Penn State Chemical Engineering Student Outcomes

We use the Accreditation Board for Engineering and Technology 1-7 outcomes as our student outcomes. Currently, with the following Performance Indicators (PIs), our students will be able to demonstrate:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
    - (1.1) Solve a material balance on a system, using a block flow diagram, listing assumptions, writing equations, solving the equations, and assessing whether the solution makes sense.
    - (1.2) Apply thermodynamics to multi-unit processes, such as power plants or refrigeration cycles.
    - (1.3) Apply thermodynamics principles to multiphase separation problems.
    - (1.4) Apply steady macroscopic mass, energy, and linear momentum conservation principles to a continuous flow system.
    - (1.5) Model time dependent behavior of a biological system.
    - (1.6) Apply governing energy balance equation(s) for a physical heat transfer situation.
    - (1.7) Given a mixture and separation goal, identify possible separation techniques and explain the advantages of each.
    - (1.8) Apply material and energy balances to analyze and design non-isothermal ideal chemical reactors.
    - (1.9) Given an under-defined problem statement with product specifications, synthesize a chemical process sequence.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
    - (2.1) Design a pump or pump system to meet desired performance criteria.
    - (2.2) Design a heat exchanger to meet desired performance criteria.
    - (2.3) Size a continuous absorption or extraction column given a separation goal and mass transfer parameters.
    - (2.4) Design ideal reactor to achieve target performance metrics.
    - (2.5) Design relief and containment systems that protect personnel, community, and the environment.
    - (2.6) Identify safety, health, and welfare, as well as global, cultural, social, and environmental issues relevant to the process design.
    - (2.7) Iteratively evaluate the initial design in light of process model and economics (e. g., heat integration).
3. An ability to communicate effectively with a range of audiences.
    - (3.1) Write or edit clear documentation (e.g., design choice, SOP, PFD, signage) to reduce risk of human error.
    - (3.2) Present an effectively organized oral presentation to audience of peers and direct supervisors.
    - (3.3) Present an effective report to audience of peers and supervisors (technical audience).
    - (3.4) Create an effective figure for an oral technical report.
    - (3.5) Write an effective technical discussion that is supported with data.
    - (3.6) Create an effective figure for a written technical report.

    - (3.7) Present design work to upper management.
    - (3.8) Write effective progress report to supervisor.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
    - (4.1) State professional responsibilities of chemical engineers and chemical engineering students.
    - (4.2) Identify and analyze ethical dilemmas in the practice of chemical engineering, considering global, economic, environmental, and societal contexts.
    - (4.3) Comprehend the importance of items including intellectual property, finance, sales, and government regulations in the chemical and related industries.
    - (4.4) Identify implications of globalization for chemical, pharmaceutical, or related industries.
    - (4.5) Identify bioethical or biocontainment concerns related to biotechnology applications.
    - (4.6) Describe a real life scenario and the impact of good and bad safety practice, with consideration to global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
    - (5.1) Evaluate individual contributions to team success and function as a contributing team member.
    - (5.2) Develop an effective team charter.
    - (5.3) Student shares in work of team (CATME *Contributing to Team Work*).
    - (5.4) Student creates a collaborative and inclusive environment (CATME *Interacting with Team Mates*).
    - (5.5) Student contributes to keeping the team on track (CATME).
    - (5.6) Create a project management plan.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
    - (6.1) Apply statistical analysis (e.g. ANOVA, linear regression, t-test) to data, including evaluation of best fit model parameters.
    - (6.2) Apply statistics to determine enzymatic and growth kinetic constants from measurement data.
    - (6.3) Derive rate laws from experimental rate data for homogeneous and/or heterogeneous kinetics.
    - (6.4) Apply chemical engineering theory to interpret experimental data.
    - (6.5) Design and execute chemical engineering experiments.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
    - (7.1) Identify professional development opportunities (e.g., books, conferences, formal education, work or volunteer assignments, civic groups., certification, FE-PE exams).
    - (7.2) Identify skills (e.g., negotiation, teaming, communication, lateral thinking) one can improve via lifelong learning.
    - (7.3) Apply search engines and databases to identify biomolecules with desired regulatory or enzymatic functions.
    - (7.5) Acquire and apply new knowledge via self-learning (indirect measure via class survey).