



INTRODUCTION TO ENGINEERING

THE ISSUE

The course, typically entitled “Introduction to Engineering,” appears to have become a major stumbling block in the development of a coherent state-wide articulation agreement between 2-year and 4-year institutions for mechanical engineering, or for that matter, any engineering discipline. This course is generally taught during the first semester of enrollment in an engineering degree program. As such, coming to agreement on the content and transferability of this course is critical to developing a broad articulation agreement.

The stumbling block appears to be the intended purpose of the course. In some curricula the course is intended to assist students determine if they want to pursue a career in engineering. In other curricula the course is intended to provide an overview of engineering and to begin developing skills necessary for success in engineering studies, while in other curricula the course is intended to provide an overview of engineering and also serve as the beginning of study in a particular field of engineering. Such different intentions make it very difficult for community colleges to develop a course that can be incorporated into a statewide articulation agreement, and for 4-year institutions to offer a course that can transfer between institutions.

These different purposes appear to be at the heart of the problem when trying to agree upon a single introductory course. A single course cannot serve all three purposes, as the different purposes tend to be mutually exclusive. A course intended to help students determine if they want to study engineering is different from a course intended to expose students who already know they want to study engineering to the different fields of engineering. And that course is yet again different from a course intended to develop knowledge, skills, and attitudes necessary for study in a particular field of engineering, knowledge, skills, and attitudes that may or may not be applicable to a different field of engineering.

A PROPOSED SOLUTION

An apparent solution is development of three independent courses, each intended to serve a particular purpose and a particular audience. The three courses are:

- An overview of engineering and science,
- An introduction to engineering and development of fundamental skills, and
- Development of fundamental discipline specific skills.

The broad content of each of these courses is discussed in the following paragraphs. The first two of these courses would become part of the ACGM and could be offered by both 2-year and 4-year institutions. The latter course would be specific to each institution offering a baccalaureate engineering degree, if the institution chooses to offer such a course. Discipline specific courses likely would not be offered by 2-year institutions because multiple courses would be needed and because of the variability among the 4-year to institutions. Proposed descriptions and outcomes for the first two courses are presented in the Appendix to this white paper.

Overview of Engineering and Science

This one credit-hour course introduces the student to the broad disciplines in engineering and science and to the possible career paths following study in each. This course would not be considered part of an engineering degree program; it is intended only as an exploratory course for those who are not sure if



they want to study engineering and want to know more. The expectation is that a number of students who take the course will not go on to become engineers or scientists; they decide upon a different career.

Introduction to Engineering

This two credit-hour course is offered by both 2-year and 4-year institutions, with agreed content and learning outcomes. It is the introduction to the fields of engineering and career paths within engineering, as well as study, writing, and thinking skills that everyone has said are contained in their introductory courses, be they discipline specific or otherwise. The expectation is that all engineering students will take this course; some students may elect to change to a different major in engineering after completing this course.

Introduction to a Specific Engineering Discipline

Programs that want to have content specific to a discipline included in the introductory would develop a free-standing one credit-hour course that contains the discipline specific content. This one credit-hour course can be taken in parallel with the general Introduction to Engineering course, or as a follow-on course. In essence, the current three credit-hour discipline specific introductory courses would be split into a two credit-hour and a one credit-hour course, with the discipline specific content being contained in the one credit-hour course.

A similar one credit-hour course can be developed by 4-year institutions that expect all students to develop skills beyond that proposed in the two credit-hour introductory course. This course could be taken in conjunction with or as a follow-on course to the common Introduction to Engineering course.

Impact on Curricula and the Student

Following the path outlined in this proposal would provide the student with the greatest flexibility and provide direction for the community colleges offering introductory engineering course work. The community colleges would be able to offer a single course that would be accepted by a breadth of institutions, rather than offering multiple courses that each serves specific institutions. From the perspective of the student, they need to be less concerned about the 4-year institution to which they are likely to transfer to determine which introductory course should be taken.

There is little perceived impact of this proposal on the 4-year institutions. Programs that currently have a two credit-hour introductory course would adopt the common course with agreed upon content. Programs that have a three credit-hour introductory course with discipline content, would adopt the two credit-hour introductory course and then develop a new one credit-hour discipline specific introductory course. In each case, the number of credit hours in the program would remain the same.

If this approach is adopted, a student who transfers from a 2-year to a 4-year institution, or who transfers from one 4-year institution to another 4-year institution, would need to add at most one hour of study. Students transferring from one 4-year institution to another 4-year institution would lose only one hour of study if the receiving program does not require a discipline specific introductory course. Students transferring to a different engineering discipline within the same university, or transferring to a different engineering program at a different institution, would lose at most one hour and have to add at most one hour (e.g. if an ME program would not accept an EE discipline specific course and insisted upon their own discipline specific course).



AN IMPLEMENTATION STRATEGY

Following is a possible implementation strategy for the proposal contained herein. Although the focus of the current work is a statewide articulation agreement for mechanical engineering, other programs should be considered when developing course content to ensure that later articulation agreements are not adversely impacted by decisions made. The steps for implementing the proposal are as follows:

1. Determine the course description and the learning outcomes of:
 - a. The overview to science and engineering, and
 - b. The broad Introduction to Engineering course.
2. Have the courses developed in Step 1 incorporated into the ACGM as the only options.
3. Implement the courses developed in Step 1 at 2-year and at 4-year institutions, as appropriate (4-year institutions may or may not choose to offer the overview course).
4. Programs that require a three credit-hour discipline specific introductory develop a one credit-hour course that supplements the common two credit-hour course.
5. Mechanical engineering programs (hopefully all engineering programs) modify their baccalaureate curriculum to utilize the common two credit-hour introductory course and a discipline specific course, as appropriate and as needed.

This strategy is believed to provide the greatest flexibility for the students, to provide necessary direction for the community colleges, and to have the least impact on curricula of the baccalaureate programs.



APPENDIX—PROPOSED COURSE DESCRIPTION AND LEARNING OUTCOMES

Overview of Engineering and Science

Course Description	Course Learning Outcomes
<p>This survey course provides students with an overview of careers in engineering and science. It is intended primarily for students who are unsure if they want to pursue study in engineering and science and want to explore those fields before deciding.</p> <p>Prerequisites: None</p>	<p>Upon successful completion of this course, students will be able to:</p> <ol style="list-style-type: none">1. Describe the difference and similarities between engineering and science.2. Identify career opportunities for engineers and scientists.3. Articulate the impact of engineering and science on modern society.4. Identify in current periodicals recent developments in engineering and science.5. Describe, in broad terms, engineering and science academic curricula.

Introduction to Engineering

Course Description	Course Learning Outcomes
<p>An introduction to the engineering profession with emphasis on technical communication and team-based engineering design. One hour of lecture and three hours of laboratory each week.</p> <p>Prerequisites: MATH 2412—Pre-Calculus Math or equivalent preparation</p>	<p>Upon successful completion of this course, students will be able to:</p> <ol style="list-style-type: none">1. Explain the engineering profession and engineering ethics, including professional practice and licensure.2. Use technical communication skills to explain the analysis and results of introductory laboratory exercises in engineering and computer science.3. Explain the engineering analysis and design process.4. Analyze data collected during laboratory exercises.5. Articulate the impact engineering has had on the modern world.6. As part of a team, design a simple engineering device, write a design report, and present the design.