

Enhancing the Education of Engineering Technology Students Through an Honors Program

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Abstract

This paper describes the Honors Program in the Electrical and Computer Engineering Technology Department at the University of Cincinnati. Included in the paper is a discussion of the requirements of the program, the benefits to both the students and the faculty, and a description of a specific honors project completed by students at the end of their freshman year.

Introduction

The Honors program has been active at the University of Cincinnati for many years¹. Until recently, few students at the College of Applied Science participated in the program. Most of the freshmen accepted to the College of Applied Science do not initially meet the requirements to join the Honors program; however, many of our freshmen perform extremely well in their courses during their first year. Two years ago, a committee of faculty members representing each of the departments in the College of Applied Science was formed to revive the Honors program at the college. The author of this paper serves as the faculty advisor to the 20 honors students currently enrolled in the Electrical and Computer Engineering Technology (ECET) Department. This paper describes the requirements of the Honors program at the University of Cincinnati and how these requirements are tailored to meet the needs of engineering technology students. Methods for identifying good candidates for the Honors program and convincing these students of the benefits of the program are discussed. Results of a survey distributed to the faculty and honors students in the ECET department that assesses the benefits and future direction of the honors program are described. Finally, one of the first projects that students in the ECET department complete as part of the honors program is outlined.

Requirements of the Honors Program

All Honors students at the University of Cincinnati must complete the following requirements in order to receive the "With Honors" distinction at graduation:

1. Maintain a 3.2 University GPA
2. Complete 36 credit hours of Honors level coursework

The 36 credit hours of coursework must include a minimum of 9 credit hours of Honors Special Topics courses. These courses typically count towards students' humanities and social science requirements. The remaining honors hours come from the following categories:

- Honors sections of required courses
- Contract Honors courses
- Independent Study
- Capstone Design projects
- Advanced Placement Credit (up to 6 hrs in two different disciplines)
- Co-op (up to 6 credits by completing special projects on co-op quarters)

Special Topics Honors Courses: The U.C. Honors program offers at least thirty special topics honors courses each academic year. These courses are open to any honors student in the university. Faculty interested in developing and teaching a special topics honors course must submit a proposal in November for the following academic year. A committee reviews proposals and selects which courses will be offered. In the last couple of years, several of the faculty at the College of Applied Science have had courses accepted as Special Topics Honors Courses^{2,3}.

Honors Sections of Required Courses: The ECET Department does not have enough faculty members to offer separate honors sections of our regular ECET courses. At this time, the only required course offering an honors section is English Composition III.

Contract Honors Courses: ECET students earn most of their honors hours through contracting. A contract honors course is one in which the student and the professor make a contract which spells out what type of work this student will be expected to do in order to count the course as an honors course. Students are not supposed to be loaded down with a lot of extra busy work but instead do more enriching work. At the end of the quarter, the professor reports on whether the student has successfully completed the contract. There is no penalty for failing to complete a contract other than the fact that the student does not earn the required honors credit. An example of a contract project for freshman is included as a separate section of this paper. Several other college faculty have published papers describing course contracts^{4,5}.

Independent Study: Students have the opportunity to work on a challenging project in some area of particular interest to them. Independent study courses typically satisfy technical elective requirements.

Co-op Special Projects: Students may earn up to six hours of honors credit by completing special projects during upper-level co-op quarters (three credit hours each for two quarters). Prior to beginning a co-op quarter, students must arrange for a special project (something above the normal co-op assignment). This project must be pre-approved by the employer, the Professional Development department, and the department advisor. When a student completes the co-op quarter and returns to school, he or she registers for a course (3 credit hours) through the Professional Development Dept. The only course requirement is to complete a final report on the project.

Comparison with other Honors Programs

While the main focus of this paper is the benefit of the honors program to our engineering technology students at University of Cincinnati, a brief comparison with other programs both within the University of Cincinnati and at other nearby universities may be beneficial. Several universities in Ohio with ABET accredited programs in engineering technology offer honors programs including but not limited to the University of Akron, Bowling Green University, Cleveland State, and University of Dayton⁶. Requirements vary considerably from program to program. University of Akron and Bowling Green University require a sequence of honors colloquia courses, honors sections of core courses and/or humanities courses, and a Senior Honors project. Cleveland State just started its honors program in Fall 2004 and requires a core of honors courses plus honors courses in a student's major field. University of Dayton requires six honors designated courses or four such courses plus study abroad. Their program also requires service or leadership and an honors thesis. University of Cincinnati does not require an honors thesis or senior honors project; however, all engineering technology students at the College of Applied Science must complete a capstone design project. Honors students have the option of earning honors credit by proposing and completing a project considered to be an honors level capstone design project. While service, leadership, and study abroad are not requirements of the honors program, many of our students gain this experience through special topics honors courses³ and by taking advantage of our exchange programs.

As mentioned previously, all honors students at the University of Cincinnati must complete 36 credit hours at the honors level in order to graduate with honors. However, there is a great deal of flexibility in how these hours are earned. Engineering Technology students at the College of Applied Science receive a practical, hands-on education. These students earn most of their hours through honors contracts which require practical and challenging projects instead of writing research papers.

Identifying and Recruiting Good Candidates for the Program

The ECET faculty teaching the freshman courses in introductory circuit analysis and digital electronics identify students through their scores on exams and their performance in lab. We look for students who are willing to take the initiative in the laboratory, are inquisitive both in lab and lecture, and are mature and responsible individuals. When potential students are identified, a meeting is arranged between the student and the faculty advisor for the ECET honors students. The requirements of the program are discussed, questions and concerns are addressed, and a general plan for completing the requirements is outlined. The Honors program is flexible enough to meet each student's particular interests. Each honors student must decide what he or she wants out of the program and must be mature enough to follow through on initiating and completing honors level work through courses and co-op projects.

Benefits of the Program

In Autumn 2004, a survey was distributed to honors students and faculty in the ECET department. The purpose of the survey was to determine the perceived benefits of the honors

program and to look for ways to improve the program. Students were asked to respond to the following set of questions:

1. What factors influenced you to join the honors program at CAS?
2. Did you have any initial concerns about joining the program? If so, what were your concerns and have they been successfully addressed?
3. How many honors credit hours have you earned?
4. Do you have a plan for completing all 36 honors hours prior to graduation?
5. Describe your experiences (good and/or bad) with honors contracts along with any suggestions for improvement.
6. Describe your experience (good and/or bad) with Special Topics Honors courses along with any suggestions for improvement.
7. What are the benefits for you of being in the honors program?
8. What are the drawbacks for you of being in the honors program?
9. Do you attend the quarterly honors luncheons? Why or why not?
10. Do you have any suggestions to improve the honors program at CAS in terms college-wide activities for honors students, some type of extra benefits for honors students, etc.?

The biggest factor influencing students to join the program was the opportunity to do more interesting and challenging work. One student commented: "I wanted the opportunity to explore classroom concepts further than the general curriculum allowed. By joining the program, I have the ability to work with others to gain this additional knowledge." A few students also pointed out the benefit to their resume: "The addition of honors programs to a resume shows not only a commitment to excel, but also a tendency to demand more from yourself than is required." Not surprisingly, the students' biggest concern in joining the honors program was the time commitment: "My initial concern was adding to the heavy work load of a full time job and school." Most students remain actively involved in the program and have plans to complete the required 36 credit hours. The perceived benefits of being in the honors program are the opportunity for more challenging work, team-work with other honors students, and the chance to interact with faculty: "Contract honors allow for different insight on a subject, often making the subject much more relevant and enjoyable than it would otherwise be. The workload isn't too strenuous." In terms of drawbacks, most students commented on the extra time required to complete projects but many added that the extra time spent was worth the effort. In terms of improvements to the program and/or extra benefits for honors students, a few students mentioned scholarship money and offering more special topics classes on our campus. One student observed: "I hate the term extra benefits, it seems to be a bribe of sorts. For me the extra benefit is being challenged and learning material and subjects that I otherwise would not have. That should be all that is really necessary for dedicated students to join. If they are truly passionate about learning and discovering new ideas on their own then the honors program is a great avenue for that to be cultivated. Sure, it would be nice for extra perks here and there but for me it doesn't really matter."

Faculty in the ECET department were asked to respond to the following questions:

1. Have any of the ECET honors students submitted honors contracts in your courses? If so, please list the courses you have developed contracts for.
Note: If the answer to question 1 is No, you can skip the rest of the survey.

2. Have you had any difficulty with the process of confirming contracts at the beginning of the quarter then confirming completion at the end of the quarter?
3. How much time do you spend developing an idea for an honors contract? Is it a difficult process?
4. What do you see as the benefits for students in completing your honors contracts?
5. Are there benefits for you as a faculty member in having honors students contracting your courses? If so, please elaborate.
6. Do you have any suggestions for improving the honors program within the ECET department in terms of recruiting students, developing meaningful contracts, benefits to honors students, etc.?

All members of the ECET faculty have contracted with honors students in at least one of their courses. The process of confirming contracts at the beginning of the quarter and confirming completion at the end of the quarter is very straightforward. There were mixed answers on the difficulty of developing an idea for an honors contract. About half the faculty commented that developing an honors project comes easy – the other half would like more notice in order to be able to develop more relevant projects. Currently, students approach faculty at the beginning of the quarter and must submit a contract with a project description by the end of the second week of that quarter. Most faculty felt that the biggest benefit to the student was the opportunity to do challenging work: "Completing the honors contracts – besides being a necessity for getting the With Honors distinction at graduation – should provide the student with the satisfaction of completing a challenge that was designed to truly test their ability. Some students may thrive on the challenge. Others may gain confidence knowing that they can do top shelf work; that they are ready for industry. And others may enjoy the extra interaction with their professors. Surely, it is a unique combination of these (and other benefits) that drives the students."

Example Honors Contract: Designing and Building a Digital Frequency Counter

In the spring quarter of their freshman year, honors students design and build a frequency counter to meet a given set of specifications in order to complete an Honors contract for Digital Electronics II. The project pulls together most of the major topics of the course including flip-flops, timers, and counters. Students receive the following project description.

Digital II Honors Project Description

Contract Application:

Must be completed by end of 2nd week of class. Go to www.honors.uc.edu and click on current students. Scroll to the bottom where it says "Click here for honors contract". Complete the form. Use the lecture course number: 32-ELTN-242 so that you will get 3 credit hours of honors credit. See Professor Ossman with any questions.

Problem:

Design a frequency counter that will display the frequency of an incoming digital clock signal.

Specifications:

1. The counter should be capable of displaying frequencies from 0 to 999 Hz using 7-segment displays.
2. The display should be accurate to within $\pm 1\%$.
3. When the system is powered up, the display should show 000.
4. A Start/Restart switch should be included to start the frequency counter.
5. When Start/Restart is hit, the display should blank until the CLK pulse frequency has been determined (i.e., don't display the counter counting the CLK pulses).
6. Design your system so that it will display

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 when the frequency of the incoming signal exceeds 999 Hz.

Some Suggested Components:

- 74160 Synchronous Decade Counters
- 74121 Monostable Multivibrator for timing

Project Requirements:

- Design and build a frequency counter that meets the specifications listed previously.
- Demonstrate the working model to your instructor.
- Write a report that describes your frequency counter design and any problems encountered. Answer the following questions in detail providing circuit diagrams if possible:
 1. How would you modify your circuit to measure frequencies up to 1 MHz?
 2. How would you modify your circuit to measure frequencies of sine waves up to 999 Hz?

Prior to receiving this project, most students experience in lab consists of wiring a circuit shown in a lab manual then making a prescribed set of measurements. In addition to bringing together all the major topics of the course, this project requires students to select components and interface different systems including the counter, the display, and the timer. In their project reports, students included several insightful comments outlining the challenges encountered and the perceived benefits of the project. A selection of these comments is included here.

“The main problem with the frequency counter designed in lab was that it was not as precise as it could have been. Since the external resistor and capacitor values were approximated to give close to a one second pulse, there was an error present. This became more apparent when a higher frequency was measured.”

“Overall, I feel designing the frequency counter was a good honors project. It forced us to use all of the skills we have been honing since the beginning of Digital I. It was also interesting because the counter was something practical that had a real world application.”

“The first thing I noticed was that there were dozen's (if not more) ways this project could be completed. I feel that personally, I would have benefited from completing a diagram or initial plan before wiring began. This would have allowed time to arrange chips efficiently and learn about features before looking at a mess of wires.”

“Initial inspection of the counter design made it seem quite simplistic. It turns out that building the counting portion of this project was rather simple. The challenges began once it was time to implement some of the specified features. All were somewhat tricky, but none compared to the enigma of the ONE-DOT.”

“This was a highly enjoyable project. For me it was a chance to put together lots of pieces of knowledge and create a useful tool. While the project started as a simple design, it quickly became complex. In all honesty, this was an excellent test of logical abilities.”

Conclusion

Students and faculty in the Electrical and Computer Engineering Technology Department have benefited from participating in the honors program at the University of Cincinnati. The honors program offers several different avenues for completing the required credit hours and therefore allows students to tailor the program to meet their own particular needs and interests. Students have the opportunity to work on challenging, hands-on projects that improve their problem solving and logical thinking skills. Faculty benefit from interacting closely with talented and motivated students.

Bibliography

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Biography

Dr. Kathleen Ossman is an assistant professor in the Electrical and Computer Engineering Technology Department at the University of Cincinnati. She received a BSEE and MSEE from Georgia Tech in 1982 and a Ph.D. from the University of Florida in 1986. Her interests include feedback control systems and digital signal processing.