DEPARTMENT OF CHEMICAL AND BIOLOGICAL ENGINEERING

Office in Engineering, Room AR102
(970) 491-5252
cbe.colostate.edu (http://cbe.colostate.edu)

Professor David S. Dandy, Department Head

Undergraduate Majors
• Major in Chemical and Biological Engineering
• Major in Biomedical Engineering and Chemical and Biological Engineering

Graduate Programs in Chemical and Biological Engineering
The department offers graduate programs leading to Master of Engineering, Master of Science, and Doctor of Philosophy degrees. Students interested in graduate work should refer to the Graduate and Professional Bulletin or the Department of Chemical and Biological Engineering (http://www.engr.colostate.edu/cheme/pages/fs_graduate_program.html).

Master Programs
• Master of Science in Chemical Engineering, Plan A*
• Master of Science in Chemical Engineering, Plan B*
• Master of Engineering, Plan C, Chemical Engineering Specialization*

Ph.D.
Ph.D. in Chemical Engineering*

* Please see department for program of study.

Courses

Chemical and Biological Engineering (CBE)

CBE 101 Chemical and Biological Engineering I Credits: 3 (2-2-0)
Course Description: Engineering design and problem solving; technical presentation skills; basic computer programming.
Prerequisite: CBE 160, may be taken concurrently.
Registration Information: Must register for lecture and laboratory.
Term Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: Yes.

CBE 102 Chemical and Biological Engineering II Credits: 3 (2-2-0)
Course Description: Applications of engineering design and problem solving; computer programming to solve engineering problems; team project.
Prerequisite: CBE 101.
Registration Information: Must register for lecture and laboratory.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: Yes.

CBE 160 MATLAB for Chemical and Biological Engineering Credit: 1 (0-2-0)
Course Description: Introduction to MATLAB programming for Chemical and Biological Engineering applications.
Prerequisite: None.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 201 Material and Energy Balances Credits: 3 (3-0-0)
Course Description: Principles of chemistry, physics, and mathematics applied to development of material and energy balances; illustration of concepts.
Prerequisite: (CBE 101 or CBE 160, may be taken concurrently or MATH 151, may be taken concurrently) and (LIFE 102, may be taken concurrently and CHEM 111 and PH 141, may be taken concurrently).
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 205 Introduction to Biological Engineering Credits: 3 (3-0-0)
Course Description: Introduction to the application of the principles of engineering and biology to the analysis, design, and optimization of bioprocesses.
Prerequisite: CBE 101 and CBE 160 and LIFE 102.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 210 Thermodynamic Process Analysis Credits: 3 (3-0-0)
Course Description: Thermodynamic fundamentals and applications to ideal and non-ideal mixtures, power cycles, and chemical equilibria.
Prerequisite: CBE 201 with a minimum grade of C and MATH 261, may be taken concurrently.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Traditional.
Special Course Fee: No.
CBE 310  Molecular Concepts and Applications  Credits: 3 (3-0-0)
Course Description: Application of modern molecular theory to chemical
and biological engineering problems in thermodynamics, chemical
kinetics, and transport phenomena.
Prerequisite: (CBE 210 with a minimum grade of C) and (MATH 340).
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 320  Chemical and Biological Reactor Design  Credits: 3 (3-0-0)
Course Description: Mechanisms and rates of chemical reactions; design
of homogeneous and heterogeneous reactors; biological reactions and
reactors.
Prerequisite: CBE 310 with a minimum grade of C and CBE 330 with a
minimum grade of C.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 330  Process Simulation  Credits: 3 (3-0-0)
Course Description: Analysis of chemical and biological engineering
problems by numerical simulation.
Prerequisite: (CBE 210 with a minimum grade of C) and (MATH 340).
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 331  Momentum Transfer and Mechanical Separations  Credits: 3 (3-0-0)
Course Description: Fluid properties; conservation equations;
compressible and incompressible flow; pumping and metering; mixing;
separation of fluid-solid mixtures.
Prerequisite: (CBE 210 with a minimum grade of C) and (MATH 340).
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 332  Heat and Mass Transfer Fundamentals  Credits: 3 (3-0-0)
Course Description: Thermal processes; steady and unsteady conduction;
convective heat transfer; radiation; heat exchanger design; mass transfer
by diffusion and convection.
Prerequisite: CBE 330 with a minimum grade of C and CBE 331 with a
minimum grade of C and CBE 310 with a minimum grade of C.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 333  Chemical and Biological Engineering Lab I  Credits: 2 (0-5-0)
Course Description: Laboratory experiments involving material balances,
thermodynamics, and momentum and heat transfer. Data analysis;
written and oral reports.
Prerequisite: CBE 332, may be taken concurrently.
Term Offered: Fall.
Grade Mode: S/U within Student Option, Trad within Student Option.
Special Course Fee: Yes.

CBE 334  Chemical and Biological Engineering Lab II  Credits: 2 (0-5-0)
Course Description: Laboratory experiments involving chemical and
biological processes; dimensional analysis for parameter identification
and order of magnitude estimation.
Prerequisite: CBE 332.
Term Offered: Fall.
Grade Mode: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 335  Chemical and Biological Engineering Design I  Credits: 3 (3-0-0)
Course Description: Chemical and biological process synthesis and
simulation; engineering economics principles.
Prerequisite: CBE 442, may be taken concurrently and CBE 320 with a
minimum grade of C.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 442  Separation Processes  Credits: 4 (4-0-0)
Course Description: Analysis of chemical and biological separations
based on thermodynamics, diffusion, and convective mass transfer;
design of separations equipment.
Prerequisite: CBE 332 with a minimum grade of C.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 439  Environmental Engineering Chemical Concepts  Credits: 3 (2-3-0)
Also Offered As: CIVE 439.
Course Description: Application of chemical principles to environmental
engineering problems.
Prerequisite: CHEM 113 and MATH 340.
Registration Information: Must register for lecture and laboratory. Credit
not allowed for both CBE 439 and CIVE 439.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 430  Process Control and Instrumentation  Credits: 3 (3-0-0)
Course Description: Measurement and control of process variables;
transient chemical and biological processes; feedback, feedforward, and
computer control concepts.
Prerequisite: CBE 320 with a minimum grade of C and CBE 442 with a
minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 440  Environmental Engineering Chemical Concepts II  Credits: 3 (2-3-0)
Also Offered As: CIVE 440.
Course Description: Application of chemical principles to environmental
engineering problems.
Prerequisite: CHEM 113 and MATH 340.
Registration Information: Must register for lecture and laboratory. Credit
not allowed for both CBE 439 and CIVE 439.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 443  Chemical and Biological Engineering Lab II  Credits: 2 (0-5-0)
Course Description: Laboratory experiments involving advanced chemical
and biological engineering concepts. Data analysis; written and oral
reports.
Prerequisite: CBE 442, may be taken concurrently or ENVE 442, may be
taken concurrently.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 451  Chemical and Biological Engineering Design I  Credits: 3 (3-0-0)
Course Description: Chemical and biological process synthesis and
simulation; engineering economics principles.
Prerequisite: CBE 442, may be taken concurrently and CBE 320 with a
minimum grade of C.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 452  Chemical and Biological Engineering Design II  Credits: 3 (2-2-0)
Course Description: Projects requiring students to design a chemical
and/or biological process with cost estimation and constraint analysis;
written and oral reports.
Prerequisite: CBE 451 with a minimum grade of C.
Registration Information: Must register for lecture and laboratory.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.
CBE 493 Professional Development Seminar Credit: 1 (0-0-1)
Course Description: Topics in engineering professional development, including ethics, role of engineers in society, and life-long learning.
Prerequisite: None.
Term Offered: Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 495 Independent Study Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 496 Group Study Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 501 Chemical Engineering Thermodynamics Credits: 3 (3-0-0)
Course Description: Definition, correlation, and estimation of thermodynamic properties; nonideal chemical and physical equilibria.
Prerequisite: CBE 202 and MATH 340.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 503 Transport Phenomena Fundamentals Credits: 3 (3-0-0)
Course Description: General topics in transport phenomena; analytical and numerical solutions of laminar flows; perturbation techniques; coupled transport.
Prerequisite: CBE 406.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 504 Fundamentals of Biochemical Engineering Credits: 3 (3-0-0)
Also Offered As: BIOM 504.
Course Description: Application of chemical engineering principles to enzyme kinetics, fermentation and cell culture, product purification, and bioprocess design.
Prerequisite: (MIP 300) and (MATH 255 or MATH 340) and (BIOM 306, may be taken concurrently or BTEC 306, may be taken concurrently or CBE 320, may be taken concurrently).
Registration Information: Credit not allowed for both CBE 504 and BIOM 504.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 505 Biochemical Engineering Laboratory Credit: 1 (0-3-0)
Course Description: Fermentation technology, bioprocess control, and protein purification.
Prerequisite: CBE 504, may be taken concurrently.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

CBE 514 Polymer Science and Engineering Credits: 3 (3-0-0)
Course Description: Fundamentals of polymer science: synthesis, characterization, processing of polymers. Physical properties of polymers; rheology of melts and solutions.
Prerequisite: (CHEM 343 or CHEM 346) and (CBE 310 or CHEM 474).
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 521 Mathematical Modeling for Chemical Engineers Credits: 3 (3-0-0)
Course Description: Application of mathematical models to analysis and design of chemical reactors and separation processes.
Prerequisite: MATH 340.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 522 Bioseparation Processes Credits: 3 (2-2-0)
Also Offered As: BIOM 522.
Course Description: Analysis of processes to recover and purify fermentation products.
Prerequisite: CBE 331.
Registration Information: Must register for lecture and laboratory. Credit not allowed for both CBE 522 and BIOM 522.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 524 Bioremediation Credit: 1 (1-0-0)
Course Description: Use of biotechnology for site remediation. Biodegradation, bioreactor design, and in situ bioremediation.
Prerequisite: CBE 540 or CIVE 540.
Term Offered: Fall (odd years).
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 540 Advanced Biological Wastewater Processing Credits: 3 (3-0-0)
Also Offered As: CIVE 540.
Course Description: Fundamentals of environmental biotechnology: environmental microbiology, microbial kinetics, basic reactor design, wastewater treatment.
Prerequisite: CBE 320 or CIVE 438.
Registration Information: Credit not allowed for both CBE 540 and CIVE 540.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.
CBE 543  Membranes for Biotechnology and Biomedicine  Credits: 3 (3-0-0)
Also Offered As: BIOM 543.
Course Description: Polymeric membrane formation, modification, module design and applications to bioseparation and biomedical separations and tissue engineering.
Prerequisite: CHEM 343 and CBE 310.
Registration Information: Credit not allowed for both CBE 543 and BIOM 543. Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 570  Biomolecular Engineering/Synthetic Biology  Credits: 3 (3-0-0)
Course Description: Rational design and evolutionary methods for engineering functional protein and nucleic acid systems.
Prerequisite: (BC 351) and (CHEM 341 or CHEM 345).
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 613  Advanced Transport Phenomena  Credits: 3 (3-0-0)
Course Description: Fundamental studies of multicomponent mass, energy, and momentum transport, with applications in advanced materials, biomedical and biochemical systems.
Prerequisite: (MATH 530) and (ATS 601 or CIVE 502 or CBE 503).
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

CBE 621  Advanced Process Control  Credits: 3 (3-0-0)
Course Description: Application of modern control theory to chemical processes. Computer control aspects emphasized.
Prerequisite: CBE 430.
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

CBE 660  System and Parameter Identification  Credits: 3 (3-0-0)
Course Description: Principles and methods for selecting the most appropriate equations, and properties within those equations, to mathematically simulate physical phenomena.
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

CBE 693  Seminar I  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 695  Independent Study  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 699  Thesis  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 707  Advanced Topics in Biochemical Engineering  Credit: 1 (1-0-0)
Course Description: Advanced biochemical engineering topics.
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

CBE 793  Seminar II  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 795  Independent Study  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

CBE 799  Dissertation  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.