Engineering and Engineering Technology Education

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STEM Education

- **S**cience
- **T**echnology
- **E**ngineering
- **M**athematics

Science and Mathematics

- Science is fundamental to a well-rounded education. Science literacy should be expected of every citizen of the 21st century.
- It is not sufficient to teach science as a compilation of facts. It is critical that all students understand what it is to "do" science.
- Mathematics is essential to doing science. One cannot do science without mathematics.
- Science and mathematics should be taught by those who have been properly trained in the disciplines that they are teaching, are stimulated by the subject matter, and are able to convey a sense of excitement to their students.
- We must find ways to inspire young people to pursue careers that require a high level of scientific sophistication and innovative approaches to solving complex problems.

Engineering vs. Technology

"Engineering programs are geared toward development of conceptual skills and consist of a sequence of engineering fundamentals and design courses built on a foundation of complex mathematics and science courses." "Thus engineering programs provide their graduates a breadth and depth of knowledge that allows them to function as designers."

"Engineering technology programs are oriented toward application and provide their students introductory mathematics and science courses and only qualitative introduction to engineering fundamentals." " Engineering technology programs prepare their graduates to apply others' designs."

- NSPE

Accreditation Board for Engineering and Technology (ABET)
Engineering Accreditation Commission (EAC)
Number of Programs Accredited (BS and MS)

Electrical Engineering	–	305	Architectural Engineering	–	17
Mechanical Engineering	–	286	Geological Engineering	–	16
Civil Engineering	–	226	Petroleum Engineering	–	16
Computer Engineering	–	205	Software Engineering	–	15
Chemical Engineering	–	160	Mining Engineering	–	13
Industrial Engineering	–	96	Naval Architecture	–	11
Engineering Physics	–	68	Metallurgical Engineering	–	9
Aerospace Engineering	–	68	Engineering Management	–	9
Materials Engineering	–	60	Ocean Engineering	–	8
Environmental Engineering	–	58	Construction Engineering	–	7
Agricultural Engineering	–	51	Surveying Engineering	–	7
Biomedical Engineering	–	50	Ceramic Engineering	–	6
Manufacturing Engineering	–	22	Engineering Mechanics	–	6
Nuclear Engineering	–	20	Others	–	32

Accreditation Board for Engineering and Technology (ABET)
Technology Accreditation Commission (TAC)
Number of Programs Accredited

Two-Year Associate Degrees

Electrical Engineering Technology	– 109
Mechanical Engineering Technology	– 67
Civil Engineering Technology	– 45
Computer Engineering Technology	– 25
Architectural Engineering Technology	– 21
Construction Engineering Technology	– 11
Drafting and Design Technology	– 11
Manufacturing Engineering Technology	– 9
Industrial Engineering Technology	– 7
Surveying Engineering Technology	– 7
Environmental Engineering Technology	– 4
Telecommunications Engineering Tech	– 3
Inst & Control Systems Engineering Tech	– 3
Biomedical Engineering Technology	– 3
Electromechanical Engineering Technology	– 2
Engineering Technology	– 2
Nuclear Engineering Technology	– 2
Aeronautical Engineering Technology	– 1
Others	– 12

Four-Year Bachelor Degrees

Electrical Engineering Technology	– 112
Mechanical Engineering Technology	– 70
Computer Engineering Technology	– 49
Civil Engineering Technology	– 26
Manufacturing Engineering Technology	– 26
Construction Engineering Technology	– 24
Engineering Technology	– 8
Industrial Engineering Technology	– 8
Architectural Engineering Technology	– 7
Electromechanical Engineering Technology	– 7
Surveying Engineering Technology	– 5
Telecommunications Engineering Tech	– 5
Air Conditioning Engineering Technology	– 3
Automotive Engineering Technology	– 2
Biomedical Engineering Technology	– 2
Inst & Control Systems Engineering Tech	– 2
Naval Architecture and Marine Technology	– 2
Nuclear Engineering Technology	– 2
Drafting and Design Technology	– 1
Others	– 14

ABET Criteria

Criterion 1. Students

Criterion 2. Program Educational Objectives

Criterion 3. Program Outcomes

Criterion 4. Continuous Improvement

Criterion 5. Curriculum

Criterion 6. Faculty

Criterion 7. Facilities

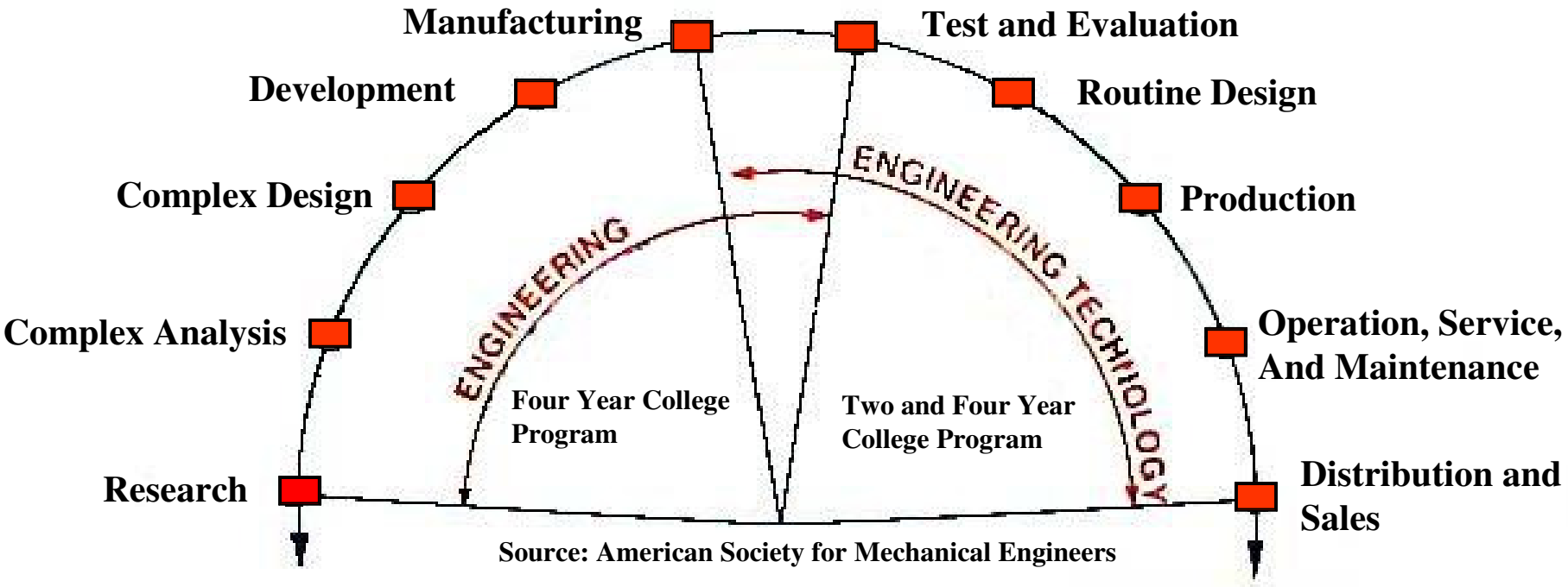
Criterion 8. Support

Criterion 9. Program Criteria

Criterion 2. Program Educational Objectives

Engineering and Engineering Technology

-Career Paths-



Criterion 3. Program Outcomes - Engineering

(a) An ability to apply knowledge of mathematics, science, and engineering.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data.

(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.

(d) An ability to function on multidisciplinary teams.

(e) An ability to identify, formulate, and solve engineering problems.

Program Outcomes – Engineering (continued)

(f) An understanding of professional and ethical responsibility.

(g) An ability to communicate effectively.

(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

(i) A recognition of the need for, and ability to engage in life-long education.

(j) A knowledge of contemporary issues.

(k) An ability to use techniques, skills, and modern tools necessary for engineering practice.

Criterion 3. Program Outcomes – Engineering Technology

(a) An appropriate mastery of the knowledge, techniques, skills, and modern tools of their disciplines.

(b) An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology.

(c) An ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes.

(d) An ability to apply creativity in the design of systems, component, or processes appropriate to program educational objectives.

(e) An ability to function effectively on teams.

Program Outcomes – Engineering Technology (continued)

(f) **An ability to identify, analyze and solve technical problems.**

(g) An ability to communicate effectively.

(h) A recognition of the need for, and the ability to engage in lifelong learning.

(i) An ability to understand professional, ethical and social responsibilities.

(j) A respect for diversity and a knowledge of contemporary professional, societal, and global issues.

(k) A commitment to quality, timeliness, and continuous improvement.

Criterion 5. Curriculum – Engineering

- One year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline.
- One and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.
- A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.
- Culmination 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.

Criterion 5. Curriculum – Engineering Technology

- Baccalaureate programs must consist of a minimum of 124 semester hours. Associate degree programs must consist of a minimum of 64 semester hours.

- Algebra, trigonometry, and an introduction to mathematics above the level of algebra and trigonometry constitute the foundation mathematics for an associates degree. Integral and differential calculus, or other appropriate mathematics above the level of algebra and trigonometry, constitutes the foundation mathematics for the baccalaureate degree.

- The basic science content can include physics, chemistry, or life and earth sciences that support program educational objectives. This component must include laboratory experience.

- The technical content must focus on the applied aspects of science and engineering in that portion of the technological spectrum closest to product improvement, manufacturing, construction, and engineering operational functions. Must represent at least 1/3 of the total credit hours of the program and no more than 2/3.

- Also communications content and social science/humanities content.

Criterion 9. Program Criteria
Excerpt from Electrical and Computer Engineering

" The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.

The program must demonstrate that graduates have: knowledge of probability and statistics, including applications appropriate to the program name and objectives; and knowledge of mathematics through differential and integral calculus, basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives.

Programs containing the modifier "electrical" in the title must also demonstrate that graduates have a knowledge of advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics.

Programs containing the modifier "computer" in the title must also demonstrate that graduates have a knowledge of discrete mathematics."

Criterion 9. Program Criteria
Excerpt from Electrical/Electronic(s) Engineering Technology

"An accreditable program in Electrical/Electronic(s) Engineering Technology will prepare graduates with the technical and managerial skills necessary to enter careers in the design, application, installation, manufacturing, operation and/or maintenance of electrical/electronic(s) systems.

Graduates of associate degree programs typically have strengths in the building, testing, operation, and maintenance of existing electrical systems, whereas baccalaureate degree graduates are well prepared for development and implementation of electrical/electronic(s) systems."

Questions

- Is it possible to teach engineering technology in K-12? If so, at what level and what, if anything, should it replace in the curriculum?
- Is it possible to teach engineering in K-12? If so, at what level and what, if anything, should it replace in the curriculum?
- Are we unintentionally confusing K-12 students about what constitutes a career in engineering vs. a career inengineering technology?
- Are there ways, other than curricular, to inspire K-12 students to pursue careers in engineering while properly preparing them to do so?

ASEE Engineering Deans' Council (EDC)
K-12 Task Force
Current and Proposed Interactions

- ASEE EDC Public Policy Colloquia.
- American Association of Engineering Societies (AAES) K-12 working group that is responding to the National Academy of Engineering (NAE) report, "Changing the Conversation."
- "Project Lead the Way" and other organizations that are introducing engineering and engineering technology courses and curricula into high schools and the colleges and universities that are partnering with these organizations.
- US Department of Education regarding their STEM cluster "Engineering and Technology Pathway" knowledge and skills statements and recommended curriculum.
- ASEE Corporate Members Council (CMC) and Engineering Technology Deans Council (ETC).