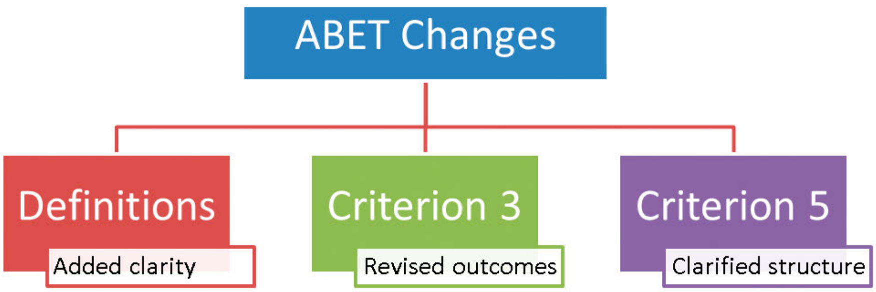
Recent changes to ABET accreditation criteria

In its ongoing effort to keep its criteria relevant, ABET has revised its student outcome and curriculum requirements.

By Walid A. Metwally



ABET, originally an acronym for the Accreditation Board for Engineering and Technology, is a nonprofit, nongovernmental organization that accredits college and university programs in the disciplines of applied and natural science, computing, engineering, and engineering technology. ABET accredits degrees at the associate, bachelor's, and master's levels. Over the years, the organization has expanded its domestic and global accreditation presence, and it currently accredits over 4,000 programs in 32 countries.

ABET accreditation activities are conducted by four accreditation commissions:

- Applied and Natural Science Accreditation Commission
- Computing Accreditation Commission
- Engineering Accreditation Commission
- Engineering Technology Accreditation Commission

These commissions are responsible for reviewing educational programs, in addition to continuously reviewing and enhancing their criteria, policies, and procedures. Recently, ABET approved changes to Engineering Accreditation Commission (EAC) criteria 3 and 5 and introduced new clarifying definitions that apply to the criteria. The changes took effect in the 2019–2020 accreditation cycle and are summarized in the figure above.

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Definitions

The definitions of program educational objectives, student outcomes (SO), engineering science, assessment, and evaluation have remained unchanged. The new, or revised, definitions are as follows:

Basic science: Basic sciences are disciplines focused on knowledge or understanding of the fundamental aspects of natural phenomena. Basic sciences consist of chemistry and physics and other natural sciences, including life, earth, and space sciences.

College-level mathematics: College-level mathematics consists of mathematics that requires a degree of mathematical sophistication at least equivalent to that of introductory calculus. Some examples of college-level mathematics include calculus, differential equations, probability, statistics, linear algebra, and discrete mathematics.

Complex engineering problems: Complex engineering problems include one or more of the following characteristics: involve wide-ranging or conflicting technical issues, have no obvious solution, address problems not encompassed by current standards and codes, involve diverse groups of stakeholders, include many component parts or sub-problems, involve multiple disciplines, or have significant consequences in a range of contexts.

Engineering Design: Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making trade-offs for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

Team: A team consists of more than one person working toward a common goal and should include individuals of diverse backgrounds, skills, or perspectives.

The new and revised definitions pro-

Criterion 3 Changes

Old Student Outcomes	New Student Outcomes
The program must have documented student outcomes that prepare graduates to attain the program's educational objectives. Student outcomes are outcomes (a) through (k), plus any additional outcomes that may be articulated by the program.	The program must have documented student outcomes that support the program's educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.
(a) An ability to apply knowledge of mathematics, science, and engineering. (e) An ability to identify, formulate, and solve engineering problems.	1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.	6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
(c) An 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.	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.
(d) An ability to function on multidisciplinary teams.	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.
(f) An understanding of professional and ethical responsibility. (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. (j) A knowledge of contemporary issues.	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.
(g) An ability to communicate effectively.	3. An ability to communicate effectively with a range of audiences.
(i) A recognition of the need for, and an ability to engage in, life-long learning.	7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Implied in 1, 2, and 6.

Criterion 5 Changes

Old Curriculum Requirements	New Curriculum Requirements
The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include the following:	The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The program curriculum must provide adequate content for each area, consistent with the student outcomes and the program's educational objectives to ensure that students are prepared to enter the practice of engineering. The curriculum must include the following:
(a) One year of a combination of college-level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.	(a) A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.
(b) One-and-one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.	(b) A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.
(c) A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.	(c) A broad education component that complements the technical content of the curriculum and is consistent with the program educational objectives.
Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.	(d) A culminating major engineering design experience that (1) incorporates appropriate engineering standards and multiple constraints and (2) is based on the knowledge and skills acquired in earlier course work.

vide clarity for the institutions and evaluators. Several implications of implementing these definitions are summarized as follows:

- Computer science is not considered a basic science. It is considered engineering science.
- Precalculus and remedial math are not considered college-level mathematics.
- Problem-solving should address complex problems.
- Considering risk in engineering design has been added and should be addressed.
- The listed engineering design characteristics and phases of the design process should be incorporated into the curriculum.
- Team diversity should be demonstrated.

Criterion 3 changes

Criterion 3 lists the SOs that describe what students are expected to know and be able to do by the time of graduation. Previously, there were 11 SOs, which now have been revised and reduced to seven. The first table on the opposite page shows the old and new SOs and how the new SOs map to the old ones.

The new SOs simplify the outcomes in a realistic, richer, and measurable manner. Several implications of implementing these new SOs are summarized as follows:

- SO 1: Programs should ensure that their engineering problems are complex.
- SO 2: All factors of engineering design should be considered (but not all factors have to influence the design).
- SO 3: The range of audiences should be at least two and should be relevant audiences.
- SO 4: The impact of engineering solutions should be considered in making judgments.
- SO 5: Team formation, collaboration, leadership, program management, and performance assessment should be properly addressed.
- SO 6: Judgment in drawing conclusions should be demonstrated.
- SO 7: The students' initiative for learning should be demonstrated.

Criterion 5 changes

Criterion 5 lists the program curriculum requirements. The second table on the opposite page shows the old and new curriculum requirements and how they map to one another.

As shown in the table, few changes have been made to the curriculum requirements. Several implications of implementing these curriculum requirements are summarized as follows:

- The minimum number of semester credit hours is clearer and easier to implement.
- All programs now have the same minimum credit hour requirements for mathematics/basic science and engineering topics.
- Computer sciences are considered engineering topics and do not necessarily require a dedicated course.
- Programs must indicate their use of modern engineering tools.

Transition considerations

The new EAC criteria were implemented in the 2019–2020 accreditation cycle. However, ABET understands that it may take a few years to fully implement the transition of internal processes to reflect these new criteria. During this transition process, it is important that programs develop a transition plan and be able to provide evidence that the plan is being followed at the time of program review. ABET does not expect a program's transition to be fully implemented for the 2019–2020 and 2020–2021 accreditation cycles. Beyond that, full implementation is expected.

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