Form E-1-A for Boston College Core Curriculum

Department/Program: Department of Engineering

1) **Have formal learning outcomes for the department's Core courses been developed? What are they?** (What specific sets of skills and knowledge does the department expect students completing its Core courses to have acquired?)

Department of Engineering has established four Program Educational Objectives (PEOs) that guide the development of our program. These PEOs were approved by the faculty on 9/9/2024.

The Human-Centered Engineering program at Boston College supports its graduates to establish themselves three to five years from graduation as professionals who:

1. Make contributions in service of society and the environment by applying engineering knowledge, skills, and techniques to conceptualize, analyze, and design solutions for complex challenges.
2. Discern their role as engineers in society and critically reflect on their professional and personal contributions to the common good.
3. Communicate effectively and responsibly with a variety of stakeholders and audiences to address professional and societal needs.
4. Engage as ethical, respectful, inclusive, and collaborative team members and leaders across disciplines.

These PEOs connect with our seven Student Outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These student outcomes relate to the knowledge, skills, and behaviors that Human-Centered Engineering students acquire as they progress through the program.

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
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.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The Department of Engineering assesses and evaluates student performance across these student outcomes each year as part of our established continuous improvement process.

To date, the Department of Engineering has offered one Core course: ENGR1801/HIST1627 Making the Modern World: Design, Ethics, and Engineering. The learning outcomes developed for this course reflect four sets of learning outcomes: learning outcomes related to the BC Core requirements for History II, Natural Science, and Engaging Difference & Justice (EDJ), and HCE Student Outcomes as detailed above. Please see Appendix I for the full set of learning outcomes for this course which includes descriptions of skills/knowledge.

2) **Where are these learning outcomes published? Be specific.** (Where are the department's expected learning outcomes for its Core courses accessible: on the web, in the catalog, or in your department handouts?)

The learning outcomes for the Human-Centered Engineering program are located here: https://www.bc.edu/content/bc-web/schools/morrissey/departments/engineering/about/programmission-objectives-outcomes.html

3) **Other than GPA, what data/evidence is used to determine whether students have achieved the stated outcomes for the Core requirement?** (What evidence and analytical approaches do you use to assess which of the student learning outcomes have been achieved more or less well?)

As part of the departmental continuous improvement process, the department collects the following information from faculty teaching courses each semester: course syllabi, lecture materials, assessment descriptions (e.g. homework, quizzes, reports, labs), anonymized examples of student work (high, medium, and low examples), student evaluations, and faculty reflections. In addition, faculty provide student outcome attainment data which are used to track student attainment across our student outcomes and drive program improvement.

While we have been collecting this data annually, our plan will be to shift to a two-year cycle, so as to fully address student performance across all student outcomes within the next six years. MMW as a Core course covers student outcomes 1-7, so data is gathered in relation to each of these outcomes annually.

4) **Who interprets the evidence? What is the process?** (Who in the department is responsible for interpreting the data and making recommendations for curriculum or assignment changes if appropriate? When does this occur?)

The Undergraduate Curriculum Committee (UCC) manages the continuous improvement process for the Department of Engineering. The UCC meets regularly throughout the semester and makes recommendations regarding curriculum improvement based on assessment data at the end of each academic year.

5) **What were the assessment results and what changes have been made as a result of using this data/evidence?** (What were the major assessment findings? Have there been any recent changes to your curriculum or program? How did the assessment data contribute to those changes?

Changes to the Core engineering course has primarily involved ensuring that the laboratory component of the course includes revised assessments to better reflect student outcome #2 (an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors). Faculty and lab instructors have revised a scaffolded set of assignments designed to teach first-year students about engineering design, guide students through the engineering design process, and engage student learning around best practices for documentation and reporting their engineering design work.

6) **Date of the most recent program review.** (Your latest comprehensive departmental self-study and external review.)

The Undergraduate Curriculum Committee met in May and June of 2025 to evaluate curriculum data and make recommendations for improvement beginning in the next academic year.

Appendix I: Learning objectives for MMW (Fall 2024)

Learning objectives

*These learning objectives have been designed to address two sets of curricular requirements: the BC Core Curriculum (indicated by **HIST II, NAT SCI, and ED&J**) and HCE student outcomes (indicated by **Student Outcome #**).*

A. **Historical knowledge**: Students will learn major events and figures in the history of engineering and technology since 1800. Students will explore contemporary engineering case studies and develop critical and analytic skills in comprehending the complex relationship between engineers, the built environment, regulatory power, corporate structures, the application of engineering logic to larger problems, and the consequences these relationships have for everyday people. (**HIST II, ED&J**)

B. **Engineering and scientific knowledge**: Students will learn what engineering is as a profession and a practice. Students will understand key engineering concepts like risk, unintended consequences, complexity, and systems; and become familiar with scientific laws and principles relevant to engineering analysis and design like force, energy, and mass transport. Through a tour of the major engineering fields, students will learn about engineering as a profession. (**NAT SCI, Student Outcome 1**)

C. **Historical methods**: Students will gain facility in methods critical to the practice of history as a field of intellectual inquiry. This includes careful reading and analysis of historical sources; situating historical sources in their own time periods; and developing written arguments that connect historical sources to course themes, especially themes around engineering and justice. (**HIST II, ED&J**)

D. **Engineering methods**: Students will learn foundations of engineering analysis and engineering design, including the application of appropriate mathematics and scientific principles to solve engineering problems (**Student Outcome 1**). In engineering laboratory sessions, students will learn to test prototypes, gather data, and critique design decisions to draw evidence-based conclusions in teams (**Student Outcome 6**). In their human-centered engineering project, students will work in teams and learn to elicit and synthesize a wide range of societal, stakeholder, and user needs and constraints to develop and refine a specific design solution (**Student Outcome 2**). Students will learn to approach design creatively, with an open mind, and with a deep appreciation for the historical context of their problem and of their work. (**NAT SCI**)

E. **Critical disciplinarity:** Through course discussion and regular reflection, including engagement with guest speakers, students will learn to see the boundaries and limits of the disciplinary approaches taken in this Complex Problems class. Students will be given the opportunity to develop critiques of how expertise has been institutionalized in academic, governmental, and other hierarchical settings. Students will think about how gender, race, class, and disability intersect in the construction of the engineering profession and in the impact of engineering knowledge. (**HIST II**, **NAT SCI, ED&J**)

F. **Communication:** Students will learn how to communicate engineering history and practice in a variety of different formats to a range of audiences. Students will be able to explain how and why engineering decisions have been made in the past and the impact of those decisions on society. Students will write persuasively about engineering problems, explain scientific findings, and deliver creative oral presentations to the Boston College community. (**HIST II**, **NAT SCI, ED&J, Student Outcome 3**)

G. **Leadership, teamwork, and responsibility:** Students will learn the importance of humility in the design process and how engineering decisions can affect people's lives. In the human-centered engineering project, they will take on leadership roles in creating engineering solutions for the common good. Students will conduct user interviews, collaborate as a group, and gain skills in team management which will include establishing group dynamics, determining clear goals, and meeting design objectives. (**HIST II**, **NAT SCI**, **ED&J, Student Outcome 5**)

H. **Ethics and engineering justice**: As a class, we will address engineering ethics and rules of professional responsibility and embed them in a larger conversation about the ethical and moral implications of engineering as a profession and practice. Coursework and discussion will demonstrate the connections among engineering solutions and their specific global, economic, environmental, and societal contexts. Students will think about how engineering decisions have been made in the past and what ethical rules were followed or broken in historical engineering case studies. Students will apply these lessons to their own engineering design projects. (**HIST II**, **NAT SCI**, **ED&J, Student Outcome 4**)