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# An Informal Survey of Calculus and Physics Requirements in Engineering Technology

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**Abstract** - *In October of 2009, a short survey was sent out to Engineering Technology Division Listserv of ASEE. Members were asked how many calculus courses they required in their ET program, how many technical calculus courses, and if they required calculus-based physics. In one week, 83 responses were received. Of the 77 schools represented, 49 were from four-year institutions and 28 were from two-year or community colleges. Of the four year institutions, the majority (~60%) require two years of calculus or technical calculus, whereas two-year schools required much less calculus; 36% require 1 semester and 45% did not require calculus at all. However, they did mention that they recommend calculus to students who plan on transferring to a four-year institution. Of the four year institutions, 29% required calculus based physics and 6% reported allowing either algebra or calculus based physics. This appears to imply that 65% require algebra based physics.*

## I. Introduction

A short survey was sent out to the members of the Engineering Technology Division Listserv of ASEE in October, 2009. Members were asked how many calculus courses they required in their ET program, how many technical calculus courses, and if they required calculus-based physics. In one week's time, 83 individuals responded, representing 77 schools in the United States. Of the schools represented, 49 were from four-year institutions and 28 were from two-year or community colleges. Many respondents requested a copy of the results as they are evaluating their math requirements. To the best of our knowledge, no-one has done a survey of Engineering Technology programs to examine math and physics requirements.

## II. Analysis

The advantage of a short survey is that it is easy and quick to respond to, and this is probably the reason that so many responses were gathered in such a short time. Obviously this was not a random sample, but rather a sampling of individuals who were interested in the survey questions and were motivated to respond to the survey. None-the-less, the results are an interesting sample and can be used when developing new ET programs or in examining program requirements when evaluating the possible need for change. The exact questions are given in table I.

Table I. Survey questions sent to the email group of ET members of the ETD Listserv of ASEE

Survey Questions
1. How many calculus courses do you require in the ET disciplines?
2. How many technical calculus courses do you require?
3. Do you require calculus-based physics?

The questions were of particular interest to our Mechanical Engineering Technology program and to our Electronic Engineering Technology program. We currently require two semesters of calculus and two semesters of physics, the first of which must be calculus-based physics and the second one can be either calculus or algebra-based physics. One of the driving questions of possible curriculum change has been what courses will be accepted from local community colleges as well as what is expected by ABET. As tuition continues to increase, more and more students start out at community colleges and then transfer to our four year program.

The data was somewhat difficult to analyze because the respondents were not asked to give their institution or their particular program. For respondents who did not give their institution, their school was determined from their email address. To obtain additional information, the ABET website (ABET.org) was mined for information regarding accredited programs. The respondents were from many different ET programs and we present these results to be used as general guidelines only.

The data compiled from the four year institutions are given in Table IIa. As Table IIa shows, almost half of the four-year schools required 2 semesters of calculus. If two semesters of technical calculus are added into this number, 60% of the four-year schools require two semesters of either traditional or technical calculus. Only 20% require more than two semesters. Some schools required two semesters of calculus and differential equations, or sometimes reported three years of calculus and differential equations. This is probably somewhat subject specific, although in examining which programs were accredited by ABET, no pattern appeared.

Two year schools, as shown in Table IIb, did not require as much math, particularly calculus, as did the four-year institutions, but many respondents indicated that they recommend calculus for students who plan on transferring. It appears that students who transfer are expected to take calculus at the transfer school. Several schools (36%) required only one semester of calculus.

Table IIa. Math requirements from 4-year institutions and the percentage with each requirement.

	N = 49
1 semester calculus	12 %
2 semesters calculus	48 %
3+ semesters of calculus	20 %
2 semesters of technical calculus	12 %
Other*	8 %

\* Other usually meant that programs taught their own math courses, or else they required a combination of courses, like one calculus like course and a course in statistics.

Table IIb. Math requirements from 2 year-institutions and the percentage with each requirement.

	N = 22
0 semesters of calculus	45 %
1 semester calculus	18 %
2 semesters calculus	5%
3+ semesters of calculus	0 %
1 semesters of technical calculus	18 %
Other*	14 %

\*Other included pre-calculus classes, 1 ¼ semesters of calculus, or ‘Intuitive Calculus’ or other institution-specific courses.

On the Accreditation Board of Engineering and Technology (ABET) web site ([abet.org](http://abet.org)) a person can look up a particular school and see which, if any, programs are accredited through ABET. The data presented here were subdivided by ABET accreditation versus non-ABET accreditation or in some cases accreditation by other agencies such ATMA, when the respondent gave the other agency. The reason for dividing the schools by ABET accreditation and non-ABET accreditation is that ABET schools meet

specific criteria. This does not imply that the non-accredited schools did not have as rigorous standards as the accredited schools, but it seemed useful to compare schools which are known to have specific standards. The data for schools which had at least one TAC (Technology Accreditation Committee) accreditation are listed in Table III.

Table IIIa. Math requirements from 4-year ABET accredited institutions and the percentage with each requirement.

	N = 33
1 semester calculus	9 %
2 semesters calculus	49 %
3+ semesters of calculus	18 %
2 semesters of technical calculus	12 %
Other*	12 %

\* Other usually meant that programs taught their own math courses, or else they required a combination of courses, like one calculus like course and a course in statistics.

Table IIIb. Math requirements from 2-year ABET accredited institutions and the percentage with each requirement.

	N = 12
0 semesters of calculus	33 %
1 semester calculus	17 %
2 semesters calculus	0 %
3+ semesters of calculus	0 %
1 semesters of technical calculus	33 %
Other*	17 %

\*Other included pre-calculus classes, 1 ¼ semesters of calculus, or ‘Intuitive Calculus’ or other institution-specific courses.

The results are very similar to the total response. Approximately 60% of both ABET accredited, as well as the total sample of four-year institutions, required either two semesters of calculus or technical calculus. For two year institutions, about 36% required one semester of calculus or technical

calculus whereas 50% of ABET accredited two-year schools required one semester of calculus, the most common requirement.

Physics was required by all the four year institutions. Since we asked, “Do you require calculus based physics?” we *inferred* that schools that said no required algebra based physics, assuming that the physics had a math requirement. So, the only conclusions that can be drawn are the number of schools that required calculus-based physics. Some respondents specifically said that they require algebra based physics and others just responded “No” to the question of “Do you require calculus based physics?” The results to the physics questions will only be given for the four-year schools because only two of two-year schools required calculus based physics, which makes sense since most two-year schools only require one semester of calculus. A few of the four-year schools allowed either algebra or calculus based physics. Table IVa and Table IVb show the results for all of the respondents as well as the respondents whose schools have at least one ABET accredited program.

Table IVa: Percentage of total 4 year schools that require algebra or calculus based physics, or in some cases, either one.

Prerequisite math for Physics	N = 49
Algebra	65 %
Calculus	29 %
Either	6 %

Table IVb: Percentage of ABET accredited four-year schools that require algebra or calculus based physics, or in some cases, either one.

Prerequisite math for physics	N = 34
Algebra	65 %
Calculus	32 %
Either	3 %

As Tables IVa and IVb show, the majority of all four-year institutions (including ABET accredited schools) require algebra based physics. The majority of respondents either specifically stated, or else we surmised if they said “do not require calculus”, that they required algebra based physics rather than calculus based physics. We did not make any assumptions regarding the number of semesters of physics, just that physics was required.

To understand how the math requirements were related to the physics requirements, we have constructed a bar chart of the results for all of the 4 year institutions. The number of semesters of calculus is on the

x-axis and the number of schools requiring those numbers of semesters is on the y-axis. Each column is broken down by the number of schools that required calculus based physics or algebra based physics. As can be seen by the figure the most common combination is algebra based physics (or technical physics) and two semesters of calculus.

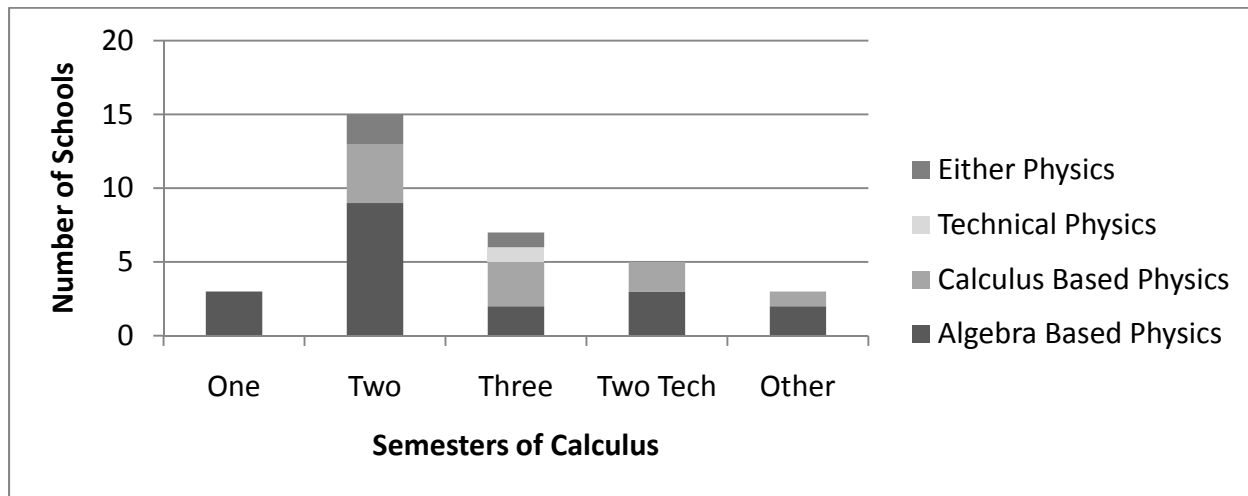


Figure 1. The number of schools that require calculus plotted by how many semesters of calculus that are required. Each vertical bar is further broken down by the type of physics that is required.

### III. Conclusion

The results of a short survey asking engineering technology educators to respond to questions regarding calculus and physics requirements for their programs were analyzed. In one week’s time 83 educators representing 77 schools responded to the survey, indicating the interest that engineering technology educators have in these requirements. The majority of 4 year institutions require two semester of calculus and the majority of 2 year institutions require one semester of calculus. Since all 4 year institutions require physics, the majority appear to require the algebra based physics as opposed to the calculus based physics. These requirements are less rigorous than most engineering programs. However, further study is required to examine the purpose of the math and physics requirements, and how they fit into engineering technology curricula. Also, the math and science background of the typical ET student should also be examined.

## Biography

**Harvey I Lyons** is a Professor of Mechanical Engineering Technology at Eastern Michigan University. He received his BS and MS at the Cooper Union, and his PhD in Mechanical Engineering at Ohio State University. He is a registered Professional Engineer and his industrial experience has principally been in bulk materials handling, mining and process industries. His academic experience includes development of departments, curricula and programs. His research interest is in the tribological behavior of metallic materials; and his teaching interests include the design and stress analysis of mechanical components and assemblies with consideration for industrial design and failure analysis.

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