Introducing Applications Design into a First Year Electronics Devices Course

Theodore E. Fahlsing
Purdue University

Abstract

The Electrical Engineering Technology department at Purdue University, West Lafayette extensively revised its curriculum to make it more effective, efficient and motivating for the students. To improve efficiency and motivation topics such as project design were identified and incorporated as a thread throughout the curriculum from entry to exit. Each course coordinator is strongly encouraged to include the topics identified as important thread topics into every course. In the first semester all students are required to complete the first course in a four-course project sequence. This course introduces students to the essential skills of project management, graphical sketching, construction, testing and safety through the fabrication of a working "prototype" of a +5 volt, +12 volt and –12volt fixed power supply.

The design topic thread does not stop with just the project sequence. The thread is developed further by incorporation into other courses and the associated labs whenever the opportunity exists. This paper will describe how the first course introducing electronic devices uses this project thread to motivate students. A picture of a completed power supply project is in Figure 1.

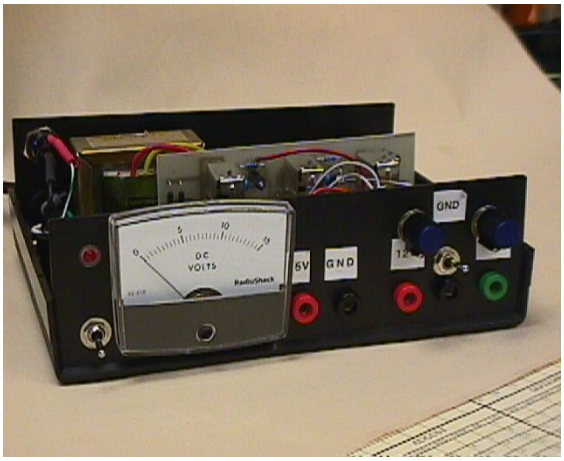

Figure 1: Power Supply

Voltage Regulated Power Supply Design

As with most introductory electronic device courses it starts with the PN junction and applications of diodes. Special emphasis is placed on device specifications. The fundamentals of basic rectification and capacitive filtering are covered in the lecture and the associated labs. The lecture topics are enhanced by using the circuit of the power supply constructed in the first course of the project sequence as a vehicle to explain the design process of selecting the appropriate specifications for the transformer, diodes for the rectifier and capacitor for the filter.

Approximately one third of the electronic device course has a focus on the DC power supply components. The use of a zener diode for voltage regulation is explained and students complete a design of a zener voltage regulated power supply. The topic of three terminal integrated circuit voltage regulated power supplies is introduced and application design is a major topic of one of the labs. This provides an excellent opportunity to illustrate the thermal properties of electronic devices. The students are required to work in a team of four to complete the design of a variable three terminal voltage regulator power supply using an LM317 integrated circuit with the proper heat sink for a specified output current. Each student is required to write an individual report. The report must include data sheets for the diode used and the LM317 voltage regulator. Each student is required to obtain the data sheets from the world-wide-web. At this point in the semester each student is required to complete an individual two-hour lab practical which requires the design and lab performance analysis of a DC voltage regulated power supply. This supports another curriculum thread of an emphasis on student team learning and individual student assessment.

Zero and Span Signal Conditioner Design

The curriculum introducing the bipolar junction transistor, transistor amplifiers and operational amplifiers follows a traditional sequence. However, a lab design project is included at the conclusion of these amplifier topics. Teams of four students use an LM335 temperature sensor to design the circuit required to display temperature in the form of 1mV per degree Fahrenheit. Each student is then required to write an individual report including data sheets obtained from the world-wide-web for the temperature sensor and operational amplifiers used in the design.

Integrated Circuit Function Generator Design

The students are directed through the XR2206 function generator data sheets in lecture. The specifications for the XR2206 are thoroughly discussed. The locations of the information are identified in the data sheets to provide the students with an example of where to look for individual specifications. Finally, several variations of circuits using this integrated circuit are presented using both single and dual power supplies. Next, cooperative or team method of learning is used to explore other alternative waveform generators utilizing a search using the world-wide-web. Each team completed a report of alternative design for a function generator.

The students built and tested the XR2206 design in the associated laboratory for this first course in electronic devices. This last lab exercise is good preparation for the second course in the project design and fabrication sequence. In this course each student is required to research and design a function generator. A picture of this completed project is in figure 2.

Figure 2: Function Generator

The first course required the students to solder, assemble a circuit board and package the power supply. The second course requires PC board layout from schematic entry using a computer routing program. The first course required students to develop a chart for project management. The second course requires each student to use a computer project management program.

Conclusion

Introducing applications design into the first year of the engineering technology curriculum enhances student motivation and interest. The opportunity to develop fabrication, design, information research, and project management skills in the first year is extremely beneficial in many areas. The rewards from early exposure to applications design assists the students by increasing their awareness of what is available and possible by using resources such as the world-wide-web and computer electronic circuit analysis simulation programs. The use of teams in the projects help develop the interpersonal communications skills required for a successful career. There are many problems in implementing design into the first year experience. However, the benefits certainly make it well worth the effort. Besides, it is just a lot more fun for the students!

Bibliography

1. Boylestad, Robert L. and Nashelsky, Lois, *Electronic Devices and Circuit Theory*, Prentice-Hall, Inc. Englewood Cliffs, N.J. (1996).

2. Exar Integrated Systems, *XR2206 Monolithic Function Generator Data Sheet*, Exar, Sunnyvale, Calif.

3. Moss, Gregory L., Fahlsing, Theodore E., and Schultz, Thomas W. 1995. An Evolutionary EET Curriculum for the Year 2001. American Society for Engineering Education

THEODORE FAHLSING

Theodore E. Fahlsing is an Assistant Professor of Electrical Engineering Technology at Purdue University, West Lafayette, Indiana. He received a B.S.I.Ed. from Purdue University in 1971 and an M.S.I.Ed. from Southern Illinois University at Carbondale in 1978. His interest is in analog electronic devices, instructional methods, curriculum development, student outreach and alumni activities. He is a member of ASEE and IEEE.