

ABET SUMMARY OF PROGRAM OUTCOMES

July 1, 2010

Outcome A. IE graduates demonstrate the ability to apply knowledge of mathematics, science, and engineering by demonstrating proficiencies as specified:

- IE graduates must show that they can employ general principles, theories, concepts, and /or formulas from calculus, differential equations, linear algebra, statistics, probability, engineering sciences, and systems engineering in the solution of problems in the industrial engineering field. For a particular problem, graduates should demonstrate that they can: define and describe the pertinent principle, theory, concept, and/or formula; explain why it is appropriate to the problem; and demonstrate how it has been applied in the solution of the problem. Examples include properly analyzing the results from a simulation study using statistics, properly analyzing manufacturing operations using factory dynamics principles, and properly using linear programming to analyze production and service systems.

Outcome B. IE graduates demonstrate the ability to design and conduct experiments, as well as to analyze and interpret data by demonstrating proficiencies as specified:

- IE graduates must conduct a statistical study of a given industrial engineering situation. Graduates should demonstrate proficiency in all five phases of statistical experimentation, namely, problem definition, system identification, model formulation, data collection, and statistical analysis.
- IE graduates must apply the fundamental principles of experimental design, namely, (a) replication, (b) randomization, and (c) local control. Each principle plays an important role in the development of a significance test. Essentially, a significance test compares variation due to a systematic effect against random variation.

Outcome C. IE graduates demonstrate the ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability by demonstrating proficiencies as specified:

- IE graduates must show an appreciation for the design process including the blend of analysis and creativity, the requirement for satisfying multiple, perhaps conflicting objectives, the trait of lacking a single correct answer, and the need for an iterative type approach.
- IE graduates must be able to conduct a design project in a systematic but flexible manner and include at least the following design steps:

- Identify the need and opportunity. This involves identifying and understanding the critical issues, constraints, and determining the overall goal and objective of the project. It often involves assessing relative impact of different projects and setting priorities based on the value that can be derived versus the time and effort required.
- Define the structure of the design project to satisfy the identified need. This involves determining the system boundaries, recognizing and differentiating the real and perceived constraints on the problem, and identifying the critical evaluation metrics. It also involves determining the resources (personnel, materials, time, budget, etc.) required to carry out the project and setting up (and then managing) a project plan.
- Gather information. This involves determining what information is critical and how best to obtain it. It often requires making tradeoffs between the types of information and the level of detail and making judgments about the value of the information relative to the level of effort and cost required to obtain it.
- Generate alternative solutions. This step requires a mix of using analytic tools and software combined with creativity and out-of-the-box thinking. Understand that a broad range of solutions is desirable.
- Evaluate and select the preferred solution(s). This includes developing a set of evaluation criteria and performance metrics and comparing each of the alternative solutions to these criteria. Realizing this is not an easy step. Tradeoffs and sacrifices are often required; criteria usually must be prioritized, either implicitly or explicitly; and many different prioritizations exist depending on the perspective (operator, manager, executive, environment, society, etc.).
- Perform sensitivity analysis on the solution(s). There is typically much uncertainty in the design process. For example, information will be unknown or uncertain or future requirements may be significantly different than planned. Thus, it is critical that some form of sensitivity analysis be conducted to understand the impact of these uncertainties on the solution and to ensure the selected design is robust over a range of potential scenarios.
- Assess the process and decide how to proceed. Often design will be done in iterative phases starting with a rough-cut analysis and moving toward a more detailed design. This process involves several iterations through the steps. The students must be able to assess the process and determine whether to iterate through the process at the same level of detail or narrow the alternatives and proceed to the next level of detail.
- Communicate the results of the design. The recommendations and solutions, as well as the design process, must be documented through drawings, models, reports, etc., and presented through various forms and media to the required stakeholders. The stakeholders will typically be interested in different types of information and levels of detail so different types of communication will be required.

Outcome D. IE graduates demonstrate the ability to function on multidisciplinary teams by demonstrating proficiencies as specified:

- IE graduates must possess an understanding of group dynamics, namely, how to create a group climate that encourages success; how to recognize and effectively utilize resources in group activities with minimal amount of activity/task overlap, and how to use communication strategies for dealing productively with conflicts.
- IE graduates must demonstrate the skills necessary to participate effectively as team members in long-term group projects. These skills include: cooperating and keeping involved and updated; accepting divergent views/opinions; encouraging active participation of team members; resolving conflict; and taking leadership roles.
- IE graduates must show the skills necessary to work successfully with people performing a variety of functions within a group. These skills include: exhibiting respect for people and the diversity in the group; accepting and incorporating appropriate thoughts/ideas from group members with different perspectives, and educating team members and sharing knowledge.
- IE graduates must report and share experiences from the group effort, namely: highlight positive experiences and discuss negative experiences and propose ideas to improve productivity and avoid repetition of the experience for others.

Multidisciplinary teams are defined in the industrial engineering program as teams in which students engage in the different disciplines within the industrial engineering field. These disciplines include: mathematical modeling, engineering economy, facilities planning, quality control, operations management, computer simulation, and production planning and control.

Outcome E. IE graduates demonstrate the ability to identify, formulate, and solve industrial engineering problems by demonstrating proficiencies as specified:

- IE graduates must show they can recognize an industrial engineering problem, which is defined as an opportunity for applying industrial engineering tools to improve operational aspects of complex manufacturing, service, and supply-chain systems.
- IE graduates must show they can define and formulate the important elements of an industrial engineering problem in a concrete, quantitative language of engineering and mathematics.
- IE graduates must show they can apply engineering, statistical, and mathematical methods to analyze the problem formulation for the purpose of understanding the qualitative and quantitative behavior of the system and the effects of potential changes made to the system.
- IE graduates must show they can isolate the most critical variables in the system and streamline the problem formulation (e.g. using visual representations) for the purpose of obtaining and communicating a clear, conceptual understanding of the system behavior.

- IE graduates must show they can apply engineering, statistical, and mathematical methods to arrive at appropriate solutions for variables that improve the operation of the system.

Outcome F. IE graduates demonstrate an understanding of professional and ethical responsibility by demonstrating proficiencies as specified:

- IE graduates must demonstrate an ability to make informed ethical choices in solving industrial engineering problems.
- IE graduates must demonstrate knowledge of the industrial engineering professional code of ethics.
- IE graduates must demonstrate an ability to evaluate the ethical dimensions of professional practice in solving industrial engineering problems and implementing solution procedures in industry.
- IE graduates must demonstrate ethical and professional behaviors in dealing with peers, faculty, and sponsors.
- IE graduates must successfully complete the engineering ethics course.

Outcome G. IE graduates demonstrate the ability to communicate effectively by demonstrating proficiencies as specified:

- IE graduates must exhibit a mastery of the forms of discourse appropriate to the profession of engineering: oral and written project proposal, oral and written progress report, technical report, technical presentation, etc. Depending on the form that is used, graduates should demonstrate that they can:
 - Describe the context (institutional and/or technological) of the problem and the significance of that problem within that context (introduction),
 - Describe clearly and precisely the procedures used to solve the problem (methods),
 - Report both verbally and visually the findings (results),
 - Interpret the findings in a way that is appropriate to the audience (discussion), and
 - Propose recommendations for a solution to the problem and justify that solution persuasively (conclusion).
- IE graduates must show that they can summarize technical material in a way that is appropriate to a particular audience. Graduates should demonstrate that they can synthesize their own work and work of others in the form of abstracts, executive summaries, and literature surveys. Graduates should be able to “speak” the basic technical language of other engineering disciplines.
- IE graduates must show that they can communicate successfully for obtaining and maintaining productive employment. For getting employment, graduates should show that they can write resumes and letters of application and perform capably in a job interview situation. For maintaining employment graduates should show that they can

write competent memos, letters, e-mail messages, and various reports (progress, personnel, trips, etc.) and give effective oral presentations to a variety of audiences.

- IE graduates must successfully complete the W courses in the curriculum. The W courses (writing intensive courses) have been introduced in every undergraduate program offered by the university as part of improving graduates written communication skills. Students in the W courses are provided active feedback on their writing abilities, and students need to pass the writing component of the course in order to pass the W course.

Outcome H. IE graduates demonstrate having the broad education necessary to understand the impact of engineering solutions in a global and societal context by demonstrating proficiencies as specified:

- IE graduates must show that they can interpret technical solutions in both a societal (more micro context) and global (more macro context). The societal context might be a particular community, state or even country. The global context might cover more than one community, nation, country, etc. Example impacts might include, but are not limited to, political, economic, religious, environmental, communication, and aesthetic impacts.

Outcome I. IE graduates demonstrate that they recognize the need for and possess the ability to engage in lifelong learning by demonstrating proficiencies as specified:

- IE graduates must demonstrate the ability to use critical information-seeking tools that enable industrial engineers to continue to stay up to date in the profession. These tools should include internet resources, professional and technical journals, handbooks, etc.
- IE graduates must show a degree plan in which elective courses have been selected based on professional goals and aspirations.
- IE graduates must demonstrate active involvement in the profession through the membership in engineering societies, achievement and maintenance of professional registration for engineers, involvement in continuing education, etc.
- IE graduates must express, upon graduation, both a full appreciation of the need for and the motivation to pursue further education and training not only in engineering but also in areas outside engineering, math or science.

Outcome J. IE graduates demonstrate that they possess a knowledge of contemporary issues by demonstrating proficiencies as specified:

- IE graduates must show that they have taken and performed adequately in a variety of university courses that are concerned with contemporary issues and/or the context for understanding those issues, including courses in the humanities, performing arts, and social sciences.

- IE graduates must demonstrate the ability to evaluate the socio-economic, political, and environmental implications of proposed technical solutions.

Outcome K. IE graduates demonstrate that they possess an ability to use the techniques, skills, and modern engineering tools necessary for industrial engineering practice by demonstrating proficiencies as specified:

- IE graduates must demonstrate knowledge of state-of-the art computerized procedures for decision-making, including, but not limited to, spreadsheet analysis, database management, and general-purpose computer languages.
- IE graduates must demonstrate knowledge of state-of-the art simulation, CAD, and material flow analysis packages.
- IE graduates must demonstrate knowledge in the use of technical library resources and literature search tools.
- IE graduates must demonstrate the ability to engage in an industry-based industrial engineering design experience.