

Massachusetts



Department of
Education

**MATHEMATICS AND SCIENCE COURSES REQUIRED OR
RECOMMENDED FOR ADMISSION INTO ENGINEERING AND
ENGINEERING TECHNOLOGY PROGRAMS AT MASSACHUSETTS
INSTITUTIONS OF HIGHER EDUCATION**

Center for Teaching and Learning

July 2003



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Massachusetts Department of Education

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David P. Driscoll
Commissioner of Education

July 30, 2003

Dear Colleagues:

I am pleased to present the results of a survey of Massachusetts institutions of higher education on recommendations and requirements for incoming engineering and engineering technology students, titled, *“Mathematics and Science Course Required or Recommended for Admission into Engineering and Engineering Technology Programs at Massachusetts Institutions of Higher Education.”* The institutions of higher education, all of which are accredited by the Accreditation Board for Engineering and Technology, were asked to identify those high school courses that were prerequisites and those they would recommend for students entering their specific program or area. We believe this information will be useful to many educators, especially high school guidance counselors.

Sincerely,

David P. Driscoll
Commissioner of Education

Introduction

The Massachusetts Department of Education conducted a survey (Appendix A) of local institutions of higher education to obtain their recommendations and requirements for incoming engineering and engineering technology students. The recommendations and requirements summarized here reflect a wide variety of engineering areas (chemical engineering, engineering and applied science, biomedical engineering, mechanical engineering, and environmental engineering) and engineering technology (see Appendix B). In addition, many of the universities and colleges in which these schools or departments of engineering and engineering technology are located have specific requirements for students applying for admission to the college or university itself. These requirements must be met in advance of any additional requirements or recommendations a specific school of engineering or engineering technology program may have.

It is important to note the differences between engineering and engineering technology. According to the American Society for Engineering Education, “engineering programs typically provide the theoretical and abstract training for planning, designing, and creating new products, where as engineering technology programs focus on application and practice, emphasizing laboratory experience.” These programs are accredited differently, and often entrance and course requirements are different.

The survey targeted four key areas: science, mathematics, technology/engineering, and English language arts. All of the post-secondary institutions were asked to identify those courses that were prerequisites and those they would recommend for students entering their specific program or area. Some of the respondents included other prerequisites such as history or foreign languages required by both the institution and the engineering program.

Respondents

All of the institutions that were contacted are accredited by the Accreditation Board for Engineering and Technology (see Appendix C) and offer a four-year program in engineering and/or engineering technology. Harvard University has an engineering sciences major but does not allow enrollment until the sophomore year. Because of its unique enrollment process, it is not included here. From the eleven institutions, thirteen surveys were completed (Tables 1 and 2).

Table 1. Institutions of Higher Education with Engineering Programs and Survey Respondents

School	Department, Respondent
Boston University	Biomedical Engineering, Associate Chair
Massachusetts Institute of Technology	School of Engineering, Director of Assessment
Merrimack College	Civil Engineering, Professor
Northeastern University	Chemical Engineering, Chair
Tufts University	School of Engineering, Associate Dean, Student Services
Tufts University	Civil and Environmental Engineering, Chair
UMass Amherst	School of Engineering, Assistant Dean
UMass Dartmouth	Civil Engineering, Professor
UMass Lowell	Francis College of Engineering, Dean
Western New England	Industrial Engineering, Professor
Worcester Polytechnic Institute	Mechanical Engineering, Department Head

Table 2. Institutions of Higher Education with Engineering Technology Programs and Survey Respondents

School	Department, Respondent
Northeastern University	School of Engineering Technology, Director
UMass Lowell*	Francis College of Engineering, Dean
Wentworth Institute of Technology	Mechanical and Electrical, Department Head

*Both Engineering and Engineering Technology programs

Science and Technology/Engineering Coursework Requirements and Recommendations for Engineering Programs by Institutions of Higher Education

Respondents were asked to identify prerequisite and recommended science courses including Advanced Placement for their area of engineering. As Table 3 indicates, all schools identified chemistry as a required or recommended course while eight of these colleges require physics at grade 11 or 12. One response listed a ‘lab science’ as required rather than one of the specific areas listed on the survey. No school explicitly requires Advanced Placement or honors-level courses as a prerequisite, although they were recommended by two institutions.

Table 3. Science and Technology/Engineering Coursework Requirements and Recommendations by Institutions of Higher Education (n = 11)

Course	Required	Recommended	Neither Required nor Recommended
Chemistry	9	2	0
Upper Physics	8	3	0
Introductory Physics	6	1	4
Biology	4	5	2
Earth/space science	0	4	7
Computer Science	n/a	6	5
Pre-engineering	n/a	5	6

Note: Computer Science and Pre-engineering were not included in the required section of the survey.

*Recommended courses are those that are not required. For example, if chemistry is required, it would not also be recommended.

Mathematics Coursework Requirements and Recommendations for Engineering Programs by Institutions of Higher Education

As with science, respondents were asked to identify required and recommended mathematics courses. As Table 4 indicates, eight programs require algebra and trigonometry, and seven of these programs also require algebra 2 and geometry. Four programs require students to have completed calculus in high school.

Table 4. Mathematics Coursework Requirements and Recommendations for Engineering Programs by Institutions of Higher Education (n=11)

Course	Required	Recommended	Neither Required nor Recommended
Algebra 1	8	3	0
Trigonometry	8	3	0
Geometry	7	3	1
Algebra 2	7	2	2
Calculus	4	3	4
Pre-Calculus	3	6	2

The importance of mathematics drew the most comments. One respondent stated that the concepts gained from algebra and trigonometry were key to student success in his program (Industrial Engineering). A dean stated, “The most important preparation skills are in the math area.” Yet another respondent commented that some students came in with strong technical skills but lacked the matching mathematical skill level. Another recommended stronger teacher training including the “ability to apply mathematical theory to real world problems.” One respondent stated that their entrance exam includes a strong mathematics component affecting placement and entrance into the programs. Although one department head commented that he had seen an increase in some mathematical skills of incoming freshman, other respondents listed weak mathematics skills as a reason for students dropping out of a program. It is evident from the responses that students interested in pursuing a degree in engineering will need to take a strong set of mathematics courses in high school.

Science, Technology/Engineering, and Mathematics Coursework Requirements and Recommendations for Engineering Technology Programs by Institutions of Higher Education

Both Wentworth and Northeastern (NEU) require algebra, while UMASS Lowell requires an upper physics course. None require algebra 2, pre-calculus, or calculus; however, all recommend these courses. It appears that there are fewer course requirements for engineering technology programs compared with engineering programs. However, upper level and honors courses in both mathematics and science are highly recommended by these schools.

Table 5. Science and Mathematics Requirements and Recommendations for Engineering Technology Programs by Institutions of Higher Education (n=3)

<u>Course</u>	<u>Required</u>	<u>Recommended</u>	<u>Neither Required nor Recommended</u>
Science			
Chemistry	1	2	0
Upper Physics	1	2	0
Introductory Physics	2	1	0
Biology	0	1	2
Earth/space science	0	2	1
Computer Science	n/a	3	0
Pre-engineering	n/a	3	0
Mathematics			
Algebra 1	2	1	0
Trigonometry	0	3	0
Geometry	0	3	0
Algebra 2	0	3	0
Calculus	0	2	1
Pre-Calculus	0	3	0

Note: Computer Science and Pre-engineering were not included in the required section of the survey.

**Recommended courses are those that are not required. For example, if chemistry is required, it would not also be recommended.*

Technology/Engineering and Computer Science Recommendations for Both Engineering and Engineering Technology Programs by Institutions of Higher Education

Respondents were asked what types of technology/engineering experience (Table 6) and what types of computer languages (Table 7) were recommended for incoming students wanting to pursue a degree in engineering and/or engineering technology. All of the respondents recommended some level of either technology/engineering or computer science coursework prior to enrollment at the post-secondary level.

One respondent commented on basic computer literacy as a needed skill for incoming students and noted that more and more students are entering the institution with these skills.

Table 6. Technology/Engineering Experience Recommended by Institutions of Higher Education (n = 13)

<u>Technology/Engineering Experience</u>	<u>Recommended</u>	<u>Not Recommended</u>
Electronics	7	6
Mechanical	8	5
Engineering Drawing	7	6
Data Protocol	3	10

Table 7. Computer Languages Recommended by Institutions of Higher Education (n = 13)

<u>Computer Language</u>	<u>Recommended</u>	<u>Not Recommended</u>
C++	3	10
Basic	3	10
C	3	10
Visual	1	11
Fortran	1	11

Respondents were also asked to identify the recommended level of computer-aided design (CAD) experience. Six respondents recommended basic knowledge of CAD, with one response suggesting CAD efficiency. No one recommended mastery of CAD and five recommended no CAD experience.

In addition to specific recommendations in these areas, respondents were asked to rate the importance of hands-on technology/engineering experiences. Five of the responses stated that hands-on experience at the high school level is very important. An additional four reported that hands-on experience is important and two reported it as being somewhat important.

English Language Arts Recommendations for Both Engineering and Engineering Technology Programs by Institutions of Higher Education

The respondents were asked to identify those skill areas of English language arts that were most important for students entering their program or school. The areas were ranked based on a scale of 1-5, with a 1 being least important and 5 being most important. The chart below shows the average ranking for each of the skills listed across the ten responses. Every category was rated a 5 at least once and none of the categories received a rating of 1.

Table 8. Ranking of English Language Arts Skills by Institutions of Higher Education (n = 13)

<u>Reading Comprehension</u>	<u>Expository/Technical Writing</u>	<u>Descriptive Writing</u>	<u>Oral Presentation</u>	<u>Persuasive Writing</u>	<u>Narrative Writing</u>
4.9	4.8	4.3	4.2	4.0	3.5

Reading and writing abilities were important across the board as seen in Table 8. One respondent noted that he has seen a shift in area of need from writing skills to reading comprehension. This comment is supported by the group mean of 4.8 for reading comprehension, making it the highest ranked in order of importance of all of the areas. In his comments he also stressed that the ability to understand what a student has read is vital to college performance and recommended additional reading assignments at the

high school level. Another comment emphasized the need for improved reading and writing skills as they pertain to communication skills.

Additional Comments

Respondents highlighted the need for programs and activities that make students more aware of engineering and engineering technology opportunities at the college level. Some thought that high school experiences could assist with this and spark an interest in engineering areas. However, one respondent cautioned against high school engineering/technology programs that are merely ‘tinkering’ in the area versus using hands-on experiences that include calculations and analyzing data using math concepts. Another comment included the need for students to have good organizational and time management skills, noting that engineering programs are demanding and time-consuming.

Summary

The information gathered from this survey makes clear that a year-long course in chemistry and upper-level physics (or a full-year of physics in grade 11 or 12) at the high school level is critical to preparation for a post-secondary engineering program. The area of mathematics received the highest number of comments. Algebra 1 and 2, trigonometry, and geometry lead the list as required areas of pre-college study. Calculus was the most recommended course. Reading comprehension and technical or expository writing were rated as the most important skills in English language arts; however, all of the categories were rated highly at least once and none of the categories received a low rating.

The requirements and expectations of engineering and engineering technology programs at accredited universities and colleges vary. Some schools have specific requirements for admissions into the engineering school or department, while others rely strictly on the entrance requirements of the university as a whole. All, however, stress the importance of a solid academic foundation highlighting mathematics, science, and reading and writing skills. Overall, as students prepare for a post-secondary engineering program, they should take strong coursework in mathematics, science, and English language arts and expand their understanding of the fields of engineering.

**Appendix A: Massachusetts Department of Education Technology/Engineering Higher Education Survey
Spring 2003**

School/Program: _____ **Interviewee:** _____

1. What are the **prerequisite science and technology courses** for your engineering program?

- a) introductory, theoretical, or grade 9 physics
- b) upper-level physics
- c) earth and/or space science
- d) chemistry
- e) biology
- f) other _____

2. Do any of the **prerequisite science courses** need to be **honors or AP** courses? If so, which ones?

YES NO _____

3a. What **science and technology courses** would you recommend incoming students to have completed?

- a) introductory, theoretical, or grade 9 physics
- b) upper-level physics
- c) earth and/or space science
- d) chemistry
- e) biology
- f) computer science
- g) pre-engineering
- h) other _____

3b. Would you **recommend** that these courses be **honors or AP** courses? YES NO

4. What are the **prerequisite math courses** for your engineering program?

- a) calculus
- b) geometry
- c) trigonometry
- d) algebra
- e) algebra II
- f) pre-calculus
- g) other _____

5. What **math courses** would you recommend incoming students to have completed?

- a) calculus
- b) geometry
- c) trigonometry
- d) algebra
- e) algebra II
- f) pre-calculus

6. What level of experience in CAD **would you recommend** incoming students to have?

- a) mastery b) efficiency c) basic knowledge d) none

7. Which computer languages **would you recommend** incoming students to have taken or to have proficiency in?

- a) Basic
b) Fortran
c) C
d) C++
e) other _____

8. What type of Technology/Engineering experience **would you recommend** incoming students to have?

- a) Electronics Lab (design, fabrication, and test)
b) Engineering Drawing
c) Mechanical Lab (Design fabrication and test)
d) Data Protocols
e) All of the Above

9. On a scale of 1 to 5 (1 being least important, 5 being most important) what **English language art skills are most important** for your incoming students to have competency in?

- a) oral presentations b) reading comprehension c) narrative writing
d) expository writing e) persuasive writing f) descriptive writing e) other _____

10. What **other high school courses are prerequisites** specifically for your engineering program?

11. What **other high school courses would you recommend** for incoming students to have taken in order to succeed in an engineering program at your school?

12. How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?

- a) Very important
b) Important
c) Somewhat important
d) Not very important
e) Not important at all

Appendix B: Recommendations and Requirements by Institution of Higher Education

Wentworth Institute /Electronics & Mechanical
Department Head

Subject	Required	Recommended
Introductory 9 th Grade Physics	Yes	No
Upper Physics	No	Yes
Earth and/or Space Science	No	Yes
Chemistry	No	Yes
Biology	No	No
Computer Science		Yes
Pre Engineering		Yes

Other Requirements:

Subject	Required	Recommended
Calculus	No	No
Geometry	No	Yes
Trigonometry	No	Yes
Algebra	Yes	No
Algebra 2	No	Yes
Pre-calculus	No	Yes
Other		

Cad Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *Yes* None: *No*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Other Computer Science Recommended: *Basic computer literacy is valuable*

Type of Technology/Engineering experience would you recommend incoming students to have?
Electronics: *Yes* Engineering Drawing: *Yes* Mechanical Lab: *Yes* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):
Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 4 Expository (technical) Writing 3
Persuasive Writing 5 Descriptive Writing 5

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
very important

Comments : There is an entrance exam which is highly based on mathematics. The higher your skill level is in math, the better you will do. Hands on experience is sometimes the way students learn best. Being able to learn this way will allow them to explore the technical areas. We are finding that students are coming in with a good level of computer literacy skills. This is very helpful. Students tend to be weak in the communication skill area. Reading and writing are also identified areas of need for incoming students. Math skills appear to be going up slightly with incoming students.

University of Massachusetts Dartmouth, Civil Engineering
Professor

Subject	Required	Recommended
Introductory 9 th Grade Physics	No	Yes
Upper Physics	Yes	No
Earth and/or Space Science	No	No
Chemistry	No	Yes
Biology	No	No
Computer Science		No
Pre Engineering		Yes

Other Requirements:

Subject	Required	Recommended
Calculus	No	No
Geometry	No	Yes
Trigonometry	Yes	No
Algebra	Yes	No
Algebra 2	Yes	No
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *Yes*: Basic Knowledge: *No* None: *No*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *Yes* C++ : *Yes*

Type of Technology/Engineering experience would you recommend incoming students to have?
Electronics: *No* Engineering Drawing: *Yes* Mechanical Lab: *No* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):
Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 2 Expository (technical) Writing 5
Persuasive Writing 2 Descriptive Writing 4

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
somewhat important

Comments : Many students come in without a concept of what a civil engineer does. It would be beneficial for students to learn about how science and math fit into engineering through a curriculum and also what engineers do. Presently we do that in our freshman course. We offer a one week course and often 100 students enroll to learn about team work, engineering, and communication skills for the college programs. Not all students can take this because it is extra curricular. The math skills of incoming students has decreased. Students often come with the sense that they have a higher level of math competency than they often do. 53% of the students admitted in the past year were not ready to take Calculus which is the first course in the program though their grades from secondary school often represented higher levels of understanding in math. When a student takes remedial courses then they are automatically behind in their program.

Merrimack College, Civil Engineering

Associate Professor

Subject	Required	Recommended
Introductory 9 th Grade Physics	Yes	No
Upper Physics	No	Yes
Earth and/or Space Science	No	Yes
Chemistry	Yes	No
Biology	No	Yes
Computer Science		Yes
Pre Engineering		Yes

Other Requirements:

Subject	Required	Recommended
Calculus	Yes	No
Geometry	Yes	No
Trigonometry	Yes	No
Algebra	Yes	No
Algebra 2	Yes	No
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *Yes* None: *No*

Computer Language Recommended: Basic: *Yes* Fortran: *Yes* C: *No* C++ : *No*

Other Computer Science Recommended: *Computer Literacy*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *No* Engineering Drawing: *Yes* Mechanical Lab: *Yes* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 5 Expository (technical) Writing 5

Persuasive Writing 5 Descriptive Writing 5

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?

somewhat important

Comments : Good engineers are problem solvers. They are inquisitive. They have a certain stick-to attitude to find a solution. They are imaginative. Self motivation is key. If a student has these traits and these desires they will make it through. Leadership skills can also play a part.

**Northeastern University, Chemical Engineering
Chair**

Subject	Required	Recommended
Introductory 9 th Grade Physics	Yes	No
Upper Physics	Yes	No
Earth and/or Space Science	No	No
Chemistry	Yes	No
Biology	Yes	No
Computer Science		No
Pre Engineering		No

Other Requirements:

Subject	Required	Recommended
Calculus	No	No
Geometry	Yes	No
Trigonometry	Yes	No
Algebra	Yes	No
Algebra 2	Yes	No
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *Yes* None: *No*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: 3 Reading Comprehension 5 Narrative Writing 2 Expository (technical) Writing 3 Persuasive Writing 3 Descriptive Writing 3

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?

not important at all

Comments : A student's interest and desire count a lot. They should have an interest in math, chemistry and physics. My reply to the English language arts skills in the past would have focused on the ability to write; however, most recently I am seeing a poorer comprehension with the students I am encountering. It is critical to their learning process at a college level that they can read and understand. I pose many questions that require outside reading - self learning. Our calculus classes move rapidly; however, they do not require a student to enter with AP or calculus taken at a high school level. The AP does have merit. In a very tight engineering curriculum, students who take advanced placement, are able to place out of some freshman courses. This allows them some flexibility to take additional courses toward minors or other interests. Finally, hands-on and related experiences are not critical to success in engineering. The field is changing rapidly and there are so many levels that it can be approached at. For example, nanometer engineering centers around things that can be only observed with high powered microscopes - knowledge about wrenches will not be overly useful. Likewise, advancing biotechnology requires engineers with skills that range from statistics (bioinformatics) to DNA splicing (recombination). The interest and the ability to self-learn go a long way. Thus, preparation should center on teaching life long learners.

Northeastern University, School of Engineering Technology

Director

Subject	Required	Recommended
Introductory 9 th Grade Physics	No	Yes
Upper Physics	No	Yes
Earth and/or Space Science	No	No
Chemistry	No	Yes
Biology	No	No
Computer Science		Yes
Pre Engineering		Yes

Other Requirements: lab science

Subject	Required	Recommended
Calculus	No	Yes
Geometry	No	Yes
Trigonometry	No	Yes
Algebra	Yes	No
Algebra 2	No	Yes
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *No* None: *Yes*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Other Computer Science Recommended: *Visual basic*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *Yes*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 5 Expository (technical) Writing 5 Persuasive Writing 5 Descriptive Writing 5

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?

very important

Comments: If students could come with these experiences it would be wonderful.

Worcester Polytechnic Institute, Mechanical
Department Head

Subject	Required	Recommended
Introductory 9 th Grade Physics	Yes	No
Upper Physics	No	Yes
Earth and/or Space Science	No	No
Chemistry	Yes	No
Biology	No	Yes
Computer Science		Yes
Pre Engineering		No

Other Requirements:

Subject	Required	Recommended
Calculus	Yes	No
Geometry	No	No
Trigonometry	Yes	No
Algebra	Yes	No
Algebra 2	Yes	No
Pre-calculus	Yes	No
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *Yes* None: *No*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *Yes* C++ : *Yes*

Type of Technology/Engineering experience would you recommend incoming students to have?
Electronics: *Yes* Engineering Drawing: *No* Mechanical Lab: *Yes* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):
Oral Presentations: 4 Reading Comprehension 5 Narrative Writing 2 Expository (technical) Writing 2
Persuasive Writing 3 Descriptive Writing 4

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
important

Comments : Would like students to come in well rounded with history and languages. It is good if they have solid preparation in math and science but beyond anything else, they need to be good and interested learners. We would like to see more high school students considering the engineering and technical fields. Some students may not understand the nature or importance of these areas. Anything that can be done to increase the awareness of these areas of study would be beneficial.

Boston University Biomedical Engineer
Professor, Associate Chairman

Subject	Required	Recommended
Introductory 9 th Grade Physics	Yes	No
Upper Physics	Yes	No
Earth and/or Space Science	No	No
Chemistry	Yes	No
Biology	Yes	No
Computer Science		Yes
Pre Engineering		Yes

Other Requirements:

Subject	Required	Recommended
Calculus	No	Yes
Geometry	Yes	No
Trigonometry	Yes	No
Algebra	Yes	No
Algebra 2	No	Yes
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *No* None: *Yes*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Other Computer Science Recommended: *nice but not necessary, basic computer literacy key*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *Yes* Engineering Drawing: *No* Mechanical Lab: *Yes* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 4 Expository (technical) Writing 5 Persuasive Writing 4 Descriptive Writing 3

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?

very important

Comments : The biomed program is 50% women, possibly because of the helping nature of the field.

Harvard College, Engineering and Applied Sciences
Academic Programs Administrator

Subject	Required	Recommended
Introductory 9 th Grade Physics	No	No
Upper Physics	No	No
Earth and/or Space Science	No	No
Chemistry	No	No
Biology	No	No
Computer Science		No
Pre Engineering		No

Other Requirements:

Subject	Required	Recommended
Calculus	No	No
Geometry	No	No
Trigonometry	No	No
Algebra	No	No
Algebra 2	No	No
Pre-calculus	No	No
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *No* None: *No*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: *0* Reading Comprehension *0* Narrative Writing *0* Expository (technical) Writing *0*
Persuasive Writing *0* Descriptive Writing *0*

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?

Comments : There are no special entrance requirements.

University of Massachusetts Lowell, Francis College of Engineering
Dean

Subject	Required	Recommended
Introductory 9 th Grade Physics	Yes	No
Upper Physics	Yes	No
Earth and/or Space Science	No	Yes
Chemistry	Yes	No
Biology	No	Yes
Computer Science		Yes
Pre Engineering		Yes

Other Requirements:

Subject	Required	Recommended
Calculus	No	Yes
Geometry	No	Yes
Trigonometry	No	Yes
Algebra	No	Yes
Algebra 2	No	Yes
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *Yes* None: *No*

Computer Language Recommended: Basic: *Yes* Fortran: *No* C: *Yes* C++ : *Yes*

Other Computer Science Recommended: *computer literacy required*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *Yes* Engineering Drawing: *Yes* Mechanical Lab: *Yes* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 3 Expository (technical) Writing 4

Persuasive Writing 5 Descriptive Writing 4

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?

very important

Comments : The most important skills needed in preparing for an engineering or engineering technology program are in the math area. Most students 'flunk out' as result of poor math skills. This is the biggest area of deficiency. We recommend high standards for K-12 math teachers including the ability to apply mathematical theory to real world problems and problem solving strategies.

University of Massachusetts, Amherst
Assistant Dean

Subject	Required	Recommended
Introductory 9 th Grade Physics	No	No
Upper Physics	Yes	No
Earth and/or Space Science	No	No
Chemistry	Yes	No
Biology	Yes	No
Computer Science		No
Pre Engineering		No

Other Requirements: A ninth grade science course is required

Subject	Required	Recommended
Calculus	No	Yes
Geometry	Yes	No
Trigonometry	Yes	No
Algebra	Yes	No
Algebra 2	Yes	No
Pre-calculus	Yes	No
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *No* None: *No*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Type of Technology/Engineering experience would you recommend incoming students to have?
Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):
Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 5 Expository (technical) Writing 5 Persuasive Writing 5 Descriptive Writing 5

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
very important

Comments: The opportunity to have hands on experience is important to spark interest in the area.

Massachusetts Institute of Technology, School of Engineering
Director of Assessment

Subject	Required	Recommended
Introductory 9 th Grade Physics	Yes	No
Upper Physics	Yes	No
Earth and/or Space Science	No	No
Chemistry	Yes	No
Biology	No	No
Computer Science		No
Pre Engineering		No

Other Requirements:

Subject	Required	Recommended
Calculus	No	No
Geometry	Yes	No
Trigonometry	Yes	No
Algebra	Yes	No
Algebra 2	No	No
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *No* None: *Yes*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Other Computer Science Recommended: *No computer language in particular, though some experience is recommended.*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: 3 Reading Comprehension 5 Narrative Writing 3 Expository (technical) Writing 5 Persuasive Writing 5 Descriptive Writing 3

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
important

Comments : An increasing percentage of our students complete 1 or more AP math or science courses. Also, an increasing percentage complete special summer engineering, science or computer programs. While not required, these experiences are viewed positively in the admissions process.

Western New England College/Industrial Engineering
Professor

Subject	Required	Recommended
Introductory 9 th Grade Physics	No	No
Upper Physics	No	Yes
Earth and/or Space Science	No	No
Chemistry	No	Yes
Biology	No	Yes
Computer Science		No
Pre Engineering		No

Other Requirements: One lab science is required

Subject	Required	Recommended
Calculus	No	No
Geometry	Yes	No
Trigonometry	No	Yes
Algebra	Yes	No
Algebra 2	Yes	No
Pre-calculus	Yes	No
Other	The algebra and trigonometry is key. The ability to relate and apply these math concepts.	

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *No* None: *Yes*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Type of Technology/Engineering experience would you recommend incoming students to have?
Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *No*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):
Oral Presentations: 3 Reading Comprehension 5 Narrative Writing 2 Expository (technical) Writing 2 Persuasive Writing 2 Descriptive Writing 5

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
somewhat important

Comments : Sometimes the hands-on experience is "tinkering" rather than engineering. If the hands-on experience includes the analyzing process using math concepts this would be much more beneficial - doing the calculations instead of just 'guessing' what would work best. Students coming with strong experiences in the technology areas have been coming to college with weak math and science needed for engineering science programs. This preparation is great for technology engineering degree programs where math/science is less demanding.

Tufts University, School of Engineering
Associate Dean, Student Services

Subject	Required	Recommended
Introductory 9 th Grade Physics	No	No
Upper Physics	Yes	No
Earth and/or Space Science	No	Yes
Chemistry	Yes	No
Biology	Yes	No
Computer Science		Yes
Pre Engineering		No

Other Requirements:

Subject	Required	Recommended
Calculus	Yes	No
Geometry	No	Yes
Trigonometry	No	Yes
Algebra	No	Yes
Algebra 2	No	No
Pre-calculus	No	No
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *No* None: *Yes*

Computer Language Recommended: Basic: *Yes* Fortran: *No* C: *No* C++ : *No*

Type of Technology/Engineering experience would you recommend incoming students to have?
Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *Yes*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):
Oral Presentations: 3 Reading Comprehension 3 Narrative Writing 3 Expository (technical) Writing 5
Persuasive Writing 5 Descriptive Writing 5

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
important

Comments : No comments.

Tufts University, Civil and Environmental Engineering
 Associate Professor/Chair

Subject	Required	Recommended
Introductory 9 th Grade Physics	No	No
Upper Physics	Yes	No
Earth and/or Space Science	No	Yes
Chemistry	Yes	No
Biology	No	Yes
Computer Science		Yes
Pre Engineering		Yes

Other Requirements:

Subject	Required	Recommended
Calculus	Yes	No
Geometry	Yes	No
Trigonometry	Yes	No
Algebra	No	Yes
Algebra 2	Yes	No
Pre-calculus	No	Yes
Other		

CAD Recommendation: Mastery: *No* Efficiency: *No*: Basic Knowledge: *Yes* None: *No*

Computer Language Recommended: Basic: *No* Fortran: *No* C: *No* C++ : *No*

Type of Technology/Engineering experience would you recommend incoming students to have?

Electronics: *No* Engineering Drawing: *No* Mechanical Lab: *No* Data Protocols: *No* All of these: *Yes*

Please rate the following English and Language Arts Skills (5 very important – 1 least important):

Oral Presentations: 5 Reading Comprehension 5 Narrative Writing 5 Expository (technical) Writing 3 Persuasive Writing 3 Descriptive Writing 5

How important is it for students to have hands-on experience in a technology/engineering high school course before entering into an undergraduate engineering program at your institution?
important

Comments : Students should be well versed in time management and organization skills. The demands of an engineering education are quite high so being able to manage one's time becomes very important.

Appendix C: Massachusetts Accredited Engineering and Engineering Technology Programs By Accreditation Board for Engineering and Technology ABET 2003
(Dates reflect year of accreditation)

Engineering Programs

Boston University

Boston, MA
Aerospace Engineering (BS) [1971]
Biomedical Engineering (BS) [1983]
Computer Systems Engineering (BS) [1983]
Electrical Engineering (BS) [1983]
Manufacturing Engineering (BS) [1971]
Mechanical Engineering (BS) [1983]

Harvard University

Cambridge, MA
Engineering Science(s) (BS) [1962]

Massachusetts Amherst, University of

Amherst, MA
Chemical Engineering (BS) [1958]
Civil Engineering (BS) [1949]
Computer Systems Engineering (BS) [1978]
Electrical Engineering (BS) [1950]
Environmental Engineering (MS) [1978]
Industrial Engineering (BS) [1950]
Mechanical Engineering (BS) [1950]

Massachusetts Dartmouth, University of

North Dartmouth, MA
Civil Engineering (BS) [1972]
Computer Engineering (BS) [1984]
Electrical Engineering (BS) [1970]
Mechanical Engineering (BS) [1970]

Massachusetts Institute of Technology

Cambridge, MA
Aerospace Engineering (BS) [2002]
Aerospace Engineering with information Technology (BS) [2002]
Chemical Engineering (BS) [1936]
Civil Engineering (BS) [1936]
Comp Science and Engineering (BS) [1978]
Electrical Engineering and Comp Science (BS) [1996]
Electrical Science and Engineering (BS) [1936]
Environmental Engineering Science (BS) [1993]
Materials Science and Engineering (BS) [1936]
Mechanical Engineering - Course 11A (BS) [2002]
Mechanical Engineering (BS) [1936]
Nuclear Engineering (BS) [1980]
Ocean Engineering (BS) [1972]

Massachusetts Lowell, University of

Lowell, MA

Chemical Engineering (BS) [1971]
Civil Engineering (BS) [1977]
Electrical Engineering (BS) [1962]
Mechanical Engineering (BS) [1962]
Nuclear Engineering Option within Chemical Engineering (BS) [2001]
Plastics Engineering (BS) [1978]

Merrimack College

North Andover, MA
Civil Engineering (BS) [1964]
Electrical Engineering (BS) [1966]

Northeastern University

Boston, MA
Chemical Engineering (BS) [1942]
Civil Engineering (BS) [1939]
Electrical Engineering (BS) [1939]
Industrial Engineering (BS) [1939]
Mechanical Engineering (BS) [1939]

Tufts University

Medford, MA
Chemical Engineering (BS) [1952]
Civil Engineering (BS) [1936]
Computer Engineering (BS) [1982]
Electrical Engineering (BS) [1936]
Environmental Engineering (BS) [1997]
Mechanical Engineering (BS) [1936]

Wentworth Institute of Technology

Boston, MA
Electromechanical Engineering (BS) [2002]
Environmental Engineering (BS) [2002]

Western New England College

Springfield, MA
Electrical Engineering (BS) [1971]
Industrial Engineering (BS) [1985]
Mechanical Engineering (BS) [1971]

Worcester Polytechnic Institute

Worcester, MA
Chemical Engineering (BS) [1942]
Civil Engineering (BS) [1936]
Electrical Engineering (BS) [1936]
Industrial Engineering (BS) [1997]
Manufacturing Engineering (BS) [1991]
Mechanical Engineering (BS) [1936]

Engineering Technology Programs

Massachusetts Lowell, University of

Lowell, MA

Civil Engineering Tech (AS) [1969]

Civil Engineering Tech (BS) [1969]

Electronic(s) Engineering Tech (AS) [1978]

Electronic(s) Engineering Tech (BS) [1978]

Mechanical Engineering Tech (AS) [1978]

Mechanical Engineering Tech (BS) [1978]

Northeastern University

Boston, MA

Electrical Engineering Tech (AE) [1986]

Electrical Engineering Tech (BS) [1970]

Mechanical Engineering Tech (AE) [1986]

Mechanical Engineering Tech (BS) [1970]

Wentworth Institute of Technology

Boston, MA

Architectural Engineering Tech (BS) [1981]

Civil Engineering Tech (BS) [1981]

Computer Engineering Tech (BS) [1987]

Electronic(s) Engineering Tech (BS) [1981]

Electronic(s) Systems Engineering Tech (BS) [1995]

Manufacturing Engineering Tech (BS) [1987]

Mechanical Engineering Tech (BS) [1981]