CHEMICAL ENGINEERING (CEN)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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