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## **Project-Based Freshmen Engineering Courses in Civil Engineering Technology**

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### **Abstract**

Old Dominion University (ODU) has developed two fundamental courses for freshmen engineering students. The first course introduces the fundamentals of the practice of engineering including innovation, creativity, design and manufacturing, commercialization, teaming skills, environmental impact, and ethics. The second course is an exploration of engineering and engineering technology disciplines with an emphasis on projects.

The purpose of these courses is to engage the students in the application of engineering early in their course of study with the hope that their interest will be reinforced and the likelihood of their being retained as students will increase. The courses are divided into three five-week modules that are distributed among departments within the college. The Engineering Technology department is responsible for two of the five-week modules in the second, projects-based course. One module is comprised of the civil, mechanical and electrical engineering technology curricula and the other module is comprised of strictly civil engineering technology.

This paper describes the freshmen engineering courses and outlines the projects that have been developed for Civil Engineering Technology at Old Dominion University. The Civil Engineering Technology program has seen an increase in students since the implementation of this freshmen project based courses, and the program has seen an increase in interest from freshmen students.

### **Introduction**

Engineering 110 and 111 are two courses described in the catalog as a ". . . . series of projects to introduce a variety of engineering and technology disciplines; hands-on experiences with selected engineering problems and issues; team approach to managing engineering projects; discovering the unknown, formulating solutions, designing, manufacturing and testing; emphasis on learning modules, communication and presentation skills, creativity and innovation." These classes were introduced in the Batten College of Engineering and Technology at ODU in an effort to increase retention among engineering students. Beginning engineering students are often overcome or discouraged by the fundamental math and science courses that are required as

prerequisites to the core engineering design courses. These freshmen engineering courses give the students exposure to engineering in a manner that keeps the students' interest alive without the rigors of mathematics for which the student is not prepared. The project-based classes introduce students to real life problems that are solved using engineering skills students will obtain through their degree programs.

Each course is organized into three five week-modules with approximately 25 students per section. This enables the freshmen students to be exposed to as many as six different engineering disciplines/problems during the course of their freshmen year. Engineering 110 is taught by the engineering departments within the college - civil and environmental, electrical and computer, and mechanical. Engineering 111 is taught by some of the same engineering departments but also includes two sessions taught by the Engineering Technology department. All students take at least one five week module from the Engineering Technology department and some students take both modules. This has greatly benefited the Engineering Technology department since it gives us an opportunity to explain the difference between engineering and engineering technology degrees.

### **Engineering Technology Modules**

The Engineering Technology department originally developed one five-week module for the freshmen-engineering course. This module was developed in order to expose students to all of the disciplines represented in the Engineering Technology department - civil, electrical and mechanical. In this module, the class section is divided into three groups and each group spends three days exploring each of the three engineering technology disciplines. The following is a description of the content covered by each of the disciplines:

- The Civil Engineering Technology (CET) three-day session focuses on surveying as a career option within CET. Surveying as a profession and its application to the engineering and design process are introduced to the students. For the hands-on portion of the session, a short introduction to leveling theory and instruction on how to operate a piece of basic surveying equipment (an automatic level) is provided. The students are then broken into 3-4 person teams to conduct a field exercise consisting of running a level-loop traverse on campus. The field results are then analyzed, with the aspects of error causes and consequences emphasized. The concept that there is no perfect measurement in engineering and that as an engineer the student needs to be aware of and able to work with that fact is introduced. The grades for this portion of the five-week session are dependant on student's participation and attendance.
- The Electrical Engineering Technology three-day session focuses on AC, DC, and digital introduction. After receiving the necessary theorem or device discussion, the students build and simulate a circuit on using Mult-Sim version 7. Electrical history is added to the content to generate some interest in students who may be more inclined toward choosing this major. Their grade for this session is based on their ability to successfully simulate the circuit.

- The Mechanical Engineering Technology (MET) three-day session provides brief introduction into the available areas of study within MET. The instructor provides a detailed explanation of differences between engineering technology and engineering curriculums, and the career possibilities for graduates of the MET program. In addition, the students are introduced to gears and they build models using Kinex building sets. Their grade for this session is based on a quiz and the results of the model building exercise.

The second engineering technology module that has been developed for the freshmen-engineering course is a CET module with an emphasis in construction. Students are introduced to civil engineering, focusing on milestones in civil engineering and the available disciplines of study. This module is also used to explain the difference between engineering and engineering technology degree programs. The unit then focuses on the design and construction industry. The students are introduced to project delivery systems and learn how design and construction interrelate. The classes are then divided into groups of three or four students and each group chooses a project to design and produces a conceptual set of plans for their project. Students are then introduced to estimating and scheduling in the construction industry and produce project estimates, schedules and models for their projects. The project culminates with a presentation of their project to the entire class. The grade for this session is based upon the project presentation, plans, estimate, schedule and model produced by each group.

In all of the engineering technology sessions, the instructor's lecture provides background information and the theory necessary to proceed with the hands on projects for approximately half of the lecture period. The students then work on their projects for the remainder of the period. There is no outside work required for the module which introduces students to all three engineering technology disciplines. However, in the module with the CET emphasis in construction, the student groups spend approximately 2 hours per week working on their projects outside of the class period.

## Results

The Engineering Technology (ET) department has seen an increase in enrollment of sophomore students. Prior to the introduction of these classes, the majority of students in the ET department were junior and senior transfer students from community colleges. Since the introduction of these courses, sophomore enrollment in the program has increased significantly. A confirmation of this increase can be found in the student headcount for CET, which increased 9 percent for the 2000 - 2001 academic year and 20 percent for the 2001-2002 academic year<sup>1</sup>. Although national trends also show an increase in enrollment, that percentage rate is roughly only 4 percent<sup>2</sup>. The Engineering Technology department as a whole has also seen percentage increases that are above the national average with an increase of 8% for the 2000-2001 academic year and 11% for the 2001-2002 academic year<sup>1, 2</sup>.

The increase in headcount in the engineering technology programs can be attributed to several factors which include the national increase in engineering degrees, the implementation of the Engineering Fundamentals program, students understanding the difference between engineering and technology, introduction of new electives in construction and geomatics, and an increased

availability of print advertisements for the engineering technology programs and field of study. Each of these factors is discussed below:

- As indicated above, there has been an increase nationally in engineering degrees. However, since the percentage increase in headcount for engineering technology at ODU is larger than the national percentage increase, it seems to indicate that the implementation of the Freshmen Engineering course may be having the positive effect that was intended.
- The Freshman Engineering course offers an opportunity to define Engineering Technology. There is a concern that the public in general and that parts of the Engineering profession in particular do not understand the role of Engineering Technology. The assignment of Technology faculty to teach the Engineering 111 course offers an excellent opportunity for students to explore the differences between Engineering Technology and traditional Engineering degree programs.

Students often make the transition from engineering to engineering technology citing difficulties with mathematics and sciences. When questioned during advising, it becomes apparent that a significant portion of these students are more inclined toward engineering practice than engineering science. In this instance, the student's performance may be attributed to a lack of motivation for the science aspect rather than an academic inability. The applications aspect of technology often stimulates these students to perform well in areas for which motivation had been absent.

- Courses in the area of construction and surveying are electives in the CET program. Some increased enrollment may be attributed to the availability of these courses, but the actual statistics concerning these courses have not been developed.
- The department has made an increased effort to promote the programs through the distribution of degree pamphlets to community college sites and visits to these same sites in an effort to meet with prospective students. This advertisement has made students aware of the distance education opportunities available in engineering technology at ODU.

## Conclusion

The CET program at ODU has seen headcount increases that exceed the national percent average for engineering during both the 2000-2001 and 2001-2002 academic years. During the 2000-2001 academic year the increase was approximately twice the national average and during the 2001-2002 academic year it was approximately five times the national average<sup>1,2</sup>. The addition of two fundamental engineering courses, which include two five week engineering technology modules, has been one of the major factors in the increased enrollment of students in this program. Other factors that may have contributed to the increased enrollment include students understanding the difference between engineering and technology, introduction of new electives in construction and geomatics, and increased advertisement of the engineering technology programs. Future goals of the authors include a survey of students to obtain specific information

on how the fundamentals courses affected their interest in and understanding of Engineering Technology.

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