**ECHM - Chemical Engineering**

**ECHM 100 Intro to Chemical Engr: 2 Credits (1 Lec, 1 Lab)**
(F) An introduction to engineering measurements, computations, problem solving, and experimental design. Discussion of the breadth of opportunities in chemical and biological engineering. Cross-Listed with EBIO 100.

**ECHM 201 Elementary Principles of Chemical and Biological Engineering: 4 Credits (4 Lec, 4 Other)**

**ECHM 205CS Energy and Sustainability: 3 Credits (3 Lec)**
(F, Sp) Students from all academic backgrounds explore an array of renewable and non-renewable energy sources and energy conversion systems. Contemporary and contentious energy related issues are presented, and course participants will formulate strategies to address them.

**ECHM 215 Elementary Principles of Chemical and Biological Engineering I: 3 Credits (3 Lec)**

**ECHM 216 Elementary Principles of Chemical and Biological Engineering II: 3 Credits (3 Lec)**

**ECHM 290R Undergraduate Research: 1-6 Credits (1-6 Other)**
PREREQUISITE: Consent of instructor. (F, Sp, Su) Directed undergraduate research/creative activity which may culminate in a written work or other creative project. May be repeated. Repeatable up to 99 credits.

**ECHM 291 Special Topics: 1-4 Credits (1-4 Other)**
PREREQUISITE: None required but some may be determined necessary by each offering department. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number. Repeatable up to 12 credits.

**ECHM 292 Independent Study: 1-3 Credits (1-3 Other)**
PREREQUISITE: Consent of instructor and approval of the Associate Dean. (F, Sp, Su) Directed research and study on an individual basis. Repeatable up to 6 credits.

**ECHM 307 Chem Engin Thermodynamics I: 3 Credits (3 Lec)**

**ECHM 321 Chemical Engineering Fluid Mechanics Operations: 3 Credits (3 Lec)**
PREREQUISITE: ECHM 201 and M 273. COREQUISITE: M 274. (F, Sp) Theory and equipment for fundamental chemical and biological engineering operations involving fluid mechanics. Equipment design and computations of operational rates.

**ECHM 322 Chemical Engineering Heat Transfer Operations: 3 Credits (3 Lec)**

**ECHM 323 Chemical Engineering Mass Transfer Operations: 3 Credits (3 Lec)**
PREREQUISITE: ECHM 307, ECHM 322. (F, Sp) Theory and equipment for fundamental chemical engineering operations involving mass transfer. Equipment design and computations of operational rates.

**ECHM 328 Chemical Engineering Reactor Design: 3 Credits (3 Lec)**
PREREQUISITE: ECHM 201, M 274. (F, Sp) Application of the chemical kinetics of homogeneous and heterogeneous reactions to the design of chemical processing equipment.

**ECHM 405 Sustainable Energy: 3 Credits (3 Lec)**
PREREQUISITE: EMAT 251 and either ECHM 307 or EMEC 320, or consent of instructor. (F) Review of energy sources, their extraction, conversion and end-use, focusing on modern technology and materials. Investigate the design, construction and operation of combustion-based energy conversion systems including boilers, engines and gas turbines, in addition to non-combustion-based energy conversion systems including solar-thermal, photovoltaics, wind turbines, fuel cells and batteries.

**ECHM 407 Chem Engin Thermodynamics II: 2 Credits (2 Lec)**
PREREQUISITE: ECHM 307 and ECHM 323 and ECHM 328. (F, Sp) Application of laws of thermodynamics to vapor-liquid phase equilibrium, liquid-liquid phase equilibrium, and chemical reaction equilibrium.

**ECHM 411R Chemical Engineering Design I: 3 Credits (2 Lec, 1 Other)**
PREREQUISITE: ECHM 321, ECHM 322, ECHM 323, ECHM 328, EGEN 310R. (F) Senior capstone course. Design and simulation of chemical engineering equipment, processes and plants.

**ECHM 412R Chemical Engineering Design II: 3 Credits (2 Lec, 1 Other)**
PREREQUISITE: ECHM 323, ECHM 328. (Sp) Senior capstone course. Design and economic analysis of chemical engineering equipment, processes and plants. Students are required to meet with a faculty one hour a week for the additional credit hour of instruction.

**ECHM 424 Transport Analysis: 3 Credits (3 Lec)**
PREREQUISITE: ECHM 323, M 273, M 274. (F, Sp) Deterministic modeling techniques are applied to processes for the transport of momentum, energy and mass. Analytical and numerical solution techniques for the differential equations commonly encountered in the transport processes.

**ECHM 428 Reaction Engineering and Reaction Modeling: 3 Credits (3 Lec)**
PREREQUISITE: ECHM 323 and ECHM 328. (F, Sp) Advanced engineering aspects of chemical reactor design. Analysis of coupled mass and energy transport processes and chemical reaction in application to realistic design and scale-up of various types of chemical reactors. Optimization problems in reactor design and operation.
ECHM 442  Chem Engin Laboratory I: 3 Credits (1 Lec, 2 Lab)
PREREQUISITE: ECHM 323, EGEN 350. (F, Sp) Experimental studies of unit operations and transport phenomena. Pilot plant studies. Design of Chemical processes and equipment from experimental studies. Cross-listed with EBI0 442

ECHM 443  Chem Engin Laboratory II: 3 Credits (1 Lec, 4 Lab)
PREREQUISITE: ECHM 442. (F, Sp) Experimental studies of unit operations and transport phenomena. Design of chemical processes and equipment from experimental studies

ECHM 451  Chemical Engineering Process Dynamics and Control: 3 Credits (3 Lec)
PREREQUISITE: ECHM 328 or EBI0 438 and M 274. (F, Sp) Transient response analysis of controllers and instruments. Design of chemical process control systems

ECHM 452  Advanced Engineering Materials: 3 Credits (3 Lec)
PREREQUISITE: EMEC 250 or EMAT 251, M 274. () On demand. Micro and macro properties of electronic materials and material processing

ECHM 490R  Undergraduate Research: 1-8 Credits (1-8 Other)
PREREQUISITE: Senior Standing and consent of instructor. (F, Sp, Su) Directed undergraduate research/project. Course will address responsible conduct of research. May be repeated Repeatable up to 12 credits.

ECHM 491  Special Topics: 1-3 Credits (1-3 Other)
PREREQUISITE: Course prerequisites as determined for each offering. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number Repeatable up to 12 credits.

ECHM 492  Independent Study: 1-3 Credits (1-3 Other)
PREREQUISITE: Junior standing, consent of instructor and approval of department head. (F, Sp, Su) Directed research and study on an individual basis Repeatable up to 6 credits.

ECHM 498  Internship: 1-12 Credits (1-12 Lec)
PREREQUISITE: Junior standing, consent of instructor and approval of associate dean. (F, Sp, Su) An individualized assignment arranged with an agency, business or other organization to provide guided experience in the field Repeatable up to 12 credits.

ECHM 503  Thermodynamics: 3 Credits (3 Lec)
PREREQUISITE: ECHM 307. (F) Chemical engineering application to phase equilibria and chemical reaction equilibrium. Liquid - liquid, vapor - liquid, and multiple reaction system

ECHM 510  Reaction Engineering/Modeling: 3 Credits (3 Lec)
PREREQUISITE: ECHM 328. (Sp) Theory and practice of industrial reactions, kinetics, synthesis, modeling of fixed and fluidized beds, process design problems

ECHM 533  Transport Phenomena: 3 Credits (3 Lec)
PREREQUISITE: ECHM 424. (Sp) Comprehensive treatment of mass, momentum, and energy transport. Cross listed with EMEC 533

ECHM 534  Mass Transfer: 3 Credits (3 Lec)
PREREQUISITE: ECHM 424. (F, Sp) Mass transfer theory, transport in liquids, porous solids, interfacial effects, related mathematical techniques and application

ECHM 535  Viscous Fluid Dynamics: 3 Credits (3 Lec)