○ Course Descriptions

❒ Undergraduate

CBE201 Molecular Engineering Laboratory
This course deals with basic experimental techniques and related principles required for understanding molecular engineering. This course covers various experimental techniques and theoretical principles for molecular reaction engineering, biochemical engineering, and polymer engineering.

CBE202 Introduction to Chemical and Biomolecular Engineering
General concepts of applying physics, chemistry, biology and mathematics to chemical and biological systems. The applications of material and energy balances, reaction engineering, viscous and potential flows, heat and mass transfer and thermodynamics will be introduced. Special topics include heat, security, materials and energy.

CBE203 Industrial Organic Chemistry
Industrial organic chemistry will offer an extensive look at the special nature of carbon chemistry. Emphasis will be placed on structure, functional groups and nomenclature as well as important classes of industrial organic reactions.

CBE205 Chemical and Biomolecular Engineering Analysis
The objective of this course is: 1)to learn a range of numerical methods for the approximate solution of mathematical equations encountered in chemical engineering, 2)to understand the shortcomings of these numerical methods, and how to choose the appropriate method for solving a given problem, and 3)to use MATLAB and HYSYS to implement these methods and apply them to a variety of chemical engineering problems. (Prerequisite course: MAS101, MAS102)

CBE206 Chemical and Biomolecular Engineering Analysis
This course is an introduction to various numerical methods that are used to solve practical problems that pertain to the field of chemical and biomolecular engineering. In this course, we will learn MATLAB and use it as a tool to solve many of the important engineering problems. (Prerequisite course: MAS101, MAS102)

CBE221 Molecular Thermodynamics and Energy Systems
The main goal is for students to be more familiar with the basic principles of thermodynamics and apply these principles to the solution of a large variety of energy flow and equilibrium problems. In particular, molecular thermodynamics is emphasized to extend its applications to energy, environment, BT and NT.

CBE260 Biomolecular Engineering
Lecture about the basic biological principles necessary for the engineering application of biomolecular phenomena.

CBE261 Biochemical Engineering
This course deals with various engineering principles required for understanding and developing bioprocesses by using microbial, animal and plant cells, and enzymes.

CBE301 Chemical and Biomolecular Engineering Laboratory
This course deals with basic experimental techniques of chemical and biomolecular engineering and their implementations or applications into final products or processes. The scope of this course includes various key experimental technologies for reaction optimization, development of catalysts, molecular separation & analysis, polymer & nanomaterials, and biotechnology.

CBE303 Physical Chemistry for Chemical and Biomolecular Engineers Ⅰ
Basic principles of physical chemistry such as thermodynamics, phase transition, diffusion, reaction kinetics and catalysis will be presented. In addition to basic understanding, this class is aimed to give deeper insight of physical chemistry by using various case studies in chemical engineering.

CBE311 Molecular Reaction Engineering
Molecular reaction engineering deals with ideal reactor model and the kinetics of chemcial and biological process. Estimation of kinetic parameters and reactor sizing are main topics in addition to the evaluation of the reactor performance.

CBE321 Separation Processes
The separation technology becomes more important in the production of fine chemicals and bioproduct as well as the separation and purification of conventional petrochemicals. The goal of this lecture is to understand the principles of separation technology for various products in separation process. It covers equilibrium stage concept and cascade continuous molecular separation. Adsorption, chromatography, membrane separation, which are used widely in bioproduct separation, are also included. (Prerequisite course: CBE202, CBE221)

CBE331 Fluid Mechanics of Microsystems
This course is designed to provide an orderly treatment of the essentials of both macroscopic problems and detailed microscopic structure of fluid flows. Topics include continuum hypothesis, kinematics, body forces and surface forces, conservation laws, constitutive equations, one-dimensional flows, dimensional analysis, low Reynolds number flows, potential flows, boundary layer theory, turbulent flows and macroscopic balances. Prerequisites by topics are as follows: ordinary differential equations and partial differentiations, multiple integrals, Taylor series, basic elements of vector analysis, material and energy balances and elementary mechanics. (Prerequisite course: CBE205)

CBE332 Heat and Molecular Transfer
Energy and mass conservation laws are applied to understand the heat and molecular transport phenomena. Tool developed in applied mathematics are frequently used to solve poblems encountered in many field of science and technology. Students are encouraged to talk about the assumptions necessary to simplify the problem.

CBE341 Process Simulation and Control
This course is designed to give juniors in chemical engineering an ability to design and analyze single loop feedback control systems.

CBE351 Introduction to Macromolecular Engineering
This course covers the general principles of synthesis, characterization, and physical behavior of polymers. It also deals with general methods of polymer processing. The course will emphasize understanding of the basic terminologies and concepts in polymer science and engineering.

CBE362 Bioinformatics
This course will cover theories and practices of bioinformatics, which is an important subject in the era of high-throughput biology and biotechnology. Topics such as basics of modern biology including genomics, transcriptomics, proteomics and metabolic pathways will be discussed first. Then, various bioinformatic tools and databases will be introduced. Sequence analysis using BLAST and multiple alignment, database design and search, protein structure prediction, protein protein interaction, DNA microarray, proteome profiling, microbial genomics and systems biology/biotechnology are the major topics to be covered.

CBE371 Electrochemical Principles for Chemical and Biomolecular Engineering
This class covers electrochemical principles for understanding of electrochemistry-based chemical and biomolecular systems. Through this class, students are expected to gain knowledge and insight on how electrochemical principals are applied to electrochemical systems such as sensors, batteries, and fuel cells.

CBE404 Physical Chemistry for Chemical and Biomolecular Engineers Ⅱ
Quantum mechanical l"language" to understand molecules and nano-scale materials are lectured. Introduction of Schrödinger equation, electron tunnelling, molecular structure of mono-, di- and poly-atoms, and origin of chemical bonding are discussed.. Atomic spectroscopy, molecular spectroscopy, and X-ray crystallography that characterize nano-scale materials are introduced. Macromolecules and colloids are also briefly discussed.

CBE441 Techniques of Process & Product Design
Design alternatives, Linear recycle material balance, Azeotropic separation system simulations and optimization using ASPEN, Heat exchanger network, Optimization technique practice using GAMES, Cost estimation and profitability analysis, Process Intensification via reactive separation. (Prerequisite course: CBE202, CBE221, CBE321)

CBE442 Chemical and Biomolecular Engineering Capstone Design Project
This class consists of technical lectures, team reviews of progress on the design projects, and oral presentations of the results of the three phases of the design project. Student teams will choose their own products and processes to design the chemical/material/biochemical production plant starting from purchasing raw materials to producing final

products. There are three different phases for carrying out the capstone design. Phase-I: Data Assembly and Technology/Business Evaluation, Phase-II: Conceptual Design, Phase-III: Developmental Design. (Prerequisite course: CBE311, CBE321, CBE441)

CBE443 Chemical and Biological Product Design Laboratory
This course provides opportunity to apply basic principles of chemical and biological product design. Especially, practice will be made on basic principles in product design such as needs analysis, definition of problems, idea generation, selection of ideas and manufacturing of products. Each group will design 3 different products and present for the evaluation. (Prerequisite course: CBE441)

CBE455 Nanochemical Technology
This course deals with theories and experimental methods for predicting the nanostructure-macroscopic property relations under equilibrium and nonequilibrium conditions. Nanofabrication methods considered in this course cover the conventional top-down lithographic techniques and the self-assembling bottom-up approaches. The building blocks for nanostructures include surfactant micelles, block copolymers, inorganic particles, liquid crystals, polymer latexes and biomolecules. Interactions between building blocks that govern the phase behavior of nanostructures will be discussed.

CBE461 Biorefineries for fuels and chemicals
This course will cover biorefineries and biobased industrial technologies including biofuels and biochemicals production from biomass, and also deal with technological principles of biorefineries, green processes, plants, concepts, current and forthcoming biobased product lines, as well as the economic aspects.

CBE462 Bioseparation Engineering
This course deals with basic principles and applications of bioseparation engineering. This course covers various key and principal separation techniques for biomolecules including cell, protein, and DNA.

CBE471 Introduction to Environmental Engineering
This course introduces environmental issues both in global scale and in our immediate neighberhood to the students at senior and master level. Students can learn about technologies developed in biotechnology and chemical engineering and utilized to solve the environment problems. Issues related in water and wastewater treatment, solid waste disposal, and air pollution control are discussed.

CBE473 Microelectronics Processes
Unit Operations in micro-electronics processing such as chemical deposition, oxidation, ion implantation, metal sputtering, Sputtering, chemical deposition process are introduced and how these unit processes are integrated to produce semiconductor chips. Especially, chemical engineering principles are focused.

CBE474 Instrumental Analysis for Chemical Engineers
A variety of instrumental analysis methods including atomic spectroscopy, molecular spectroscopy, nuclear magnetic resonance spectroscopy, molecular mass spectrometry, surface characterization by spectroscopy and microscopy, electroanalytical chemistry, chromatographic separation will be presented to improve the analytical skills of the chemical engineers.

CBE481 Special Topics in Chemical and Biomolecular Engineering
Recent advances in chemical and biomolecular engineering are lectured. Details on the topics are available at the beginning of each semester.

CBE483 Engineering Principles of Human Physiology
Biotechnology for humans amounts to about 80% of biotechnology markets and the major areas for this contributions are drug delivery, tissue engineering, biochips and recombinant DNA products. Thus, there is need to help engineering students better understanding of engineering principles of human physiology Mass and Energy balance of human body, respiratory system for oxygen exchange through membrane, blood circulation and blood coagulation, digestive bioreactor systems, filtration and urinary system. In addition, the recent development of artificial blood, diabetes and high blood pressure will be introduced with tissue engineering and gene therapy.

CBE490 Undergraduate Research in Chemical and Biomolecular Engineering

Various research topics ranging from the application to fundamental principles of chemical and biomolecular engineering are assigned by the thesis advisor. The final thesis should be submitted to the thesis committee.

CBE491 Special Topics in Chemical and Biomolecular EngineeringⅡ
Recent advances in chemical and biomolecular engineering are lectured. Details on the topics are available at the beginning of each semester.

CBE492 Special Topics in Chemical and Biomolecular EngineeringⅢ
Recent advances in chemical and biomolecular engineering are lectured. Details on the topics are available at the beginning of each semester.

CBE495 Individual Study
Special topics of personal interest is studied under the guidance of advisor. It includes laboratory work, literature survey, or computer simulation but is not limited to these activities.

CBE496 Seminar for Undergraduate Students
This course in intended to give chemical engineering undergraduates opportunities to contact currently important chemical engineering topics. Speakers are invited from a wide spectrum of fields such as institutions, government, and so forth.