

Revising a Civil Engineering Curriculum at the University of Tennessee at Chattanooga

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Abstract

In early 1999, the faculty at the College of Engineering and Computer Science at the University of Tennessee Chattanooga agreed to replace the broad based undergraduate Engineering program with a discipline-based Engineering program. This change was prompted by several reasons. These included a change in the composition of the faculty, response from the parents and students, industry concerns and the college's continued commitment and concern for the students. It is anticipated that this new curriculum will take effect in the fall of 2001 with an initial Accreditation Board for Engineering and Technology (ABET) visit slated for the fall of 2003.

The Civil Engineering faculty members were charged with designing and implementing the new curriculum in the Civil Engineering Department. This paper describes the nature and rationale of the curriculum revisions as well as the proposed implementation. This new curriculum exposes the students to the depth and breadth of discipline essential to modern civil engineering practice while still maintaining a strong core and interdisciplinary focus. Additionally, the paper presents an effort to introduce an organized interdisciplinary design experience during each year of the students study.

Introduction

The College of Engineering at University of Tennessee at Chattanooga (UTC) is in the process of implementing a substantially revised undergraduate degree program which will lead to a disciplined-based degree in Chemical Engineering, Civil Engineering, Electrical engineering, Environmental Engineering, Industrial Engineering and Mechanical Engineering. At present UTC offers a general degree program in Engineering at the undergraduate level which leads to the Bachelor of Science in Engineering. The current program was adopted in 1969 and was structured around an interdisciplinary core of courses, which was intended to provide the student with a broad based background in the engineering sciences. The Civil Engineering program at UTC currently has approximately 40 students.

The primary goal for an undergraduate education is a strong preparation in mathematics, basic science and engineering science in order to prepare the student for entry-level positions in industry or for graduate studies. As such it is emphasized that the move to discipline-based engineering programs will not effect the schools commitment to engineering fundamentals and the capstone interdisciplinary design.

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Background

In order to address the need for a discipline-based curriculum, a committee was formed among the faculty members in the college. This self-study process began in early 1997 and was initiated by several reasons:

- Only 9% of freshman engineering majors selected general engineering
- Increase marketability of graduates
- Enlarge enrollment
- Need to ready our graduates to enter into our region's diverse industrial job base.

During the following two years, the process involved:

- Undergraduate Engineering Program Committee meetings, which developed the core and individual discipline programs
- Full faculty meetings which labored over the document submitted by the programs committee
- Formation of an Engineering Curriculum Committee which was now charged with the task of finalizing the proposal document to be submitted to the University Curriculum Committee.

Revising Civil Engineering Curriculum

It was critical that the College retain some of the appeal of the general engineering program and as such it was decided that the broad-based core curriculum be maintained with minimal revisions. The specific content of the subject areas was largely governed by ABET accreditation standards with the interdisciplinary capstone design basically left unchanged.

Engineering Core

The core is intended to stress certain fundamental physical understanding and to lay foundation for the rest of the engineering education. After many lengthy meetings, the decision was made to organize the civil engineering core into the following seven principal subject areas:

- Basic Engineering Science
- Mathematics
- Statics and Strength of Materials
- Dynamics
- Thermal/Fluid sciences
- Circuits and Signals
- Measurement and Controls

In the freshman year, students are introduced to design through a unique class known as "Introduction To Engineering Design". They are introduced to the design process in interdisciplinary engineering problems with the design exercises culminating in a conceptual group design project. While problems may be of

limited scope, they relate fundamentals useful to engineering modeling. The other core subjects include a course in statics and three courses in mathematics. Table 1 shows the freshman level engineering course offerings.

During the sophomore year, students are introduced to the fundamentals of mechanics through a class in strength of materials. The course consists of one three-hour lecture, as well as a separate three-hour laboratory session. The revised Engineering Computations course will introduce the students to computations using Excel and Visual Basic for applications accessed through the Excel platform. Solution of linear and non-linear equations, integration, ordinary differential equations and elliptic differential equations will complete the material coverage in the computation course.

The math and physics course in the core curriculum is considered to constitute a major part of the necessary fundamental concepts that stress the understanding of the underlying physical process. At this level, the student will take two math courses and one course in physics. Table 1 shows the rest of the second year level courses.

In the junior year, students will take three additional subjects from the core - Fluid Mechanics, Materials Science and Engineering Economy.

Subject Areas

Based on the old general engineering program, most of the subject area courses are new. During the last two years of study, between the core courses and the capstone, the student is exposed to the civil engineering discipline at a more advanced level. The new civil engineering program only offers a structures option. The structures option focuses primarily on four traditional civil engineering areas – structures, geotechnical, transportation and environmental engineering.

In the junior year, in the area of mechanics, the students will take one course each in: structural analysis, structural design, soil mechanics and two courses in transportation engineering. This will be in addition to the several core courses, which will be offered throughout the curriculum.

In the final year of study, two courses in structural analysis and design and one course in foundation analysis and design highlight the course offerings in the mechanics area. Rounding off the courses in the subject areas, the student will take a course in surveying in the second year of study, and one course each in geology and environmental engineering in the final year.

The Capstone

The interdisciplinary undergraduate capstone is a two-semester sequence course. Since design is integrated throughout the curriculum, the students enter the last year of their studies with a broad perspective on design and other necessary tools to tackle meaningful design projects. The first sequence is a guided design experience that includes design methodology, concept generation, decision making, technical project management and teamwork. The second semester of the capstone course, involves the completion of detailed and final design phases of the problem initiated in the first semester – including building a model, testing and evaluation. Written and oral communication plays a major role in completion of the capstone course.

A unique feature of the course is that it is taught by three faculty members drawn from three different engineering areas. The current make-up of the faculty members conducting the capstone is: Mechanical Design/Solid Mechanics, Industrial Engineering/Engineering Management and Fluid Mechanics/Heat transfer.

| FRESHMAN | | SOPHOMORE | |
|------------------------------------|----|--------------------------------------|----|
| Basic Engineering Science | 3 | Plane and Route Surveying | 3 |
| Freshman Engineering Design | 1 | Mechanics of Materials | 4 |
| Vector Statics | 3 | Electrical Circuits and Systems | 3 |
| Freshman Engineering Lab | 1 | Dynamics | 3 |
| Introduction to Engineering Design | 3 | Engineering Computations | 3 |
| Basic Engineering Science | 15 | Basic Engineering Science | 10 |
| General Education | 7 | Statistics | 3 |
| | | General Education | 7 |
| JUNIOR | | SENIOR | |
| Fluid Mechanics | 4 | Foundation Analysis and Design | 3 |
| Structural Analysis I | 3 | Structural Analysis II | 3 |
| Transportation Engineering I,II | 6 | Hydrology | 3 |
| Environmental Processes | 3 | Water Supply & Waste Water Treatment | 3 |
| Structural Engineering Design I | 3 | Structural Engineering Design II | 3 |
| Soil Mechanics | 3 | Technical Elective | 3 |
| Material Science | 3 | Senior Design | 6 |
| Engineering Economy | 3 | Basic Engineering Science | 0 |
| Basic Engineering Science | 0 | General Education | 6 |
| General Education | 6 | | |

Table1 Requirements in semester hours – minimum hours required for graduation is 134 hours

Closure

The faculty in the College of Engineering have developed a curriculum designed to ready engineers for the workforce of the 21st century. This has been accomplished by reducing the number of credit hours from 144 to 134 needed for graduation. The program also retains our traditional emphasis on broad-based engineering education and the interdisciplinary design experience, which has been the cornerstone of the UTC engineering program since its inception. The reactions from the students has been very positive to a point where seniors are willing to stay around one more year so that they can graduate under the new system.

The regular and adjunct faculty needed to implement the new courses are already available. Some rearrangement will be made as to the number sections offered in the core courses so that the teaching load for the existing faculty is not unreasonable.

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Edwin P. Foster

Ed Foster is a professor in civil engineering at UTC. He received his Ph.D. from Vanderbilt University in 1974. Dr. Foster developed the civil engineering program at the University of Tennessee at Nashville before coming to the Chattanooga campus in 1979 to start a civil engineering concentration. He has been a consultant to many engineering firms and concentrates in the areas of structural engineering analysis and design.