Intended Learning Outcomes of CBME's courses

CENG 1000	On successful completion of this course, students are expected to be able to: 1. Explain the broad significance of the discipline of chemical engineering and its impact on a wide range of other disciplines. 2. Describe what chemical engineering is and what chemical engineers do. 3. Evaluate the relevance of chemical engineering as a future study or career option. 4. Perform basic material and energy balance, and kinetics calculations.
CENG 1500	On successful completion of this course, students are expected to be able to: 1. Describe the history and evolution of materials, and explain how new materials have been developed. 2. Examine the structure and property relationships of materials and define categories of materials and their applications, both in everyday products and in more advanced applications, including electronics, communications and space science. 3. Describe the key principles related to the structural and processing design of materials. 4. Examine materials' molecular structure and industrial processes to illustrate key aspects of issues such as safety versus cost, benefit versus environmental impact and durability versus recycling. 5. Explain how the principles of diffusion are applied to the fabrication of metal alloys and polymer blends. 6. Evaluate the social and environmental impact of materials and examine some innovative solutions to social and environmental problems.
CENG 1600	On successful completion of this course, students are expected to be able to: 1. Describe the major areas covered by medical biotechnology. 2. Explain the basic technical concepts, scientific and engineering principles of biotechnology. 3. Describe the opportunities and challenges faced by the biotechnology industry. 4. Analyze the potential and impact of modern biotechnology on human health and the economy. 5. Identify the key components contributing to biotechnology of commercial interest. 6. Research topics in biotechnology and its current development. 7. Communicate technical ideas clearly to a general audience in writing and orally. 8. Work collaboratively as a member of a multi-disciplinary team.

CENG 1980	On successful completion of this course, students are expected to be able to: 1. Describe the industrial operation of chemical engineering. 2. Apply chemical engineering knowledge to industry problems. 3. Address safety issues relevant to process design and unit operations in the chemical engineering industry. 4. Communicate technical results in an industrial setting. 5. Evaluate the range of career options available to chemical engineers in industry.
CENG 2030	On successful completion of this course, students are expected to be able to: 1. Explain the significance of assessing customers' needs in chemical product design. 2. Conduct the process of identifying customers' needs. 3. Develop ideas that might satisfy customers' needs. 4. Define the process of "process synthesis" for manufacturing products. 5. Identify product needs and fundamental design features for products in the energy sector (non-renewable and renewable energy products). 6. Assess the critical role of product purity in the fabrication of microelectronics products and develop processing operations that satisfy the demand for product purity. 7. Identify opportunities in the development of food and health care products. 8. Describe how molecular biology and genetics may be exploited in the biotechnology industry. 9. Synthesize simple processes for the manufacture of pharmaceutical products. 10. Explain the basis of using nanotechnology for the development of new products.
CENG 2110	On successful completion of this course, students are expected to be able to: 1. Explain the essential building blocks of processes, taking into account the categories and attributes of the materials involved, including raw materials, intermediates, products and by-products. 2. Use a variety of methods of organizing information relating to materials for the purpose of process analysis. 3. Identify mass and energy balances for different kinds of chemical processing units with and without chemical reaction. 4. Define the key principles, tools and techniques used in conducting economic analysis in the chemical industry. 5. Conduct estimates of various economic factors, such as capital investment, product cost, financing cost, depreciation and profitability, of an existing or new chemical process or project.

CENG 2210	On successful completion of this course, students are expected to be able to: 1. State, explain and apply the laws of thermodynamics. 2. Use the machinery of thermodynamics to calculate thermodynamic properties of interest. 3. Use published thermodynamic property tables and diagrams. 4. Formulate and solve problems pertaining to simple chemical processes. 5. Present solutions to problems in an organized, transparent and precise manner. 6. Apply the concepts of thermodynamics to interpret physical phenomena in nature.
CENG 2220	On successful completion of this course, students are expected to be able to: 1. Distinguish and analyze the fundamental concepts and properties of fluids. 2. Apply equations of hydrostatics and the Archimedes principle in order to compute forces and moments acting on submerged and floating bodies. 3. Apply conservation equations and the Bernoulli equation to problems in fluid flow. 4. Use control volumes to determine the velocity, flow rate, mass, force or energy balance for fluid flows. 5. Describe the characteristics of laminar and turbulent flows in pipes. 6. Use Buckingham's Pi theorem to develop dimensionless groups and apply similarity and modeling procedures.
CENG 3120	On successful completion of this course, students are expected to be able to: 1. Apply basic chemical engineering principles to design chemical processes conceptually. 2. Use Excel and ASPEN+ to simulate an optimization chemical process flow sheet. 3. Apply a range of basic design heuristics, guidelines or rules of thumb to make design decisions and select appropriate equipment. 4. Target and design energy systems in chemical processes. 5. Synthesize distillation systems and heat recovery networks.
CENG 3210	On successful completion of this course, students are expected to be able to: 1. Explain the fundamental principles of various separation processes. 2. Evaluate a range of separation processes, and select a separation strategy appropriate to a given scenario. 3. Apply knowledge of separation processes and strategies to solve a variety of problems.
CENG 3220	On successful completion of this course, students are expected to be able to: 1. Explain the key principles and assumptions relating to steady-state conductive, forced and free convective, and radiative heat transfer in both

	simple and complex process environments. 2. Evaluate a range of approaches to the analysis and design of heat exchangers, and assess various methods of fouling mitigation. 3. Explain the basic principles and concepts of mass transfer . 4. Compare the methodologies of continuous contacting process design and traditional design. 5. Develop numerical solutions and conduct simulations using unconventional examples.
CENG 3230	On successful completion of this course, students are expected to be able to: 1. Explain the basic principles of reaction and reactor engineering. 2. Design and analyze a variety of reactor units. 3. Evaluate, select and use a reactor appropriate to a given scenario. 4. Integrate knowledge of reaction, bioconversion, chemistry and engineering to solve problems related to reaction and reactor engineering.
CENG 3910	On successful completion of this course, students are expected to be able to: 1. Operate a variety of pumps, including positive displacement pumps and Rotodynamic pumps. 2. Describe the key principles and attributes of different types of pump. 3. Evaluate pump characteristics to select a pump to suit a given scenario. 4. Identify the relationships between power, volumetric/overall efficiency and head against flow rate of the pumps.
CENG 3920	On successful completion of this course, students are expected to be able to: 1. Identify the different behaviors, including compression ratio, refrigerating effect, heat of compression, net refrigeration effect and coefficient of performance of the refrigerating cycle with different expansion devices. 2. Analyze the behaviors of a range of expansion devices in a variety of scenarios.
CENG 3927	On successful completion of this course, students are expected to be able to: 1. Explain the behaviors of gas, electric and induction cooking burners. 2. Describe the impact of operating conditions on the efficiency of cooking burners, taking into account factors including bowl base area, amount of water and power. 3. Create a set of operating conditions and assess the impact of one of these operating conditions on burner efficiency. 4. Calculate the correlation between the operation of the burner and its efficiency.

CENG 4120	On successful completion of this course, students are expected to be able to: 1. Describe the techniques involved in developing process models and estimating transfer functions. 2. Explain the key principles of process dynamics. 3. Design, analyze and tune a feedback control system. 4. Explain the key concepts relating to advanced control. 5. Use computer tools, such as MATLAB and Simulink, to illustrate the key concepts of process dynamics and control. 6. Apply the principles of process dynamics and control to solve practical, real-world problems.
CENG4510	On successful completion of this course, students are expected to be able to: 1. Explain the physical properties of common polymers. 2. Discuss general theories relating to polymer condensed states. 3. Evaluate a range of approaches to polymer solution thermodynamics. 4. Design DNA templates for appropriate nanotechnology.
CENG4 4620	On successful completion of this course, students are expected to be able to: 1. Evaluate a wide range of biotechnological products and their impact on people and society. 2. Select the appropriate microbial or animal host to produce specific bioproducts. 3. Apply key bioproduction and fermentation principles used in the conceptual design of bioreactors. 4. Apply key downstream bioprocessing principles used in the conceptual design of bioseparation modules. 5. Comply with the conventions of good manufacturing practice (GMP) for biopharmaceutical products.

CENG 4640	On successful completion of this course, students are expected to be able to: 1. Explain metabolic pathways and their interactions, particularly those involved in catabolism and anabolism. 2. Perform quantitative engineering calculations on key metabolic parameters, including yield calculations, heat evolution and oxygen uptake. 3. Use state of the art metabolic simulation packages to investigate metabolism and analyze metabolic interactions and their effect on the overall performance of the cell. 4. Explain the basis of Michaelis-Menten kinetics and the significance of the underlying assumptions. 5. Investigate the enzyme:substrate concentration ranges where these assumptions are valid and compare these to the actual physiological state of a typical cell. 6. Develop more rigorous and more complete mechanisms that have broader application within the cell. 7. Explain the significance of inhibition and activation of enzymes. 8. Describe the nature of the reaction rate:substrate concentration relationship in the absence and presence of inhibitors and activators. 9. Investigate the basis of more complex enzyme kinetics including allostearic effects and multiple site mechanisms. 10. Apply basic chemical engineering thermodynamics to biological systems. 11. Investigate the thermodynamic basis of key cellular processes, including transport through membranes, pH and ionic gradients. 12. Conduct thermodynamic calculations at typical cellular physiological conditions of concentration, temperature, pH etc. 13. Conduct metabolic flux analysis (MFA) and metabolic control analysis (MCA) for simple reaction sequences. 14. Investigate how the overall flux of a pathway can be changed by varying enzyme concentrations and how this can be formally addressed using MCA. 15. Evaluate the modeling of more complex systems and how such modeling may assist in assessing a metabolic process and be used to improve the process.
CENG4670	On successful completion of this course, students are expected to be able to: 1. Explain the fundamental principles of dosage form science. 2. Assess the stability of pharmaceutical products. 3. Apply the principles of pharmaceutical processing to solve practical, real-world problems. 4. Integrate knowledge of medical science, pharmaceutical science and engineering principles to solve problems in pharmaceutical processing for different dosage forms.

CENG 4710	On successful completion of this course, students are expected to be able to: 1. Define and evaluate a range of contemporary environmental problems. 2. Design a suitable treatment process for a specified pollution problem. 3. Integrate various treatment processes to conduct a whole industrial process.
CENG 4720	On successful completion of this course, students are expected to be able to: 1. Identify and evaluate the fundamental laws, management systems and regulations relating to environmental pollution and protection. 2. Assess the pollution impacts from industrial developments. 3. Apply the principles of pollution prevention and pollution treatment processes to solve practical, real-world problems. 4. Apply the principles of Environmental Management System ISO14000, Environmental Impact Assessment, Integrated Pollution Conrol-IPC, IPPC, and Environmental Auditing to solve problems in the processing industries.
CENG 4911	On successful completion of this course, students are expected to be able to: 1. Evaluate research and experimental results in the design and development of a chemical or biochemical process and/or product, integrating new and existing knowledge to complete a process- and product-focused design. 2. Working both collaboratively in small teams and individually, identify problems and areas of uncertainty, critically evaluate potential solutions, select an appropriate solution and justify the selection. 3. Communicate effectively, using appropriate technical terminology, both orally through discussions, meetings and formal presentations, and in writing through an end of project report. 4. Manage a project, employing time effectively to set and meet appropriate targets and deadlines. 5. Identify, select and critically analyze research and data relevant to the selected project, using a range of sources and retrieval tools and techniques. 6. Demonstrate technical competence in the execution of the selected project, apply independent judgment and defend decisions made throughout the project. 7. Draw on the project experience to extrapolate the pressures and responsibilities typical to a professional industrial environment.