems. Monitoring, planning, design, construction, maintenance/rehabilitation and operation. Emphasis on water, storm water, waste water, transportation, electrical power distribution and telecommunications systems.

CEE 641 Seepage & Earth Dam Desgn (3 Credits)
Engineering & Comp Sci
Types of earth dams. Method of construction. Case histories. Stability of dams. Seepage-flow nets. Effective stress analysis. Darcy's law. Estimation of flow. Design of filters. Instrumentation. Design of dams for earthquake forces.
Advisory recommendation Prereq: CEE 337

CEE 642 Treatment Processes in Environmental Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 442
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.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CEE 643 Transportation Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 443
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.

CEE 648 Building Environmental Modeling and Simulations (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 658
Building environmental analysis; contaminant source and sink models; single-zone, multizone, and computational fluid dynamics models.
Advisory recommendation Prereq: MAE 341 and MAE 355

CEE 649 Building Materials and Envelope (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 659
Understanding of heat, air and moisture transfer effects on building envelope/enclosure through linking material properties, assembly design and hygorthermal performance with structural and mechanical considerations. Introduction to advanced computational tools for building enclosures.

CEE 650 Environmental Risk Assessment & Toxicology (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 650, CEN 650
Double-numbered with BEN 450, CEN 450, CEE 450
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 651 Physical-Chemical Process (3 Credits)
Engineering & Comp Sci
Principles used in the analysis and design of physical-chemical water/waste-treatment processes.

CEE 652 Biologicl Waste Treatment (3 Credits)
Engineering & Comp Sci
Theories and Advanced design concepts for aerobic, anoxic and anaerobic system applications.

CEE 653 Applied Aquatic Chemistry (3 Credits)
Engineering & Comp Sci
Principles of aquatic chemistry applied to the solution of environmental engineering problems. Includes acid-base, carbonate, precipitation-dissolution, coordination, and oxidation-reduction chemistry.
Advisory recommendation Prereq: CEE 471 or CEE 671

CEE 657 Biogeochemistry (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 457
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.
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 659 Advanced Hydrology (3 Credits)
Engineering & Comp Sci
Development of advanced theories of hydrologic action: precipitation frequencies, precipitation-runoff relations, magnitude and frequency of maxima and minima; interpretation and application of these theories.

CEE 660 Seminar Civil Engineering (0 Credits)
Engineering & Comp Sci
Research report presentations by students and visiting specialists in civil engineering and associated sciences and professions. Required each semester of all M.C.E. candidates.
Repeatable

CEE 662 Chem/Soil & Natural Srfcs (3 Credits)
Engineering & Comp Sci
General principles. Chemical properties of soils, nature of surfaces, soil formation, soil minerals, and mechanisms regulating solute chemistry in soil solutions.

CEE 663 Introduction to Sustainable Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 463
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 665 Modern Urban Infrastructure (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 465
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 666 Design of Concrete Bridges (3 Credits)
Engineering & Comp Sci
Analysis and design of highway concrete bridges. Bridge economics, aesthetics, construction, load distribution, and design using load resistance factor design (LRFD). Analysis of stresses and deformations, and the relation to AASHTO-LRFD Design Specifications.

CEE 670 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 671 Environmental Chemistry and Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 661
Double-numbered with CEE 471, CEN 461
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.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

CEE 672 Applied Env Microbiology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 672
Double-numbered with CEE 472, CEN 472
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 673 Transp Procss/Env Engrng (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 473
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.
Advisory recommendation Prereq: CEE 327 or MAE 341, CEE 341

CEE 676 Multiscale Material Modeling and Simulations (3 Credits)
Engineering & Comp Sci
Advanced computational and theoretical tools to model and simulate the behavior of materials from the fundamental building blocks to the continuous functional form at multiple scale levels.

CEE 677 Design of Structural Systems (3 Credits)
Engineering & Comp Sci
Planning, analysis, and design of structural systems, e.g. buildings and bridges. Structure economics, aesthetics, construction, analysis, and design will be presented. Reference will be made to the AASHTO-LRFD Specifications, and the International Building Codes.

CEE 678 Rehabilitation of Civil Infrastructure (3 Credits)
Engineering & Comp Sci
Double-numbered with CEE 478
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.
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 687 Environmental Geostatistics (3 Credits)
Engineering & Comp Sci
Cross-listed with GEO 687
Statistical analysis of spatial patterns in environmental data. Exploratory data analysis; estimation, modeling, and interpretation of variograms; prediction using driging. Applications in engineering, geography, earth science and ecology. Use of geostatistical software.

CEE 690 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

CEE 737 Applied Soil Mechanics (3 Credits)
Engineering & Comp Sci
Shallow and deep foundations, buried structures, and earth structures.
Advisory recommendation Prereq: CEE 638

CEE 739 Soil Stabilization (3 Credits)
Engineering & Comp Sci
Principles and practice of stabilization techniques for soil and rock material: chemical, mechanical electrosmosis, chemical and cement grouting, de-watering, heating, and dynamic consolidation.
Advisory recommendation Prereq: CEE 637

CEE 740 Soil Dynamics (3 Credits)
Engineering & Comp Sci
Earthquakes: magnitude, intensity, design acceleration history, response spectra, soil behavior under dynamic loads, wave propagation, shear modulus and damping dynamic analysis, design of retaining walls, shallow foundations and deep foundation for earthquakes.
Advisory recommendation Prereq: CEE 637

CEE 764 Industrial Hygiene Eng (3 Credits)
Engineering & Comp Sci
Environmental hazards to human health. Toxic properties of industrial dusts, gaseous contaminants, and ionizing radiations. Theories and principles of maximum permissible doses. Control techniques.

CEE 789 Special Investigtns/CEE (3 Credits)
Engineering & Comp Sci
Special investigations and research in civil engineering designed to meet the needs of individual students.
Repeatable

CEE 995 Master's Exit Paper (0 Credits)
Engineering & Comp Sci
Written paper on a topic in civil or environmental engineering, supervised by a faculty advisor and submitted in accordance with current departmental guidelines.

CEE 996 Master's Project (3 Credits)
Engineering & Comp Sci
Investigation of a civil engineering or environmental engineering or science problem. A written report is required in accordance with current departmental guidelines. Required of all students electing the non-thesis option for a master's degree.
Repeatable

CEE 997 Masters Thesis (0-6 Credits)
Engineering & Comp Sci
Research thesis on some phases of engineering to be selected by student and approved by department chair.
Repeatable

CEE 999 Dissertation (0-15 Credits)
Engineering & Comp Sci
Research Studies directed to the dissertation under supervision of member of Graduate School faculty.
Repeatable

Computer and Information Science

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

CIS 600 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 607 Mathematical Basis for Computing (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 607
Mathematical logic including predicate calculus, induction, theories with equality relations and groups. Mathematical logic applied to structures like nonnegative integers, tuples, lists, and trees.

CIS 612 Cloud Computing (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 612
Virtualized data centers, including virtual machine management, power management, and networking; cloud computing applications; and mobile cloud computing.

CIS 623 Assured Programming with Formal Methods (3 Credits)
Engineering & Comp Sci
Reasoning about programs and secure systems. Specification-based, test-driven program development and verification. Development of programs using software tools for secure software systems.

CIS 624 Fundmntls (3 Credits)
Engineering & Comp Sci

CIS 625 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. Programming project required.

CIS 626 Theoretical Foundations of Computer Science (3 Credits)
Engineering & Comp Sci
Computability and decidability, first-order logic, lambda calculus systems, program verification, semantics of programming languages, theory of language.
Advisory recommendation Prereq: CIS 607

CIS 628 Introduction to Cryptography (3 Credits)
Engineering & Comp Sci
Classical and public-key cryptography. Topics include classical cryptosystems and their cryptanalysis, RSA and other public key cryptosystems, pseudo-random sequences, zero-knowledge protocols, related ethical and social concerns.
Advisory recommendation Prereq: (CIS 477 or 675) or (MAT 534 or 541)

CIS 629 Blockchain: Foundation and Applications (3 Credits)
Engineering & Comp Sci
Cross-listed with FIN 629
Bitcoin principles, Blockchain foundation, peer-to-peer networks, distributed ledgers and blockchain programming. Programming-oriented topics include transactions, smart contracts, token applications, and efficiency. Domain applications include financial intermediaries, supply-chains and other emerging areas. Basic programming/scripting skills (e.g., python or javascript) are required.

CIS 631 Compiler Design (3 Credits)
Engineering & Comp Sci
Development of the logical design of a compiler: lexical analyzer, parser, symbol table, error routines, code generator, and code optimizer. Analysis of formal algorithms for each component, description of overall compiler-construction techniques.

CIS 632 Modeling Concurrent Systems (3 Credits)
Engineering & Comp Sci
Formal methods for specifying, modeling, and analyzing concurrent systems, and mathematical basis for such methods. Automated and semi-automated tools to apply these methods to analyze emergent behavior of computing related applications.
Advisory recommendation Prereq: CIS 607/CSE 607

CIS 634 Assurance Foundations (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 634
Foundational theory, concepts, and computer-assisted reasoning tools necessary for assurance. Topics include functional programming, theorem proving, and logic for reasoning about access control, security, and trust.

CIS 635 Adv Comp Programming (3 Credits)
Engineering & Comp Sci

CIS 637 Multiagent Systems: Concepts and Programming (3 Credits)
Engineering & Comp Sci
Double-numbered with CIS 437
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.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

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

CIS 645 Graph Theory (3 Credits)
Engineering & Comp Sci
Cross-listed with MAT 645
Fundamentals of graph theory and special topics including networks, matching, connectivity, planarity, and automorphism groups.
Advisory recommendation Prereq: MAT 531

CIS 646 Enumeration, Designs, and Matroids (3 Credits)
Engineering & Comp Sci
Cross-listed with MAT 646
Generating functions, Polya enumeration, set systems, design parameters, finite projective planes, matroids.
Advisory recommendation Prereq: MAT 531

CIS 651 Mobile Application Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 651
Double-numbered with CIS 444, CSE 444
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.

CIS 652 Building Assured Components (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 652
Development of system components with provable functional properties. Students gain hands-on experience walking the virtuous cycle of executable specifications, formal verification, and translation of specifications into a mainstream language.
Advisory recommendation Prereq: CIS 634

CIS 655 Computer Architecture (3 Credits)
Engineering & Comp Sci
Computer-architecture characteristics and their effect on the design and performance of programs. Price-performance tradeoffs, instruction set design, memory hierarchies, pipelining, storage systems, selected topics in parallel architectures. Architecture of specified computers.
Advisory recommendation Prereq: CIS 341

CIS 656 Concepts in Concurrent Programming (3 Credits)
Engineering & Comp Sci
Introduction to concurrent programming. Programming-language features for expressing concurrent execution (processes), process communication, and process synchronization; methods of proving properties of concurrent programs, techniques for implementing concurrent systems.
Advisory recommendation Prereq: CIS 623

CIS 657 Principles of Operating Systems (3 Credits)
Engineering & Comp Sci
Design and implementation of operating systems. Process and memory management, resource scheduling, synchronization, file system management, I/O and kernel services and structuring.
Advisory recommendation Prereq: CIS/CSE 486

CIS 661 Logic Programming 1 (3 Credits)
Engineering & Comp Sci
Formal logic as a programming language. Use of theorem prover as interpreter for programming languages, particularly Horn clause systems. Representation of problem transformations of programs. Applications, including natural-language processing, database representation, and query and expert systems; extensions of Horn clause formalisms.

CIS 662 Introduction to Machine Learning & its Algorithms (3 Credits)
Engineering & Comp Sci
Linear regression, logistic regression, classification, clustering, and tree-based machine learning; feature extraction and selection; bias-variance trade-off; probabilistic and statistical analyses of learning models and algorithms. Programming assignments.

CIS 663 Biometrics (3 Credits)
Engineering & Comp Sci
Foundational principles, concepts, and the formulation of algorithms used in biometrics. Analysis of fingerprint, face, gait, keystrokes, etc. Pattern recognition approach to design and analysis of biometric systems. Security of biometric systems.

CIS 665 Computer Vision (3 Credits)
Engineering & Comp Sci
Image formation, edge detection, filtering, stereo vision, surface orientation. Optical flow, boundary detection, region growing, texture, motion analysis, representation of two- and three-dimensional objects. Knowledge representation issues for computer vision.

CIS 666 Expert Systems (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 683
Production rules, forward/backward chaining, Rete algorithm, structured objects, introduction to an expert system language/shell, probabilistic inference networks, fuzzy logic, knowledge acquisition, and explanation generation. Programming project or term paper required.

CIS 667 Introduction to Artificial Intelligence (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 684
Double-numbered with CIS 467
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.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CIS 668 Natural Language Processing (3 Credits)
Engineering & Comp Sci
Double-numbered with CIS 468
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 669 Data Science Capstone (3 Credits)
Engineering & Comp Sci
Capstone course for MS in Data Science students. Focus on solving real-world and industry-inspired problems and generating professional data products.
Prereq: CSE 581 and MAT 695

CIS 670 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 671 Introduction to the Theories of Computation and Complexity (3 Credits)
Engineering & Comp Sci
Graduate- level survey of regular languages, finite state machines, elementary theory of computation, classification of unsolvable problems, elementary computational complexity theory, NP-completeness, and related notions.
Advisory recommendation Prereq: CIS 607

CIS 672 Mathematical Logic I (3 Credits)
Engineering & Comp Sci
First order logics and interpretations. Godel-Henkin completeness theorem, Herbrand's Theorem, compactness theorem, and the Lowenheim-Skolem Theorem. Basic model theory with applications to the theory of fields. Categoricity in power.

CIS 675 Design and Analysis of Algorithms (3 Credits)
Engineering & Comp Sci
Asymptotic analysis and recurrences; classical numeric algorithms; advanced data structures; graph algorithms; divide-and-conquer, greedy choice, dynamic programming, and other computational strategies; NP-completeness.
Advisory recommendation Prereq: CIS 607/CSE 607

CIS 678 Quantum Computing (3 Credits)
Engineering & Comp Sci
Purpose of QC; quantum registers; quantum state transitions; classical vs quantum models of computation; quantum cellular automata and Hilbert Space 12; no-cloning theorem; quantum teleportation; quantum logic.
Advisory recommendation Prereq: CIS 607/CSE 607, MAT 397 OR MAT 331

CIS 681 Software Modeling and Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 681
Project-based course covering software modeling, architecture, design, and implementation using diagramming, analysis tools, and common sense engineering methods to analyze performance of concurrent, message-driven systems.

CIS 685 Simulation & Modelling (3 Credits)
Engineering & Comp Sci
Use of the digital computer for simulation systems. Modeling, construction of flowcharts, fixed-time increment and time-status register methods of simulating, simulation languages, generation of random numbers, experimental design, and analysis of simulated data.
Advisory recommendation Prereq: IOR 525, 526, or MAT 521, 525

CIS 686 Discrete Event Systems (3 Credits)
Engineering & Comp Sci
A spectrum of discrete event models used to describe and analyze discrete event systems will be covered including automata, Petri nets, Markov chains, and introductions to queuing models and discrete event simulation.
Advisory recommendation Prereq: ECS 525 or MAT 521 or ELE 606

CIS 687 Object Oriented Design (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 687
Basic methods of object oriented software design and implementation. Object oriented software engineering methodologies: specification, hierarchical decomposition, reuse and extensibility. Implementation of projects in object oriented programming language and analysis of design case studies.

CIS 688 Internet Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 686
A laboratory projects course. Programming models on web clients and servers. Topics include: browser and server object models, tagged languages, emphasizing HTML and XML, ASP programming, and database connectivity.

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

CIS 690 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 700 Selected Topics In CIS (1-6 Credits)
Engineering & Comp Sci
A variety of subjects surveyed or a particular subject in depth.
Repeatable 4 times for 12 credits maximum

CIS 712 Data Parallel Computing (3 Credits)
Engineering & Comp Sci
Languages and algorithms for massively parallel computation on SIMD architectures. Illustrations drawn from applications such as shortest path determination, connected components, N-body problems, graphics, differential equations, simulated annealing, calculation in finite fields. Substantial programming project.
Advisory recommendation Prereq: CIS 623

CIS 731 Artificial Neural Networks (3 Credits)
Engineering & Comp Sci
Perceptrons and feedforward networks. Backpropagation. Self-organizing feature maps and Boltzmann machines. Deep networks, convolutional networks, recurrent networks, adversarial networks, sparse networks. Attention mechanism, transformers, and generative models. Applications of neural networks.
Advisory recommendation Prereq: CIS 662

CIS 735 Machine Learning for Security (3 Credits)
Engineering & Comp Sci
Foundational principles of machine learning (ML) algorithms as applied to security. Feature extraction and selection; supervised and unsupervised learning classifiers; performance evaluation and vulnerability analysis of ML algorithms; and case studies of ML application to security.
Prereq: CIS 675

CIS 752 Wireless Network Security (3 Credits)
Engineering & Comp Sci
Wireless communication technologies, wireless LAN, mobile IP, mobile ad-hoc networks, wireless sensor networks, secure routing, secure locationing, key management, trust management, group communication, energy efficiency.
Advisory recommendation Coreq: CIS/CSE 758 or CIS/CSE 785

CIS 760 Topics Comp & Comp Logic (3 Credits)
Engineering & Comp Sci
Repeatable

CIS 767 Mathematical Theory of Computation (3 Credits)
Engineering & Comp Sci
The classical theory of effective computability, primarily concerned with the existence of computer methods. Topics: Turing machines, computable functions, recursion, unsolvable problems, degrees of unsolvability, applications.
Advisory recommendation Prereq: CIS 521

CIS 774 Principles of Distributed Access Control (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 774
Specification, verification, and design of secure networks using formal logic. Includes historical access control models, role-based access control, and logics for reasoning about authentication, authorization, audit, delegation, and trust.
Advisory recommendation Prereq: CIS 607 OR CSE 607

CIS 775 Distributed Objects (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 775
Design and implement software components using the Component Object Model (COM). Students will develop programs with COM components, ActiveX controls, and distributed applications.

CIS 776 Design Patterns (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 776
A seminar course based on the book "Design Patterns." Object oriented design methods emphasizing conceptual understanding rather than software development projects.

CIS 778 Advanced Windows Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 778
Seminar/projects course including: MFC library; windows architecture Graphics Device Interface; common, ActiveX, and Explorer controls; bitmaps; property sheets; toolbars; and status bars.

CIS 784 Software Engineering Studio (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 784
Applied software engineering and project management. Students are expected to analyze, plan, design, implement, test, and evaluate original software system to stand alone or be integrated into an existing environment. All work performed in teams.
Advisory recommendation Prereq: CSE 682 or CSE 687

CIS 787 Analytical Data Mining (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 787
Knowledge discovery process, data warehouses, OLAP, data mining inference based on statistics and machine learning, rule generation; emphasis on analytical aspects; applications.
Advisory recommendation Prereq: CIS 675, ELE 606, CSE 607

CIS 790 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 890 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 970 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 990 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 996 Master's Project (3 Credits)
Engineering & Comp Sci
Analysis and specification of a substantial programming exercise from a precise software definition. Top-down, modular design of algorithms and data structures. Complete and professional documentation of full implementation, including verification and performance analysis.

CIS 997 Masters Thesis (1-6 Credits)
Engineering & Comp Sci
Repeatable

CIS 999 Dissertation (1-15 Credits)
Engineering & Comp Sci
Repeatable

Computational Science

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.

CPS 600 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 621 Introduction to Probability and Statistics (4 Credits)
Engineering & Comp Sci
Double-numbered with CIS 321
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.
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 640 Tpcs:Ntwkng&Multimed Appl (3 Credits)
Engineering & Comp Sci
Current topics in networking and multimedia applications. Topics may include advanced networking solutions, performance issues and design of multimedia delivery systems, and integration of distributed multi-media software.
Repeatable

CPS 681 Explorations in Computing and Programming (3 Credits)
Engineering & Comp Sci
A project-focused study in core computing concepts. Implementation and synthesis of the concepts via scripting, programming, and IDEs, focusing on large distributed data. Utilize computing as an "amplifier" for journalism. Basic programming experience recommended.

CPS 688 Algorithms for Computational Journalism and Linguistics (3 Credits)
Engineering & Comp Sci
A hands-on approach to algorithms for practical applications. Collaborative filtering, graphical algorithms, visualization of information, searching and document ranking, and optimizations. Focus on Internet-based programming and database-oriented client-server model.

CPS 690 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

CPS 700 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 782 Capstone Project Course for Computational Journalism (3 Credits)
Engineering & Comp Sci
Jointly taught by computer science and journalism instructors. Students are asked to submit a major project proposal in computational journalism.
Advisory recommendation&Coreq: CIS 668 or IST 664

Computer Engineering

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

CSE 607 Mathematical Basis for Computing (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 607
Mathematical logic including predicate calculus, induction, theories with equality relations and groups. Mathematical logic applied to structures like nonnegative integers, tuples, lists, and trees.

CSE 612 Cloud Computing (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 612
Virtualized data centers, including virtual machine management, power management, and networking; cloud computing applications; and mobile cloud computing.
Advisory recommendation Prereq: CSE 458

CSE 618 Machine Intelligence with Deep Learning (3 Credits)
Engineering & Comp Sci
Mathematical fundamentals of classification models; deep neural networks; convolutional and recurrent neural networks; analysis, implementation and acceleration of inference and learning; and state-of-art applications on high-performance computing platforms.

CSE 634 Assurance Foundations (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 634
Foundational theory, concepts, and computer-assisted reasoning tools necessary for assurance. Topics include functional programming, theorem proving, and logic for reasoning about access control, security, and trust.

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

CSE 643 Computer Security (3 Credits)
Engineering & Comp Sci
Operating system security. Unix security. Trusted Computing Base. Authentication. Access control. Security models. Capability. Sandboxing. Software vulnerabilities. Worms. Viruses. Secure engineering principles. Secure programming. Auditing. Forensics.

CSE 644 Internet Security (3 Credits)
Engineering & Comp Sci
Internet architecture. Security and attacks on TCP/IP, DNS, and BGP protocols. Internet protocol security. Firewall. Intrusion detection. Network traceback. Web security. Encryption. Public Key infrastructure. One-way harsh function. Digital signature. Security protocols.

CSE 651 Mobile Application Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 651
Double-numbered with CIS 444, CSE 444
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 652 Building Assured Components (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 652
Development of system components with provable functional properties. Students gain hands-on experience walking the virtuous cycle of executable specifications, formal verification, and translation of specifications into a mainstream language.

CSE 658 Data Networks: Design and Performance (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 658
Data network design principles. Performance, modeling, and analysis of networks. Delay models. Multi-access communications. Routing and flow control algorithms. Familiarity with basics of data networks.

CSE 661 Advanced Computer Architecture (3 Credits)
Engineering & Comp Sci
Advanced computer architecture including discussion of instruction set design (RISC and CISC), virtual memory system design, memory hierarchies, cache memories, pipelining, vector processing, I/O subsystems, co-processors, and multiprocessor architectures. Case studies of current systems.

CSE 664 Introduction to System-on-Chip Design (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 664
Design principles and fabrication of computer chips. Standard cell based system-on-chip design, top down design flow, RT level design and synthesis, pipelining and performance analysis, software-hardware co-design and co-simulation.

CSE 665 Principles and Practices of FPGA-based Design (3 Credits)
Engineering & Comp Sci
Become familiar with Field Programmable Gate Arrays architecture, programming and applications. A hands-on learning experience using commercially available development kits. Use the FPGA platform as a System on Chip in a parallel computing environment.
Advisory recommendation Prereq: CSE 561

CSE 670 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 671 Embedded System Design (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 667
Methodologies for systematic design of embedded systems. System specification, architecture modeling, component partitioning, estimation metrics, hardware software co-design. Embedded computing platforms and programming. ASIC, CPU, and glue logic. Individual project required.

CSE 674 Advanced Data Structures and Algorithms (3 Credits)
Engineering & Comp Sci
Internals of all major data structures. Algorithms for sorting, balancing trees, graph querying, hashing and compression are discussed. Cache effects. Parallel algorithms.

CSE 681 Software Modeling and Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 681
Project-based course covering software modeling, architecture, design, and implementation using diagramming, analysis tools, and common sense engineering methods to analyze performance of concurrent, message-driven systems.

CSE 682 Software Engineering (3 Credits)
Engineering & Comp Sci
Requirements and specifications including tools such as PSL/PSA, SREM, design techniques; Functional decomposition; data flow; data structure, theoretical issues in testing, testing strategies: path; domain; mutation and error specific, cost and reliability models.

CSE 683 Expert Systems (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 666
Production rules, forward/backward chaining, Rete algorithm, structured objects, introduction to an expert system language/shell, probabilistic inference networks, fuzzy logic, knowledge acquisition, and explanation generation. Programming project or term paper required.

CSE 684 Introduction to Artificial Intelligence (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 667
Double-numbered with CIS 467
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.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

CSE 686 Internet Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 688
A laboratory projects course. Programming models on web clients and servers. Topics include: browser and server object models, tagged languages, emphasizing HTML and XML, ASP programming, and database connectivity.

CSE 687 Object Oriented Design (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 687
Basic methods of object oriented software design and implementation. Object oriented software engineering methodologies: specification, hierarchical decomposition, reuse and extensibility. Implementation of projects in object oriented programming language and analysis of design case studies.

CSE 690 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 691 Special Problems in Computer Systems Engineering (1-4 Credits)
Engineering & Comp Sci
Topics vary and represent current interests in computer engineering.
Repeatable

CSE 731 VLSI Timing Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 761
Delay modeling and timing analysis of interconnections and gates. Critical path analysis and delay budgeting. Buffer insertion and device sizing. Switch and circuit level simulations.
Advisory recommendation Prereq: CSE 664

CSE 762 Distributed Computing Systems (3 Credits)
Engineering & Comp Sci
Distributed systems modeling using languages such as ADA and CSP. Issues of concurrency control, deadlocks, synchronization,resource allocation, failure recovery and knowledge representation in distributed operating systems, data bases and AI systems; including case studies.
Advisory recommendation Prereq: CSE 585, 661

CSE 764 Advanced Topics in Synthesis of VLSI Systems (3 Credits)
Engineering & Comp Sci
Issues in design and synthesis of modern VLSI systems from abstract high-level behavioral specifications: temporal and spatial optimizations, synthesis for low power, reconfigurale computing, (digital/analog and SW/HW) co-design, formal specification and verification.
Advisory recommendation Prereq: CSE 561, 664

CSE 765 System Verification and Testing (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 765
Concepts, methods, and technology for effective verification of complex systems. Coverage metrics, event- and assertion-based verification, and formal methods including model checking and logical equivalence checking. Testing strategies, architecting testbenches, and design for verification.

CSE 771 Sequential Machine Theory (3 Credits)
Engineering & Comp Sci
Theoretical aspects and algebraic structure of sequential machines. Characterization of complete and incomplete machines, decomposition, and state assignment problems. Deterministic and nondeterministic finite state machines and regular expressions. Linear machines and machine identification.

CSE 772 Testing of Digital Circuits (3 Credits)
Engineering & Comp Sci
Physical circuit failures and fault models. Test generation algorithms. Fault stimulation and fault coverage. Random pattern testing. Sequential circuit testing. Test application and response processing techniques. Memory, PLA, and function testing. Design for test.

CSE 773 CAD: Formal Design (3 Credits)
Engineering & Comp Sci
This course teaches the theory, practice, and tools for using higher-order logic as a means for describing, designing, and verifying computer systems.
Advisory recommendation Prereq: CSE 561, 607

CSE 774 Principles of Distributed Access Control (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 774
Specification, verification, and design of secure networks using formal logic. Includes historical access control models, role-based access control, and logics for reasoning about authentication, authorization, audit, delegation, and trust.
Advisory recommendation Prereq: CIS 607 OR CSE 607

CSE 775 Distributed Objects (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 775
Design and implement software components using the Component Object Model (COM). Students will develop programs with COM components, ActiveX controls, and distributed applications.
Advisory recommendation Prereq: CSE 681 and 687

CSE 776 Design Patterns (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 776
A seminar course based on the book "Design Patterns." Object oriented design methods emphasizing conceptual understanding rather than software development projects.
Advisory recommendation Prereq: CSE 681 and 687

CSE 778 Advanced Windows Programming (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 778
Seminar/projects course including: MFC library; windows architecture Graphics Device Interface; common, ActiveX, and Explorer controls; bitmaps; property sheets; toolbars; and status bars.
Advisory recommendation Prereq: CSE 681 or CSE 687

CSE 781 Database Management Systems (3 Credits)
Engineering & Comp Sci
Group discussion of papers in the field. Data and storage structures, interrogation and update, data base creation, architectural alternatives, problem specification languages, and modeling and optimization. Research proposal required.
Advisory recommendation Prereq: CSE 581

CSE 782 Models and Metrics in Software Engineering (3 Credits)
Engineering & Comp Sci
Need of models and metrics; software science; cyclomatic complexity; and extensions; error analysis; reliability, cost and productivity models.
Advisory recommendation Prereq: CSE 682

CSE 784 Software Engineering Studio (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 784
Applied software engineering and project management. Students are expected to analyze, plan, design, implement, test, and evaluate original software system to stand alone or be integrated into an existing environment. All work performed in teams.
Advisory recommendation Prereq: CSE 681 or CSE 687

CSE 787 Analytical Data Mining (3 Credits)
Engineering & Comp Sci
Cross-listed with CIS 787
Knowledge discovery process, data warehouses, OLAP, data mining inference based on statistics and machine learning, rule generation; emphasis on analytical aspects; applications.
Advisory recommendation Prereq: CIS 675, ELE 606, CSE 607

CSE 788 Computer-Aided Design for VLSI and Digital Systems (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 762
Computer aids for automatic physical design of digital systems. Algorithms for partitioning, placement, wire routing, layout compaction, etc. Programming competence required.
Advisory recommendation Prereq: CSE 664

CSE 789 Comuter Aided Design of Digital Systems: Logic Design (3 Credits)
Engineering & Comp Sci
Computer aids for automatic logic design. Heuristic algorithms for single and multiple output, two-level and multiple-level logic minimization, logic synthesis, design verification, simulation and formal methods, hardware accelerators.
Advisory recommendation Prereq: CSE 561, 607

CSE 790 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 791 Special Problems in Computer Systems Engineering (1-4 Credits)
Engineering & Comp Sci
Topics vary and represent current interests in computer engineering.
Repeatable 6 times for 24 credits maximum

CSE 864 Topics in VLSI Design (3 Credits)
Engineering & Comp Sci
Seminar on the design and analysis of very large scale integrate circuits and systems. Opportunities for chip fabrication and testing.
Advisory recommendation Prereq: CSE 664

CSE 890 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 permission of supervising instructor or instructor and the department.
Repeatable

CSE 891 Special Problems in Computer Systems Engineering (1-4 Credits)
Engineering & Comp Sci
Work on special projects. Instructor presents new or special material.
Repeatable

CSE 970 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 990 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 995 Engineer Degree Project (0-6 Credits)
Engineering & Comp Sci
Independent investigation or original research on engineering problem under faculty supervision.
Repeatable

CSE 996 Master's Project (0 Credits)
Engineering & Comp Sci
Engineering investigation or analysis and evaluation of a journal paper. Written report in accordance with current departmental guidelines. Required of all students electing the nonthesis option for the master's degree.
Repeatable

CSE 997 Masters Thesis (1-6 Credits)
Engineering & Comp Sci
Independent investigation on a topic of interest under supervision of a member of the graduate school faculty. Credit to be arranged.
Repeatable

CSE 999 Dissertation (1-15 Credits)
Engineering & Comp Sci
Research on a doctoral dissertation under the supervision of a member of the graduate school faculty. Credit to be arranged.
Repeatable 30 times for 999.99 credits maximum

Electrical & Computer Engineering

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

ECE 601 Appl/Complex Function Thr (0 Credits)
Engineering & Comp Sci

ECE 602 Boundary Value Problems I (0 Credits)
Engineering & Comp Sci

ECE 603 Func Meth/Linear Analysis (0 Credits)
Engineering & Comp Sci

ECE 605 Analysis of Nonlinear Sys (3 Credits)
Engineering & Comp Sci

ECE 606 Probabilistic Methods/Ece (0 Credits)
Engineering & Comp Sci

ECE 607 Cmptr Engr Anly & Models (0 Credits)
Engineering & Comp Sci

ECE 611 Intro Lin Feed Cont Sys (0 Credits)
Engineering & Comp Sci

ECE 612 Modern Control Syst Synth (0 Credits)
Engineering & Comp Sci

ECE 621 Electromagnetic Fields (0 Credits)
Engineering & Comp Sci

ECE 631 Network Analysis (0 Credits)
Engineering & Comp Sci

ECE 633 Discrete & Intgrt Circuit (0 Credits)
Engineering & Comp Sci

ECE 643 Thry/Semiconductor Device (0 Credits)
Engineering & Comp Sci

ECE 651 Analog Communications (0 Credits)
Engineering & Comp Sci

ECE 655 Intro/General Systms Thry (0 Credits)
Engineering & Comp Sci

ECE 658 Computer Commnctn Network (0 Credits)
Engineering & Comp Sci

ECE 659 Microproc&Microcomptrs I (0 Credits)
Engineering & Comp Sci

ECE 661 Digital Cmptr Organizatn (0 Credits)
Engineering & Comp Sci

ECE 662 Computer Arithmetic (0 Credits)
Engineering & Comp Sci

ECE 663 Assoc Processing Tech (0 Credits)
Engineering & Comp Sci

ECE 664 Vlsi Design Methods (0 Credits)
Engineering & Comp Sci

ECE 665 Microprccsr/Microcmptr II (0 Credits)
Engineering & Comp Sci

ECE 667 Microprogrammed Comp Arch (0 Credits)
Engineering & Comp Sci

ECE 670 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

ECE 682 Software Engineering (0 Credits)
Engineering & Comp Sci

ECE 686 Apl Implemntatn & Extnsns (0 Credits)
Engineering & Comp Sci

ECE 690 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 691 Special Problems in Ece (0 Credits)
Engineering & Comp Sci

ECE 698 Specl Topics in Computers (0 Credits)
Engineering & Comp Sci

ECE 702 Boundary Value Prob II (0 Credits)
Engineering & Comp Sci

ECE 712 Optimal Control Systems (0 Credits)
Engineering & Comp Sci

ECE 713 Non-Ln,Samp&Carr Cont Sys (0 Credits)
Engineering & Comp Sci

ECE 715 Robot Manipulators I (0 Credits)
Engineering & Comp Sci

ECE 721 Antennas & Antenna Systms (0 Credits)
Engineering & Comp Sci

ECE 725 Electromagnetic Engr I (0 Credits)
Engineering & Comp Sci

ECE 726 Cmputatnl Meth/Fld Theory (0 Credits)
Engineering & Comp Sci

ECE 727 Adv Electromag Theory (0 Credits)
Engineering & Comp Sci

ECE 735 Digital Electronic Crcts (0 Credits)
Engineering & Comp Sci

ECE 741 Solid State Theory/Engs I (0 Credits)
Engineering & Comp Sci

ECE 742 Electronic Materials (0 Credits)
Engineering & Comp Sci

ECE 743 Theory/Semicndctr Devices (0 Credits)
Engineering & Comp Sci

ECE 747 Quantum Electronics I (0 Credits)
Engineering & Comp Sci

ECE 751 Digital Communications (0 Credits)
Engineering & Comp Sci

ECE 753 Radar Engineering (0 Credits)
Engineering & Comp Sci

ECE 754 Optical Inform Processing (0 Credits)
Engineering & Comp Sci

ECE 755 Digital Signal Process I (0 Credits)
Engineering & Comp Sci

ECE 756 Random Processes (0 Credits)
Engineering & Comp Sci

ECE 759 Microproc & Microcmptr II (0 Credits)
Engineering & Comp Sci

ECE 763 Parallel Procssng Systems (0 Credits)
Engineering & Comp Sci

ECE 766 Computer Peripherals (0 Credits)
Engineering & Comp Sci

ECE 768 Modeling&Perf Eval/Comptr (0 Credits)
Engineering & Comp Sci

ECE 771 Sequential Machine Theory (0 Credits)
Engineering & Comp Sci

ECE 782 Modls&Metrcs/Softwre Engr (0 Credits)
Engineering & Comp Sci

ECE 786 Pattern Recognition (0 Credits)
Engineering & Comp Sci

ECE 787 Digital Image Processing (0 Credits)
Engineering & Comp Sci

ECE 788 Digtl Sys I-Physical Dsgn (0 Credits)
Engineering & Comp Sci

ECE 789 Computer Aided Des-Logic (0 Credits)
Engineering & Comp Sci

ECE 790 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 791 Special Problems in Ece (0 Credits)
Engineering & Comp Sci

ECE 795 Electrnc Device & Circts (0 Credits)
Engineering & Comp Sci

ECE 811 Adv.Topics in Control Sys (0 Credits)
Engineering & Comp Sci

ECE 821 Sp Top:Electromag Theory (0 Credits)
Engineering & Comp Sci

ECE 827 Elctromgntc Egr II (0 Credits)
Engineering & Comp Sci

ECE 851 Detectn & Estimatn Thry (0 Credits)
Engineering & Comp Sci

ECE 853 Adv Tpcs/Communicatn Thry (0 Credits)
Engineering & Comp Sci

ECE 855 Digital Signal Process II (0 Credits)
Engineering & Comp Sci

ECE 890 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 990 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 997 Masters Thesis (0 Credits)
Engineering & Comp Sci

ECE 999 Dissertation (1-15 Credits)
Engineering & Comp Sci
Repeatable

Engineering and Computer Science
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

ECS 600 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 629 Modeling and Optimization Techniques (3 Credits)
Engineering & Comp Sci
Introduction to major deterministic and stochastic modeling techniques, including linear programming and its extensions, integer programming, dynamic programming, Markov chains, queuing theory, simulation, and other modeling techniques.

ECS 630 Simulation and Data Analytics (3 Credits)
Engineering & Comp Sci
Introduction to discrete-event simulation, system dynamics, and agent-based simulation; hybrid simulation modeling, input and output data analysis, tools and techniques needed for practice, uses of simulation for predictive and prescriptive analytics.
Advisory recommendation Prereq: ECS 526

ECS 636 Sustainable Development and Infrastructure Management (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 639
Introduction to public infrastructure systems. Management of infrastructure systems. Monitoring, planning, design, construction, maintenance/rehabilitation and operation. Emphasis on water, storm water, waste water, transportation, electrical power distribution and telecommunications systems.

ECS 650 Managing Sustainability: Purpose, Principles, and Practice (3 Credits)
Engineering & Comp Sci
Cross-listed with BUA 650
Dynamics and interdependence of economic, social, and environmental systems. Sustainable management frameworks, tools, and metrics. Local, national, and international implications. Relevance of technology, ethics, law, and policy. Interdisciplinary emphasis.

ECS 651 Strategic Management and the Natural Environment (3 Credits)
Engineering & Comp Sci
Cross-listed with BUA 651
Sustainability from firm perspective. Regulatory, international, resource, market, and social drivers of environmental strategy. Impact of sustainability-related strategies on competitive advantage and potential liability.
Advisory recommendation Prereq: ECS 650/BUA 650

ECS 656 Lean and the Growth Mindset (3 Credits)
Engineering & Comp Sci
Strategic planning and problem solving leveraging lean principles and techniques through deliberate practice. Project-based course incorporates modern management principles and practices including lean, agile, design thinking, and positive psychology to drive operational excellence.

ECS 666 Advanced Course in Engineering I (6 Credits)
Engineering & Comp Sci
Multidisciplinary course of study to develop engineering leadership skills. Weekly problems on engineering law, engineering mathematics, modeling, control theory, system and signals, thermodynamics, structural analysis, materials.

ECS 667 Advanced Course in Engineering II (6 Credits)
Engineering & Comp Sci
Continuation of ECS 666. Covers fluid mechanics, environmental engineering, computer hardware and software theories, modeling and simulation, network theory and implementation.
Advisory recommendation Prereq: ECS 666

ECS 670 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

ECS 681 Opns Resch/Decsn Mkg (3 Credits)
Engineering & Comp Sci

ECS 690 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

ECS 691 Fundamentals of Research (1 Credit)
Engineering & Comp Sci
Subjects such as selection of a dissertation topic, state-of-the-art search, research proposal, intellectual property, and academic integrity will be examined within the context of a mini-research project.

ECS 697 Capstone Project in Operations Research and System Analytics (3 Credits)
Engineering & Comp Sci
Capstone course for MS in Operations Research and System Analytics. Focus on solving real-world and industry-inspired problems and generating professional outputs.
Advisory recommendation Prereq: ELE 603 and ELE 606 and ECS 629 and MAE 630 and CIS 662

ECS 700 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 759 Sustainability-Driven Enterprise (3 Credits)
Engineering & Comp Sci
Cross-listed with BUA 759
CAS in Sustainable Enterprise capstone. Sustainable approaches to complex organizational challenges, opportunities: organizational, industry, stakeholder analysis, sustainability objectives, strategies, and metrics. Multidisciplinary team consulting project.
Advisory recommendation Prereq: (ECS 650 OR BUA 650) AND (ECS 651 OR BUA 651)

ECS 770 Professional Training (0 Credits)
Engineering & Comp Sci
Repeatable

Entrepreneurship and Emerging Enterprises
EEE 600 Selected Topics (1-6 Credits)
Management
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

EEE 620 Foundations of Entrepreneurship (3 Credits)
Management
The process of entrepreneurship in start-up and established corporate environments. Approaches entrepreneurship as both attitudinal and behavioral, with applicability in a variety of contexts. Global dimensions of entrepreneurship are investigated as they relate to the independent and corporate entrepreneur. Cannot be repeated for credit. Must be admitted to a graduate program at SU.

EEE 621 Corporate Entrepreneurship (3 Credits)
Management
Double-numbered with EEE 420
Examination of the application of entrepreneurship concepts and behaviors within established organizations, assessment of factors contributing to a company's entrepreneurial orientation, and identification of ways to foster higher levels of entrepreneurship within firms.

EEE 622 Entrepreneurial Turnarounds (3 Credits)
Management
Double-numbered with EEE 422
Process of entrepreneurial turnarounds in nascent and established corporate environments. Examination of internal and external causes leading to the troubled condition. Development and implementation of successful recovery strategies from the top down. Additional work required for graduate students.
Repeatable 2 times for 6 credits maximum
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

EEE 624 Entrepreneurial Deal Making (3 Credits)
Management
Double-numbered with EEE 424
Students will learn about the spectrum of deals struck by entrepreneurs over the course of a company¿s life. Identifying opportunities and negotiating with co-founders, prospective partners, early stage employees, customers, landlords, tenants, banks, potential investors, and Boards of Directors are all part of your role as an entrepreneur. Additional work required for graduate students.

EEE 630 Entrepreneurship in Engineering and Science (3 Credits)
Management
The intersection of engineering and entrepreneurship, focusing on the commercialization of new technologies into start-up ventures. Types of technologies, technology life cycles, windows of opportunity, the market chasm, and intellectual property as these issues apply to venture creation by those with technical backgrounds.

EEE 640 Social Entrepreneurship (3 Credits)
Management
Examination of the opportunities and challenges associated with using entrepreneurial solutions to address social problems. Course integrates management, evaluation, and analytical techniques to support the launch, operation, and expansion of social purpose organizations.

EEE 643 Emerging Enterprise Consulting (3 Credits)
Management
Students work in consulting teams to assist small local firms and entrepreneurs. Problems are isolated and solutions are then developed and implemented. A team consultant's report is then prepared.

EEE 644 Dilemmas and Debates in Entrepreneurship (3 Credits)
Management
Double-numbered with EEE 444
Designed around a series of critical dilemmas confronted by entrepreneurs when creating and growing a venture. Entrepreneurs explore with students the issues surrounding these dilemmas in a structured format. Additional work required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

EEE 646 Diversity and Entrepreneurial Opportunity (3 Credits)
Management
Double-numbered with EEE 446
Understanding the historical and theoretical constraints entrepreneurs face due to their ethnicity, gender identification, place of birth, and/or socio-economic class. Discuss various strategies, policies, and actions at the disposal for students to become change-makers. Additional work required for graduate students.
University Requirement Course: IDEA Requirement Eligible
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/)

EEE 651 Finance for Emerging Enterprises (3 Credits)
Management
Double-numbered with EEE 451
This course will help aspiring entrepreneurs learn how to finance their venture. Topics include economic model development, bootstrapping, friends/family financing, crowdfunding, angel/venture capital financing. Requires use of Microsoft Excel. Additional rigor for graduate students.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

EEE 652 International Entrepreneurship (3 Credits)
Management
Cross-listed with INB 652
Double-numbered with EEE 452, INB 452
A fusion of two areas of study: global business and entrepreneurship. The theories, concepts, and tools of international business are discussed from the perspective of the entrepreneur. Additional work required of graduate students.

EEE 653 LaunchPad (3 Credits)
Management
Double-numbered with EEE 453
As the name implies, the course is meant to take your existing student business to the next level and provide you with the tools needed to grow and sustain the business. While this is not a typical or traditional University course, you will be challenged in ways you probably have not been challenged as a student. Additional work and rigor required for graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

EEE 670 Experience Credit (1-6 Credits)
Management
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

EEE 675 Entrepreneurial Family Business Management (3 Credits)
Management
Double-numbered with EEE 375
Examines family business issues, such as managing relationships, communication and conflict, ownership and governance, strategy, and succession. Focus is entrepreneurial management of family firms, including maintaining an entrepreneurial spirit throughout the firm and across generations. Additional work required of graduate students.

EEE 676 Advanced Topics in Family Business Management (3 Credits)
Management
Double-numbered with EEE 476
Covers advanced topics in family business management, such as taxation, establishment of trusts and estates, legal transfer of ownership, legal forms and valuation. Additional work required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

EEE 682 Entrepreneurial Marketing (3 Credits)
Management
Double-numbered with EEE 482
The interface of entrepreneurship and marketing. Covers cutting-edge approaches to entrepreneurial marketing in new or fast-growing companies. Additional work and rigor required for 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/)

EEE 690 Independent Study (1-6 Credits)
Management
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

EEE 900 Selected Topics (1-6 Credits)
Management
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.

EEE 930 Theoretical Foundations of Entrepreneurship (3 Credits)
Management
History, direction, and substance of developments in the field of entrepreneurship. Advanced topics related to theoretical foundations and the advancement of research within the field. Admission to doctoral program in the School of Management is required.

EEE 932 Contemporary Entrepreneurship Research (3 Credits)
Management
A broad survey of major topics in contemporary entrepreneurship research. Covers the primary theoretical underpinnings of the field and to important entrepreneurship topics.

EEE 990 Independent Study (1-6 Credits)
Management
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

Engineering

EGR 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

EGR 670 Professional Practice (0 Credits)
Engineering & Comp Sci
Full-time practical engineering work experience with a participating employer, which is related to the student's field of study, and is of a semester's duration.
Repeatable

EGR 770 Professional Training (0 Credits)
Engineering & Comp Sci
Full time practical work experience, with a participating employer, which is related to the student's field of study and is of a semester's duration.
Repeatable

Electrical Engineering

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/)

ELE 601 Applications of Complex Function Theory (3 Credits)
Engineering & Comp Sci
Theory of functions of a complex variable. Fourier and Laplace transforms. Applications to engineering problems.

ELE 602 Boundary Value Problems I (3 Credits)
Engineering & Comp Sci
Partial differential equations in engineering problems. Method of separation of variable. Sturm-Liouville systems and orthogonal functions. Series and integral representations.

ELE 603 Functional Methods of Engineering Analysis (3 Credits)
Engineering & Comp Sci
Linear functional systems from the viewpoint of vector spaces. Function spaces, differential and integral operators, eigenvalues and eigenfunctions, Jordan forms, functions of a matrix and state-space solutions.

ELE 606 Probabilistic Methods in Electrical Engineering (3 Credits)
Engineering & Comp Sci
Set-theoretic basis of probability. Probabilistic modeling of practical problems. Random variables in one and several dimensions. Functions of random variables. Moments, characteristic functions, correlation, sampling. Poisson process. Laws of large numbers and central limit theorem.

ELE 612 Modern Control Systems (3 Credits)
Engineering & Comp Sci
State space representation. State variable feedback design. Controllability, observability, and identifiability. Optimum design and the matrix Ricatti equation.

ELE 614 Power System Analysis and Control (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 414
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.
Advisory recommendation Prereq for 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 615 Microgrids (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 415
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 617 Power Electronics (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 417
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.
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 618 Sensors & Measurements (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 418
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 621 Electromagnetic Fields (3 Credits)
Engineering & Comp Sci
Development of electromagnetic theory from the basic postulates leading to Maxwell's equations in differential and integral forms. Solution to static, quasi-static, and wave-propagation problems.

ELE 623 Microwave Engineering Fundamentals (3 Credits)
Engineering & Comp Sci
Microwave engineering fundamentals including transmission line theory, impedance matching techniques, microwave network analysis and device characterization. Practical illustration of these concepts via network analyzer measurements, spectrum analyzer measurements, and computer based electromagnetic modeling tools.

ELE 625 High Frequency Transmission Systems (3 Credits)
Engineering & Comp Sci
Transmission line parameters, transients on lossless lines, time-harmonic excitation of lines, Smith chart, impedance matching techniques, matrix representation of multiport devices, coupled transmission systems, even and odd mode theory, circuit theory of rectangular waveguides.

ELE 633 Discrete and Integrated Analog Electronic Circuits (3 Credits)
Engineering & Comp Sci
Linear and non-linear circuit models of electronic devices as derived from structural and empirical parameters. Anatomy and applications of integrated operational amplifiers; active filters, multipliers, comparators, voltage-controlled oscillators, wave-form generators, phase-locked loops.

ELE 635 Digital Electronic Circuits (3 Credits)
Engineering & Comp Sci
Digital device and circuit technology and trends. Nanoscale semiconductor devices and memories as well as magnetic and optical memories. Semiconductor industry road map. Device fabrication techniques. DA and AD conversion circuits.

ELE 642 Introduction to Solid-State Physics (3 Credits)
Engineering & Comp Sci
Cross-listed with PHY 576
Elementary aspects of physics of solids; crystal lattices and diffraction, phonons and thermal properties in crystals, elementary band theory, and semi-conductor physics.
Advisory recommendation Prereq: PHY 567

ELE 643 Theory of Semiconductor Devices (3 Credits)
Engineering & Comp Sci
Fundamental theory of semiconductor devices and their linear and nonlinear mathematical and circuit models. Frequency response and switching characteristics of discrete and integrated structures comprising both bipolar and field effect devices.

ELE 651 Digital Communications (3 Credits)
Engineering & Comp Sci
Baseband data transmission. Advanced digital modulation techniques. Optimum receivers. Topics in information theory and coding.
Advisory recommendation Prereq: ELE 551

ELE 652 Digital Audio Signal Processing (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 452
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 653 Image and Video Processing (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 453
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.

ELE 654 Introduction to Radar Systems (3 Credits)
Engineering & Comp Sci
Double-numbered with ELE 454
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.

ELE 658 Data Networks: Design and Performance (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 658
Data network design principles. Performance, modeling, and analysis of networks. Delay models. Multi-access communications. Routing and flow control algorithms. Familiarity with basics of data networks.
Advisory recommendation Prereq: CIS 321 or MAT 521; Coreq: ELE 606

ELE 659 Digital Signal Processing I (3 Credits)
Engineering & Comp Sci
Discrete time signals. Z-transform. Discrete Fourier transform. Fast Fourier transform. Finite impulse response filters. Infinite impulse response filters. Effects of finite word length.

ELE 664 Introduction to System-on-Chip Design (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 664
Design principles and fabrication of computer chips. Standard cell based system-on-chip design, top down design flow, RT level design and synthesis, pipelining and performance analysis, software-hardware co-design and co-simulation.

ELE 667 Embedded System Design (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 671
Methodologies for systematic design of embedded systems. System specification, architecture modeling, component partitioning, estimation metrics, hardware software co-design. Embedded computing platforms and programming. ASIC, CPU, and glue logic. Individual project required.

ELE 670 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 681 Introduction to Photonic Engineering (3 Credits)
Engineering & Comp Sci
Topics include: geometrical theory; optical diffraction theory; angular spectral propagation theory; Fresnel and Frauhofer integral solutions; gaussian beam theory; reflection and refraction; mathematics of polarization; lenses and lenslike media; and photons and atoms.

ELE 682 Fiber Optic Communication (3 Credits)
Engineering & Comp Sci
Topics include: 1) network structures; 2) links; 3) full nets; 4) measures of networks; 5) conductivity; 6) transfer rates; 7) present network constraints; 8) new demands on networks; 9) architectures and interconnections; 10) instrumentation for analysis; and 11) control, regulation, and standardization.

ELE 683 Infrared Engineering (3 Credits)
Engineering & Comp Sci
Topics include: 1) review of optical diffraction theory; 2) radiometry; 3) blackbody radiation theory; 4) IR sources; 5) atmospheric IR transmissions; 6) IR optics; 7) IR detectors and noise; 8) IR lasers; 9) passive systems; and 10) active, heterodyne IR radar systems.

ELE 685 Photonic Devices (3 Credits)
Engineering & Comp Sci
Topics include: 1) electro optic detectors; 2) photo diodes; 3) avalanche photo-diodes; 4) multi-quantum well detectors; 5) photo-multipliers; 6) micro-channel plates; 7) multi-quantum well modulators; 8) Mach-Zhender modulators and switches; 9) couplers; 10) wavelength division couplers; and 11) grating devices.

ELE 690 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 691 Special Topics in Electrical Engineering (1-4 Credits)
Engineering & Comp Sci
Topics vary and represent current interests in electrical engineering.
Repeatable

ELE 702 Boundary Value Problems II (3 Credits)
Engineering & Comp Sci
Continuation of ELE 602. Green's functions, integral equations, transform methods, and approximation techniques.
Advisory recommendation Prereq: ELE 601, 602

ELE 703 Convex Optimization (3 Credits)
Engineering & Comp Sci
Concepts and applications of convex optimization. Topics include convex sets, convex functions, linear programming, quadratic programming, semidefinite programming, duality theory, software tools.

ELE 704 Neural Networks and Fuzzy Logic Applications (3 Credits)
Engineering & Comp Sci
Neural networks and fuzzy logic to develop algorithms and computer programs for engineering and other applications, such as financial, medical, and sociological. Use non-parametric statistics to measure performance.
Advisory recommendation Prereq: ELE 603

ELE 712 Optimal Control Systems (3 Credits)
Engineering & Comp Sci
Performance criteria and static optimization. The Maximum Principle. Optimum regulator problem. Dynamic programming. Gradient methods for dynamic optimization.
Advisory recommendation Prereq: ELE 612

ELE 715 Robot Manipulators I (3 Credits)
Engineering & Comp Sci
Cross-listed with MEE 715
Robot manipulators and their defining equations. Transformations, kinematics, dynamics, and motion trajectories. Control considerations, compliance and organization of programming. Includes a hardware and software laboratory.
Advisory recommendation Prereq: ELE 612

ELE 721 Antennas and Antenna Systems (3 Credits)
Engineering & Comp Sci
Characteristics of electromagnetic radiators. Equivalent circuits of antenna elements: dipoles, loops, helices, horns, and other radiators. Phased arrays. Pattern synthesis. Numerical methods. Broadband antennas. Measurement techniques.
Advisory recommendation Prereq: ELE 621

ELE 722 Microwave Filters (3 Credits)
Engineering & Comp Sci
General filter structures at microwave frequencies. Prototype filters obtained by network synthesis method. Image parameters. Richards' transformation. Kuroda Identities. Coupled-line equivalent circuits. Design, simulate, build, and test a microwave filter.
Advisory recommendation Prereq: ELE 623

ELE 723 Microwave Transistor Amplifiers (3 Credits)
Engineering & Comp Sci
Two-port network representations, matching networks, power gain equations, stability conditions, simultaneous conjugate match, constant gain, VSWR and noise figure circles, balanced and feedback amplifiers. Design, simulate, build, and test a microwave amplifier.
Advisory recommendation Prereq: ELE 623

ELE 724 Microwave Oscillators (3 Credits)
Engineering & Comp Sci
Matching networks, S-parameters. Oscillation conditions, One-port and two-port Negative-resistance Oscillators, oscillator design using large-signal measurements, DROs, YIG Oscillators, VCOs, and Phase noise. Design, simulate, build, and test a microwave oscillator.
Advisory recommendation Prereq: ELE 623

ELE 725 Electromagnetic Engineering I (3 Credits)
Engineering & Comp Sci
Time varying electromagnetic fields. Field theorems, propagation and reflection of waves, wave guides, resonators, radiation, and diffraction. Applications to antenna theory.
Advisory recommendation Prereq: ELE 621

ELE 726 Computational Methods of Field Theory (3 Credits)
Engineering & Comp Sci
Functional analysis, method of moments, and variational methods. Applications to electrostatics, magnetostatics, two-dimensional electromagnetic fields, antennas, scatterers, and apertures.
Advisory recommendation Prereq: ELE 621

ELE 728 Planar Microwave Antennas (3 Credits)
Engineering & Comp Sci
Review of the fundamentals of antennas. Theory of microstrip antennas, dual and circularly polarized antennas, feeding techniques, mutual coupling, arrays of patches, effect of substrate and the ground plane. Design, simulate, build, and test a planar microwave antenna.

ELE 735 Digital Electronic Crcts (3 Credits)
Engineering & Comp Sci

ELE 742 Electronic Materials (3 Credits)
Engineering & Comp Sci
Electronic properties of dielectric, magnetic, and superconducting materials. Application to devices.
Advisory recommendation Prereq: ELE 621

ELE 751 Wireless Communications (3 Credits)
Engineering & Comp Sci
Cellular communication systems. Mobile radio propagation. Modulation techniques. Equalization, diversity, and channel coding. Link budget analysis. Speech coding. Multiple access techniques. Spread spectrum systems and CDMA. Wireless systems and networking.
Advisory recommendation Prereq: ELE 606 and 651

ELE 752 Coding Theory and Its Applications (3 Credits)
Engineering & Comp Sci
Algebra or error correcting codes, finite fields, cyclic codes, BCH codes, Convolutional codes, Viterbi and stack algorithms. Applications to communications and data storage systems.
Advisory recommendation Prereq: ELE 606 and 651

ELE 753 Radar Engineering (3 Credits)
Engineering & Comp Sci
Radar system requirements and principles of radar detection and parameter estimation. Factors affecting radar range, signal detection in noise, decision criteria. Target identification techniques. Radar antenna characteristics. Time-space-frequency-phase interrelationships.
Advisory recommendation Prereq: ELE 651

ELE 755 Digital Image Processing (3 Credits)
Engineering & Comp Sci
Two-dimensional signals and systems. Image formation and perception. Representation, coding, filtering, restoration, and enhancement. Feature extraction and scene analysis. Introduction to computer vision.
Advisory recommendation Prereq: ELE 601, 659

ELE 756 Random Processes (3 Credits)
Engineering & Comp Sci
Stationary and nonstationary random processes. Gaussian process. Narrow-band representation. Response of linear filters and nonlinear detectors to random processes. Applications to communication problems.
Advisory recommendation Prereq: ELE 606; Coreq: ELE 651

ELE 757 Information Theory (3 Credits)
Engineering & Comp Sci
Basic information measures. Source coding. Capacity of discrete channels. Coding theorem for noisy channel. Concepts of error correction codes. Extensions to continuous and wave form channels.
Advisory recommendation Prereq: ELE 606; Coreq: ELE 651

ELE 758 Selected Topics in Data Networks (3 Credits)
Engineering & Comp Sci
Topics vary each term. Typical topics: Gigabit networks, network security, ATM networks, and personal communication networks.
Repeatable
Advisory recommendation Prereq: ELE 658

ELE 759 Digital Signal Process II (3 Credits)
Engineering & Comp Sci
Spectral analysis with Fast Fourier transform. Advanced filtering algorithms. Multichannel signal processing. Selected topics on DSP applications.
Advisory recommendation Prereq: ELE 659

ELE 761 VLSI Timing Analysis (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 731
Delay modeling and timing analysis of interconnections and gates. Critical path analysis and delay budgeting. Buffer insertion and device sizing. Switch and circuit level simulations.

ELE 762 Computer-Aided Design for VLSI and Digital Systems (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 788
Computer aids for automatic physical design of digital systems. Algorithms for partitioning, placement, wire routing, layout compaction, etc. Programming competence required.

ELE 765 System Verification and Testing (3 Credits)
Engineering & Comp Sci
Cross-listed with CSE 765
Concepts, methods, and technology for effective verification of complex systems. Coverage metrics, event- and assertion-based verification, and formal methods including model checking and logical equivalence checking. Testing strategies, architecting testbenches, and design for verification.

ELE 781 Dielectric Waveguides and Fibers (3 Credits)
Engineering & Comp Sci
Topics include: 1) propagating and radiating modes in dielectric waveguides; 2) circular waveguides-fibers; 3) modes in fibers; 4) single mode fibers; 5) Raleigh and Raman effects and losses in fibers; and 6) practical experiments in laboratory.
Advisory recommendation Prereq: ELE 621 or ELE 681

ELE 784 Optical Information Processing (3 Credits)
Engineering & Comp Sci
Fourier transforming and imaging properties of lenses. 2-D linear systems. Frequency analysis. 2-D information processing, synthetic aperture radar, planar and volume holography and applications. Bragg diffraction, optical memory and photonics in computing systems.
Advisory recommendation Prereq: ELE 681

ELE 786 Laser Propagation and Modulation (3 Credits)
Engineering & Comp Sci
Topics include: 1) wave propagation in anisotropic media, 2) index modulation tensors, 3) bifringent toptical systems, 4) periodic media, 5) acousto-optics, 6) electro-optic effects, 7) second harmonic generation, 8) phase conjugation, and 9) nonlinear optics.
Advisory recommendation Prereq: ELE 681

ELE 787 Lasers (3 Credits)
Engineering & Comp Sci
Review of quantum mechanics, review of light propagation theory. Interaction of light and atoms and electrons. Rate equations. Mode locking and Q. switching, gas, solid-state and semiconductor lasers, laboratory experiments/demonstrations.
Advisory recommendation Prereq: ELE 681

ELE 790 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 791 Advanced Topics in Electrical Engineering (1-4 Credits)
Engineering & Comp Sci
Topics vary and represent current interests in electrical engineering. Each offering has a graduate-level prerequisite.
Repeatable

ELE 821 Special Topics in Electromagnetic Theory (3 Credits)
Engineering & Comp Sci
Advanced and current topics in electromagnetic theory. Topics vary each term. May include: array theory, electromagnetic compatibility, numerical methods, propagation and radiation in ionized media, moving media, and random media.
Repeatable

ELE 827 Electromagnetic Engineering II (3 Credits)
Engineering & Comp Sci
Modern methods for solving electromagnetic field problems. Equivalence theorems, Green's function techniques, integral equations, variational solutions and transform solutions.
Advisory recommendation Prereq: ELE 725

ELE 847 Semiconductor Optoelectronics (3 Credits)
Engineering & Comp Sci
Optical and optoelectronic properties of semiconductors. Applications to lasers, lamps, photodetectors, and solar cells.
Advisory recommendation Prereq: ELE 643

ELE 849 Special Topics in Solid State (3 Credits)
Engineering & Comp Sci
Modern methods for analyzing the quantum normal modes of materials in the solid state and their technological applications. May be repeated for credit with instructor's consent.

ELE 851 Detection and Estimation Theory (3 Credits)
Engineering & Comp Sci
Hypothesis testing and parameter estimation. Series representation of random processes. Detection and estimation of known signals in white and nonwhite Gaussian noise. Detection of signals with unwanted parameters.
Advisory recommendation Prereq: ELE 756

ELE 852 Kalman Filters (3 Credits)
Engineering & Comp Sci
Models for linear systems and stochastic processes, estimation techniques, Kalman filter derivation using innovations and Bayesian approaches, Kalman filter for Gauss-Markov model, Kalman filter design methodology, extended Kalman filters.
Advisory recommendation Prereq: ELE 603, 756

ELE 853 Advanced Topics in Communication Theory (3 Credits)
Engineering & Comp Sci
Typical topics: spread-spectrum techniques, synchronous communications, signal theory, spectral estimation, radar and sonar applications of detection and estimation theory.
Repeatable
Advisory recommendation Prereq: ELE 756

ELE 890 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 permission of supervising instructor or instructor and the department.
Repeatable

ELE 891 Special Problems in Electrical Engineering (1-4 Credits)
Engineering & Comp Sci
Repeatable

ELE 970 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 990 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 995 Engineer Degree Project (0-6 Credits)
Engineering & Comp Sci
Independent investigation or original research on an engineering problem under supervision of member of the faculty. Credit to be arranged.
Repeatable

ELE 996 Master's Project (0 Credits)
Engineering & Comp Sci
An engineering investigation or the analysis and evaluation of a journal paper. A written report is required in accordance with current departmental guidelines. Required of all students electing the nonthesis option for the master's degree.
Repeatable

ELE 997 Masters Thesis (1-6 Credits)
Engineering & Comp Sci
Independent investigation on a topic of interest under supervision of a member of the Graduate School faculty. Credits to be arranged.
Repeatable

ELE 999 Dissertation for the PhD (1-15 Credits)
Engineering & Comp Sci
Research work on a doctoral dissertation under the supervision of a member of the Graduate School faculty. Credits to be arranged.
Repeatable

Mechanical and Aerospace Engineering

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

MAE 600 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 611 Analytical and Computational Dynamics (3 Credits)
Engineering & Comp Sci
Modern analytical rigid body dynamics formulation and computational techniques applied to multibody systems. Kinematics of motion, analytical and computational determination of inertia properties, Kane¿s equations, holonomic and nonholonomic constraints, recursive algorithms, collisions.

MAE 613 New Product Development (3 Credits)
Engineering & Comp Sci
Methods of product concept generation, understanding of the market and customer needs. Design with a view to the entire product life cycle, from feasibility through disposal. Product development encompassing engineering and manufacturing issues, and management of the processes and intellectual property.

MAE 615 Instrumentation (3 Credits)
Engineering & Comp Sci
Basic theory of electronics, modulation, recording, and measurement combined with basic fundamentals in mechanical engineering, such as acoustics, vibration, heat transfer, stain, and turbulence.

MAE 617 Applied Engineering Simulation (3 Credits)
Engineering & Comp Sci
Fundamentals of advanced numerical methods. Applications of engineering simulation across various engineering disciplines. Features, capabilities, and limitations of commercial engineering simulation tools. Integration of simulation-based modeling and analysis into engineering design workflows.

MAE 621 Failure Analysis of Composite Materials (3 Credits)
Engineering & Comp Sci
Review of mechanical behavior of composites. Failure predictions for composites based on macroscopic mechanisms. Fatigue and fracture. Damage, delamination and debond growth. Residual strength and life predictions. Damage tolerance and nondestructive inspection.

MAE 625 Fracture Mechanics (3 Credits)
Engineering & Comp Sci
Introduction to basic elements: elastic and elastic-plastic crack tip stress and strain fields, stress intensity factor, crack extension form, J integral, fracture toughness, fatigue crack growth, and the applications of fracture mechanics.

MAE 626 Vibration of Mechanical Systems (3 Credits)
Engineering & Comp Sci
Fundamental physical and mathematical aspects of vibration phenomena in linear systems. Theory of transients, eigenvalue problems, vibration isolation and measurement techniques.

MAE 627 Advanced Helicopter Dynamics (3 Credits)
Engineering & Comp Sci
Mathematics of rotating systems, rotary wing dynamics, and calculation of aerodynamic forces both in rotating and fixed frames.

MAE 628 Linear Systems (3 Credits)
Engineering & Comp Sci
Introduction to control theory and linear time invariant systems. Feedback and stabilization, controllability, observability, and application of control design methods to systems of relevance in mechanical and aerospace engineering.

MAE 630 Advanced Practical Optimization (3 Credits)
Engineering & Comp Sci
Advanced theory and application of numerical optimization. Topics may include: Unconstrained/constrained linear and nonlinear problems; multiobjective, discrete and global optimization; optimization under uncertainty; evolutionary optimization. Knowledge of Linear Algebra and Ordinary Differential Equations required. Matlab used.

MAE 633 Theory of Materials (3 Credits)
Engineering & Comp Sci
Double-numbered with MAE 433
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. Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 635 Advanced Mechanics of Materials (3 Credits)
Engineering & Comp Sci
Stress analysis. Beam-column analysis by series and variational techniques, beams on elastic foundation, torsion with restrained warping, deflections due to transverse shear, introductory problems in plates and shells.
Advisory recommendation Prereq: ECS 325.

MAE 640 Nonlinear Control (3 Credits)
Engineering & Comp Sci
Nonlinear analysis and control systems theory. Tools to analyze and design feedback control systems for complex nonlinear systems including examples from engineering and robotics.

MAE 641 Adaptive Control (3 Credits)
Engineering & Comp Sci
Adaptive-based control methods for uncertain nonlinear systems. A Lyapunov-based framework is used for the synthesis and analysis of the controllers including direct and indirect adaptive methods, neural networks, and learning-based approaches.

MAE 643 Fluid Dynamics (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 643
Review of undergraduate fluids; kinematics, vorticity; dynamics, stresses, Euler and Navier-Stokes equations; energy, Bernoulli's equation; potential flows; Stokes flows; boundary layers; flow separation; other applications.
Advisory recommendation Prereq: MAE 341 or CEN 333

MAE 644 Applied Fluid Dynamics (3 Credits)
Engineering & Comp Sci
Fundamental flow phenomena encountered in practical engineering situations. Topics may include: flow separation, turbulent mixing, bluffbody aerodynamics, three dimensional flow, flow control, high-lift devices, cavitation, fan stall, flow-structure interaction.
Advisory recommendation Prereq: MAE 643

MAE 645 Fluid Dynamics Measurements (3 Credits)
Engineering & Comp Sci
Measurement of pressure, density, and velocity in low- and high-speed flows. Hot wire anemometry and laser Doppler anemometry. Flow visualizations and image analysis. Digital data acquisition and time series analysis. Uncertainty estimation. Lecture and laboratory sessions.

MAE 647 Gas Dynamics (3 Credits)
Engineering & Comp Sci
Equations of motion for compressible perfect fluids. Crocco's equation. Wave equation. Acoustic speed. Unsteady flows. Shock formation. Normal and oblique shocks. Prandtl-Meyer expansion. Wave interactions. Method of characteristics. Supersonic diffuser, nozzle jet flows.

MAE 648 Biofluid Dynamics (3 Credits)
Engineering & Comp Sci
Cross-listed with BEN 648
Principles of momentum transfer in bioengineering systems. Flight and swimming in nature including flagellar propulsion. Newtonian and non-Newtonian fluid phenomena, including low-Reynolds-number flow, pulsatile and separated flows. Flow past bifurcations. Respiratory and blood circulatory flows.

MAE 651 Advanced Thermodynamics (3 Credits)
Engineering & Comp Sci
Review of thermodynamic laws and macroscopic coordinates of general systems. Reversibility, equilibrium and exergy. Introduction to statistical thermodynamics.
Advisory recommendation Prereq: MAE 251

MAE 655 Advanced Heat Transfer (3 Credits)
Engineering & Comp Sci
Theory and application of heat transfer by conduction and radiation for both steady and unsteady state conditions. Mathematical, graphical, and numerical methods of solution.

MAE 657 Convective Heat and Mass Transfer (3 Credits)
Engineering & Comp Sci
Fluid properties and transport equations. Introduction to turbulent transport. Laminar and turbulent heat transfer in internal and external flows. Free convection. Heat transfer in high-speed flow. Convective mass transfer. Special topics.
Advisory recommendation Prereq: MAE 643

MAE 658 Building Environmental Modeling and Simulations (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 648
Building environmental analysis; contaminant source and sink models; single-zone, multizone, and computational fluid dynamics models.
Advisory recommendation Prereq: MAE 341 and MAE 355

MAE 659 Building Materials and Envelope (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 649
Understanding of heat, air and moisture transfer effects on building envelope/enclosure through linking material properties, assembly design and hygorthermal performance with structural and mechanical considerations. Introduction to advanced computational tools for building enclosures.

MAE 670 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 671 Numerical Methods in Mechanical Engineering (3 Credits)
Engineering & Comp Sci
Derivation and use of numerical methods for polynomial approximation, extraction of roots, evaluation of determinants, eigenvectors and eigenvalues, orthogonal transformations, angles of orthogonal transformation, robotics, differential equations, mechanism analysis, Fourier representation.

MAE 672 Engineering Data Analytics (3 Credits)
Engineering & Comp Sci
This course introduces students the fundamental concepts of engineering data techniques including data collection, cleaning, transformation, management and analysis. It also provides students with hands-on experiences exploring key concepts related to data science and engineering field.

MAE 673 Fundamentals of Photovoltaics (3 Credits)
Engineering & Comp Sci
Fundamental topics on photovoltaic materials and devices. Analysis of different photovoltaic materials and performance evaluation of photovoltaic devices. Solar cell structures and fabrication technologies.

MAE 675 Methods of Analysis in Mechanical Engineering (3 Credits)
Engineering & Comp Sci
Methods of analyzing linear mechanical systems based on theorems in linear algebra, tensor calculus, and linear differential equations. Vector spaces, linear transformations, tensor fields, and eigenvalue problems.

MAE 682 Computational Solid Mechanics (3 Credits)
Engineering & Comp Sci
Theory and implementation of the finite element method (FEM). Boundary value problems in solid mechanics. Commercial and open source FEM software.

MAE 683 Applied Environmental Acoustics and Noise Control (3 Credits)
Engineering & Comp Sci
Double-numbered with MAE 483
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.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

MAE 686 Advanced Fuel Cell Science and Technology (3 Credits)
Engineering & Comp Sci
The scientific challenges of fuel cells will be discussed: fundamental electrochemistry, thermodynamics and kinetics of electrode process, with emphasis on fundamental principles of fuel cells, mass transport processes and performance of fuel cells. Department Consent Required.

MAE 688 Machine Learning for Mechanical Engineers (3 Credits)
Engineering & Comp Sci
This course mainly focuses on applications of state-of-the-art machine learning (ML) techniques in mechanical engineering. It also covers the fundamentals of probability and statistical learning theory. This class requires basic/intermediate-level programming in Python.

MAE 690 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 700 Selected Topics: Mechanical & Aerosapce Engineering (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 721 Theory of Elasticity (3 Credits)
Engineering & Comp Sci
General theorems governing the mechanics of linear elastic solids. Cartesian tensor analysis. Kinematics of infinitesimal deformations and force transmission. Balance principles and linear elastic constitutive theory. Plane and three- dimensional problems in elastostatics and elastodynamics.

MAE 723 Asymptotic Methods for Engineering Applications (3 Credits)
Engineering & Comp Sci
Introduction including problems in vibrations and fluid mechanics. Regular and singular perturbations; asymptotic matching. Boundary value problems; distinguished limits. Multiple scale expansions, WKB theory.

MAE 728 Geometric and Optimal Control (3 Credits)
Engineering & Comp Sci
Linear controllability and observability. Introduction to geometric control: Lie algebras, distributions, nonlinear controllability and observability. Control of mechanical systems: geometric mechanics, Lagrangian and Hamiltonian methods. Optimal control: Pontryagin¿s Maximum Principle for systems on manifolds.

MAE 731 Bending of Plates and Shells I (3 Credits)
Engineering & Comp Sci
Small-deflection theory of plates. Analysis of variously shaped plates under various loading and support conditions. Membrane theory of shells. Bending theory of cylindrical shells.
Advisory recommendation Prereq: MAE 635

MAE 735 Buckling Problems (3 Credits)
Engineering & Comp Sci
Physical and mathematical aspects of buckling. Analysis of elastic buckling phenomena for columns, beams, arches, rings, plates, and shells under various loading and support conditions. Buckling due to thermal stress, inelastic buckling, creep buckling.
Advisory recommendation Prereq: MAE 635

MAE 741 Fundamentals of Turbulence (3 Credits)
Engineering & Comp Sci
Qualitative description, main parameters and scaling variables; similarity analysis of mixing layers, jet boundary layers, pipe flows; extension to transport and mixing with emphasis on K-E models.
Advisory recommendation Prereq: MAE 643

MAE 746 Viscous Fluids (3 Credits)
Engineering & Comp Sci
Exact solutions of Navier-Stokes equations. Low Reynolds-number flows. Hydrodynamic theory of lubrication. Boundary-layer equations, exact and approximate methods of solution. Compressible viscous flows.
Advisory recommendation Prereq: MAE 643

MAE 765 Combustion Phenomena in Engineering (3 Credits)
Engineering & Comp Sci
Reacting gases-equilibrium composition and kinetics. Kinetically and diffusionally controlled combustion. Ignition. Flames in premixed gases. Laminar flame speed. Turbulent flames. Detonation Diffusion flames. Applications to combustion equipment.
Advisory recommendation Prereq: MAE 651

MAE 771 Computational Fluid Mechanics (3 Credits)
Engineering & Comp Sci
Numerical solutions using finite difference methods and other techniques. Principles of approximations; accuracy considerations. Applications including boundary-layer and potential flow solutions.

MAE 785 Continuum Mechanics (3 Credits)
Engineering & Comp Sci
Foundations of the mechanics of deformable bodies. Elements of tensor calculus. Kinematics of deformation and transmission of force. Balance principles. Theory of constitutive equations and an introduction to hyperelastic solids and Stokesian fluids.

MAE 849 Advanced Topics in Fluid Mechanics (3 Credits)
Engineering & Comp Sci
Topics dealing with fluid flow, such as theories of turbulence, jets, wakes, cavities, magnetohydrodynamics.
Repeatable 2 times for 6 credits maximum

MAE 879 Advanced Topics in Mechanical Design (3 Credits)
Engineering & Comp Sci
Selected topics dealing with problems in mechanical design, such as theory of lubrication and bearings, balancing problems, high-speed mechanisms.
Repeatable 2 times for 6 credits maximum

MAE 889 Selected Topics (3 Credits)
Engineering & Comp Sci
Selected topics dealing with the theory and design of steam and gas turbines, centrifugal and axial flow compressors.
Repeatable 2 times for 6 credits maximum

MAE 990 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

MAE 994 Capstone Project (0 Credits)
Engineering & Comp Sci
Review technical papers or reports in the open literature related to student's field of interest. Students prepare oral presentation to the faculty summarizing the technical content of the document.

MAE 995 Graduate Seminar (0 Credits)
Engineering & Comp Sci

MAE 997 Master's Thesis (1-9 Credits)
Engineering & Comp Sci
Repeatable

MAE 999 Dissertation (1-15 Credits)
Engineering & Comp Sci
Repeatable

Mechanical Engineering
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

MEE 600 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 631 Strengths&Mech Behvr/Mats (3 Credits)
Engineering & Comp Sci

MEE 636 Matrls & Procs in Manuf (3 Credits)
Engineering & Comp Sci

MEE 637 Mechanics of Heterogeneous Solids (3 Credits)
Engineering & Comp Sci
Effective elastic moduli of composite materials. Bounds on effective moduli. Classical analysis of laminated plates. Higher order laminated plate theory. Wave propagation. Inelastic and nonlinear effects.

MEE 641 Fundamentals/Turbulence (0 Credits)
Engineering & Comp Sci

MEE 670 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

MEE 676 Comp Cntrl Machns&Procs (3 Credits)
Engineering & Comp Sci

MEE 690 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

MEE 700 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 715 Robot Manipulators I (3 Credits)
Engineering & Comp Sci
Cross-listed with ELE 715
Robot manipulators and their defining equations. Transformations, kinematics, dynamics, and motion trajectories. Control considerations, compliance and organization of programming. Includes a hardware and software laboratory.

MEE 725 Advanced Engineering Dynamics (3 Credits)
Engineering & Comp Sci
Newton's laws of motion. Motion of a particle; a rigid body. Work and energy. Theorem of virtual displacements. D'Alembert's principle. Generalized coordinates. Lagrange's equations. Hamilton's principle. Small vibrations. Ballistics. Balancing. Gyroscopes.

MEE 727 Vibration (3 Credits)
Engineering & Comp Sci

MEE 775 Dynamics of Controls (3 Credits)
Engineering & Comp Sci
Continuation of MEE 725. Analysis of mechanical and hydraulic control systems of linear and nonlinear characteristics. Stability criteria in systems subject to self-induced vibrations. Operational calculus and Laplace transforms for linear systems of one and two degrees of freedom. Multiple controller servomechanisms.
Advisory recommendation Prereq: MEE 725

MEE 790 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

MEE 800 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 825 Theory of Plasticity (3 Credits)
Engineering & Comp Sci
Basic behavior of materials and formulation of laws governing plastic flows. Different inelastic behaviors of metals. Yielding and the yielding loci. Strain hardening laws. Complete stress-strain relations. Total strain theory and incremental strain theory. Plastic potential. Boundary value problems. Variational principles. Plastic anistropy.
Advisory recommendation Prereq: MAE 721

MEE 827 Theory/Ideally Plas Mat (3 Credits)
Engineering & Comp Sci

MEE 829 Advanced Topics in Dynamics (3 Credits)
Engineering & Comp Sci
Selected topics dealing with dynamics of rigid bodies, vibration and stability of linear systems.
Advisory recommendation Prereq: MEE 727

MEE 831 Bending Plates & Shells I (3 Credits)
Engineering & Comp Sci

MEE 835 Buckling Problems (3 Credits)
Engineering & Comp Sci

MEE 856 Advanced Topics in Heat Transfer (3 Credits)
Engineering & Comp Sci
Selected topics in heat transfer. Boiling, condensation, melting, ablation, rarified gas flow, liquid metals, cooling of electronic components.
Advisory recommendation Prereq: MAE 655

MEE 859 Advanced Topics in Thermodynamics (3 Credits)
Engineering & Comp Sci
Selected topics in classical and statistical thermodynamics of interest to mechanical and aeronautical engineers.
Repeatable 2 times for 6 credits maximum
Advisory recommendation Prereq: MAE 651

MEE 885 Advanced Topics in Thermal Engineering (3 Credits)
Engineering & Comp Sci
Selected topics in theory and design of equipment and plants for power generation, air conditioning, refrigeration, water purification, and other thermal engineering application.
Repeatable 2 times for 6 credits maximum
Advisory recommendation Prereq: MAE 655

MEE 895 Advanced Topics in Mechanics of Deformable Bodies (3 Credits)
Engineering & Comp Sci
Selected topics in theories of elasticity, plasticity, and rheology, such as finite strain theory, elastic and plastic waves, anisotropic bodies, special mathematical techniques.
Repeatable 2 times for 6 credits maximum
Advisory recommendation Prereq: MAE 721

MEE 990 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

MEE 996 Special Projects (1-6 Credits)
Engineering & Comp Sci
Repeatable

Manufacturing Engineering
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

MFE 600 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 633 Enterprise Systems (3 Credits)
Engineering & Comp Sci
Technical overview of Enterprise Systems and their impact on organizations. The concepts, fundamentals, issues and technologies in planning, implementing and operating an Enterprise System. Current trends, issues, technologies and extensions. Laboratory exercises
Advisory recommendation Prereq: CSE 581 or IST 659

MFE 634 Productivity and Quality Engineering (3 Credits)
Engineering & Comp Sci
Measuring, evaluating and improving productivity in conjunction with total quality methods. Multidimensional measures of performance. Quality function deployment, concurrent engineering, loss function; system, parameter and tolerance design using statistically designed experiments. Statistical quality control overview.
Advisory recommendation Prereq: ECS 526

MFE 635 Manufacturing Systems (3 Credits)
Engineering & Comp Sci
Survey of different types of manufacturing systems and design methodologies. Topics include transfer line, flow shops, job shops, manufacturing cells, flexible manufacturing systems, and computer integrated manufacturing systems. Integration of manufacturing components and emerging trends.
Advisory recommendation Prereq: ECS 526

MFE 636 Materials and Processing in Manufacturing (3 Credits)
Engineering & Comp Sci
Properties of metals, polymers, ceramics; mechanics and mechanisms of deformation processing, manufacturing processes. Laboratory demonstrations.

MFE 639 CAD/CAM Systems (3 Credits)
Engineering & Comp Sci
Advanced topics in Computer Aided Design and Solid Modeling, Computer-integrated Manufacturing, Concurrent Engineering, Process Planning, Manufacturing Control, Measurement and Analysis.

MFE 654 Production System Design and Control (3 Credits)
Engineering & Comp Sci
Introduction to design, planning, execution, and control of production systems using mathematical, computational, and other modern techniques. Forecasting, inventory control, lean manufacturing, materials requirement planning, enterprise resource planning, and supply chain planning.
Advisory recommendation Prereq: ECS 526

MFE 670 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

MFE 676 Computer Control of Machines and Processes (3 Credits)
Engineering & Comp Sci
Application of microcomputers, programmable controllers, numerical controls, analog-digital conversion, robotics, software development, laboratory experiments.

MFE 690 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 692 Design for Manufacturing (3 Credits)
Engineering & Comp Sci
Major design project which would include initial design definition, analysis/CAD, manufacturability studies, design modification, manufacturing layout and data bases.
Advisory recommendation Prereq: MFE 636

MFE 693 Design for Manufacturing (3 Credits)
Engineering & Comp Sci

MFE 700 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 735 Artificial Intelligence in Manufacturing Systems (3 Credits)
Engineering & Comp Sci
Artificial Intelligence as a tool for modeling, planning, and controlling manufacturing systems. Knowledge representation, inference methods, expert systems, blackboard framework, neural networks, and their application in manufacturing systems. Issues involved in building intelligent manufacturing systems.
Advisory recommendation Prereq: MFE 635

MFE 850 Advanced Topics in Manufacturing (3 Credits)
Engineering & Comp Sci
Selected topics in conventional and non-conventional manufacturing processes, flexible manufacturing cell, automated manufacturing, production planning, quality control.
Repeatable 2 times for 6 credits maximum

MFE 990 Independent Study (3-6 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 997 Master's Thesis (0-9 Credits)
Engineering & Comp Sci
Repeatable

Materials Science
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.

MTS 625 Topics in Solid-State Thermodynamics (3 Credits)
Engineering & Comp Sci
Application of classical and statistical thermodynamic principles to the behavior of solids. Phase equilibria, diffusion, defects, interfaces, use of tabulated data in real problems, elastic, magnetic, and electric systems.

MTS 631 Advanced Physical Metallurgy (3 Credits)
Engineering & Comp Sci
Solid-state processes. Structure of pure metals. Phase diagrams. Solid solutions, eutectic and peritectic reactions. Diffusion, nucleation, and growth phenomena. Transformation processes.

MTS 632 Transformations in the Solid State (3 Credits)
Engineering & Comp Sci
Reactions and transformations in solids. Allotropy, critical phenomena in solid solutions, nucleation, growth, precipitation from supersaturated solid solutions, recovery, recrystallization and growth, eutectoid transformations. Martensite transformations, etc.
Advisory recommendation Prereq: MTS 631

MTS 655 Electron Transport Phenomena in Crystals (3 Credits)
Engineering & Comp Sci
Electron states. Dynamics of electrons. Electron spin. Thermal energy. Interaction of electrons with the lattice and crystal defects. Thermoelectricity. Hall Effect, magneto resistance. Optical properties. Superconductivity.

MTS 671 Mechanical Behavior of Materials (3 Credits)
Engineering & Comp Sci
Mechanical behavior of metallic materials. Effects of stress systems on deformation. Static and dynamic properties of metals and alloys. Plastic deformation. Residual stresses. Stress concentrations. Metal forming.

MTS 672 Dislocation Theory (3 Credits)
Engineering & Comp Sci
Deformation laws on the basis of dislocation theory. Types of dislocations. Stress field of dislocations. Interaction between dislocations. Yield point phenomenon; strain hardening. Age hardening. Fracture initiation and crack propagation.

MTS 682 Electron Diffraction and Electron Microscopy (3 Credits)
Engineering & Comp Sci
Kinematic theory of electron diffraction and electron microscopy. Dynamics theory. Contrast from perfect and imperfect crystals. Specimen preparation and experimental methods.
Advisory recommendation Prereq: MTS 581

MTS 684 Modern Microstructural Techniques (3 Credits)
Engineering & Comp Sci
Cross-listed with SST 684
Basic principles, capabilities and applications of various microstructural methods not covered in MTS 581 and MTS 682. Scanning electron microscopy, electron probe microanalysis, X-ray fluorescence, field ion microscopy.
Advisory recommendation Prereq: MTS 581

MTS 690 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 720 Formation of Thin Solid Films (3 Credits)
Engineering & Comp Sci
Science and engineering of the formation of thin solid films. Vacuum technology, film formation, theories of nucleation and accommodation, growth and structure of single crystal films.
Repeatable

MTS 721 Properties of Thin Solid Films (3 Credits)
Engineering & Comp Sci
Topics chosen principally from: mechanical, piezoelectric, magnetic, electron transport , superconductive, and optical properties.

MTS 748 Theory of Alloys (3 Credits)
Engineering & Comp Sci
The application of bond theories in prediction of: structure, stability and reactivity of alloy phases, intermetallic compounds, carbides, nitrides, etc. Topics covered include valence bond theory, crystal field theory, Engel-Brewer correlation as well as other periodic classifications of properties which are of value in making the above types of predictions.

MTS 756 Magnetic Phenomena in Crystals (3 Credits)
Engineering & Comp Sci
Orbital magnetic susceptibility, spin paramagnetism, fero, ferri, antiferromagnetism, exchange interaction, Ising model, domain structure, fine particles, thin films, magnetic anisotropy, reversible and irreversible magnetization processes.
Advisory recommendation Prereq: MTS 631

MTS 800 Selected Topics in Mechanics of Materials (1-6 Credits)
Engineering & Comp Sci
Imperfections in solids, fracture and yielding criteria, fatigue, creep, ultrasonic effects, radiation damage, surface phenomena and related subjects of current interest.
Repeatable

MTS 820 Selected Topics in Materials Science (1-4 Credits)
Engineering & Comp Sci
Recent developments in the field of materials science.
Repeatable

MTS 837 Advanced Problems in the Physics of Metals (3 Credits)
Engineering & Comp Sci
Quantitative treatment of the theory of the properties of metals and alloys.
Advisory recommendation Prereq: PHY 662

MTS 867 Theory of Surfaces and Interfaces (3 Credits)
Engineering & Comp Sci
Fundamental theory of the interfaces formed between various combinations of solids, liquids, and gases based on the thermodynamic and electronic models. Phenomena of adsorption, capillarity, catalysis, electronic emissions, double layer effects, and heterojunctions.

MTS 890 Metallurgical Research Techniques (3 Credits)
Engineering & Comp Sci
Topics selected from the following and related areas: high and low temperature research, high vacuum, high pressure experimental stress analysis, quantitative metallograpy, nondestructive testing, electron microscopy, mass spectrometry, X-ray and electron diffraction.
Repeatable 2 times for 6 credits maximum

MTS 960 Advanced Seminar in Materials Science (3 Credits)
Engineering & Comp Sci
Recent scientific and engineering advances in specific fields of materials science.
Repeatable

MTS 990 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 997 Masters Thesis (1-6 Credits)
Engineering & Comp Sci

MTS 999 Dissertation (1-15 Credits)
Engineering & Comp Sci

Nuclear Energy Track
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)

Solid-State Science and Technology
SST 684 Modern Microstructural Techniques (3 Credits)
Engineering & Comp Sci
Cross-listed with MTS 684
Basic principles, capabilities and applications of various microstructural methods not covered in MTS 581 and MTS 682. Scanning electron microscopy, electron probe microanalysis, X-ray fluorescence, field ion microscopy.
Advisory recommendation Prereq: MTS 581

SST 800 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

SST 820 Selected Topics in Solid-State Science and Technology (1-4 Credits)
Engineering & Comp Sci
Recent developments in the field.
Repeatable

SST 990 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploring a problem or problems in solid-state science. Individual independent study upon plan submitted by student.
Repeatable

SST 997 Masters Thesis (0-6 Credits)
Engineering & Comp Sci
Repeatable

SST 999 Dissertation (1-15 Credits)
Engineering & Comp Sci
Repeatable