Session T2D2

Engineering Technology Capstone & Design Projects

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Abstract

One of the program objectives of an engineering technology program is to prepare the graduates to be technically competent and productive in industry once employed. The skills acquired in school can lead him/her to a very successful and rewarding engineering technology career. One way the engineering technology program can prepare the graduate with the necessary design skills is through the senior capstone design course. It is the closest thing to solving real world projects in the classroom.

It is in the "design process" that students need to become familiar with early on in the curriculum. It is almost too late if students come into a senior capstone design class not knowing how to design or don't have any project management skills. At Southern University, Baton Rouge, Louisiana, the Electronics Engineering Technology (EET) department is trying to address that need. The EET department has instituted the idea of introducing this process in our beginning laboratory circuits courses(DC/AC), Electronics I and II. This design process will be taught in the form of design projects in the laboratory course assigned to each student group. The design projects, although small in scope, will accomplish the task of familiarizing the students with the design process. A typical project would have duration of three to four weeks. This paper will describe how the student will be able to demonstrate their understanding of the design process and project management skills needed for the capstone design course taken in the student's senior year. Through early preparation of laboratory-based design projects, the student will become familiar with the design process and will be able to design and build a engineering project successfully.

Proceedings of the 2006 ASEE Gulf-Southwest Annual Conference
Southern University- Baton Rouge, Louisiana

Introduction

Criterion 4 of the ABET engineering criteria requires a student to participate in a major design experience.[1][2]. Capstone design course offerings are a common way engineering programs meet this criteria. Senior capstone design projects are key elements in most engineering and engineering technology undergraduate programs. Students usually engage in these two semester course-equivalent subjects near the beginning of their senior year.

The senior capstone design projects course in the Engineering Technology program has several objectives. One objective is to enable students to integrate theoretical and practical skills gained throughout their lecture and laboratory courses. Another objective requires that senior capstone design experiences build on knowledge gained from earlier courses. The spirit of teamwork and associated concepts of effective task distribution, time and budget management are important outcomes of senior design projects. Successful documentation and presentation of the work performed throughout the project are equally important objectives.[3]

Students should be taught design principles early on in order to effectively work on a senior design project and be successful in their senior year. This is why a need to introduce the "design process" and integrate this in the lab as lab-based projects in the beginning sequence of electronic courses. This would be a first of its kind since these lab-based projects will coincide with on-going capstone course lectures.

Background

ABET 2000 criteria requires that the senior capstone experiences build on knowledge gained from earlier courses in the curriculum. [2]

As an outcome of an ABET visit October 2003, the Electronics Engineering Technology (EET) program at Southern University, Baton Rouge, LA, was cited with a weakness in the area of senior design projects because the projects did not have enough rigor in design content. It is a result of this visit that we found that some of the EET students did not know how to design or were not familiar with the design process. Our students are not taught design as it pertains to a team project until their senior year. In an industrial advisory committee meeting, a recommendation was made by an industry partner to introduce design not only in problems in lecture classes but in the labs as well. In an effort to support this recommendation, although small in scope, a laboratory-based project including circuit design could be given to the student that would accomplish this objective. This would definitely get the student oriented toward the design process. This would be the closest thing to a senior design project.

We are looking at the lab component of the first basic EET courses (DC circuit analysis, AC circuit analysis, Electronics I and II) taught in the curriculum. A Southern University catalog description of the courses are as follows:[4].

DC CIRCUIT ANALYSIS- (Credit, 3 hours) Introductory course to circuit analysis purely for a dc approach. The methods and concepts are discussed in detail for direct current networks. Series and parallel circuits, Ohms law, Kirchhoff's current and voltage law, Mesh analysis, Nodal analysis, superposition, Thevenin, Norton, and Maximum Power Transfer theorems are among the DC related subjects of discussion.
AC CIRCUIT ANALYSIS- (Credit, 3 hours) A continuation of EENT 110 that is a study of basic electrical components and network theorems in alternating current circuits including resonance and AC power.
ELECTRONIC CIRCUITS I- (Credit, 3 hours) Covers the theory and structure of semiconductor devices, the analysis and design of rectifiers and their filters, and the development of the theory and technique of circuit bias for BJT. Basic troubleshooting techniques are also introduced.
ELECTRONIC CIRCUITS II - (Credit, 3 Hours) Topics covered included biasing of BJTs and FETs , DC and AC equivalent circuits, analysis and design of small and large signal low frequency amplifiers, coupling techniques, multistage amplifiers, coupling techniques, multistage amplifiers, power rating, and decibel units.
The student will be introduced to the design process through a lab project. It will involve management skills and team involvement. These will be "mini" design projects encompassing a three to four week duration for completion.

Design Methodology

In the senior capstone design class, there is a need for students to become familiar with the design process early in the basic electronics courses. Beginning engineering technology students in general don't know how to design or work on a team project. In practice, teams are used for engineering projects for many reasons: [5]

- To gain innovation from a variety of creative minds
- To utilize people with different expertise and strengths
- To address a task in greater detail
- To serve as a check for each other, identifying potential errors and problems.

Students are held accountable for their work in the group by peer evaluation. At the end of the semester, students will be asked to evaluate themselves and each other using a peer evaluation form. A sample of questions asked on the form will come from the following categories[6].

1) How do team members contribute to the team's work as a whole?
2) How do team members interact with each other
3) How do team members work to keep the team on track?
4) What is the quality of work that the team members perform.
5) Do the team members have related knowledge, skills, and abilities?

The intent of this study is to introduce a short term lab project of three to four week duration. Students will work in teams of four to five students depending on class size to solve a circuit design problem. Students will consult with a faculty advisor or instructor as for monitoring progress of the project. Students will use electronics workbench for troubleshooting their circuit design. In addition, students also will be taught the key elements in writing a design proposal including abstract writing, project definition and objectives, time management, budget, and circuit drawings using simulation software. This concept will be introduced in the beginning lab courses starting Spring 2006 and continuing until the sophomore class taking DC circuits (Spring 2006) reach the senior year and where results can be evaluated.

Evaluation

Students in each of the four lab classes will be evaluated on a oral presentation involving their lab project design and term paper only. Evaluation of lab design projects will be 25% of the final lab grade. There will also be an assessment by each team member on individual performance and will constitute 5% of their grade.

Conclusions

In summary, freshman and sophomore Electronics Engineering Technology students will be taught how to design early and how to go about solving a small design project involving team skills. In the Electronics Engineering Technology curriculum at Southern University, the design process will be taught in the laboratory class of the four basic electronics courses. Once the student has been introduced to the concepts of the design process early on, the transition will be much easier when they take the senior capstone design course two to three years later. This new approach in classroom innovation is too new to yield any results, this only a proposal and concept at this stage. This concept will introduced in the four lab courses Spring semester 2006. It will take about two to three years before we see any results from this group when these students take the senior design project course.

References

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