TEACHING PORTFOLIO

Dr. Albert Lozano-Nieto

School of Engineering Technology and Commonwealth Engineering (SETCE)
Commonwealth College
The Pennsylvania State University

September 2001

Dr. Albert Lozano-Nieto
School of Engineering Technology and Commonwealth Engineering (SETCE)
Commonwealth College
The Pennsylvania State University

September 2001

TEACHING PORTFOLIO

TABLE OF CONTENTS

1.- INTRODUCTION

Higher Education is changing. Our approach on teaching in Higher Education is changing even faster. Long gone is the concept of a university professor as the owner of knowledge that is being transferred to his or her students. Long gone also is the concept that listening to lectures and transcribing the professor's words into their notebooks is the best way for the students to learn. Long gone also is the belief that there is no reason to continue learning after students have reached their goals in graduating. All these old paradigms, which once made up the skeleton of higher education, are now gone and need to be replaced by newer ones. Our current society demands another approach to higher education, more in consonance with our social reality. Our society needs professionals who are not only technically competent in their own fields but have that global vision and understanding that is required to face today's ever more complex problems. Our own experience, first as undergraduate and graduate students and secondly as teachers with our own observations in the classrooms, have lead us towards new teaching approaches. These newer teaching approaches view students not as passive recipients in the transfer of knowledge, but as taking an integral part in their own learning, what sometimes causes us to learn from them.

A wise man once said: "*It is not Teacher the one that copies and repeats but the one that creates and teaches; it is not disciple the one who follows and passes the courses, but the one who is able to assimilate the Teacher's lessons and eventually carry them to the next step*." If we want to create the successful professionals and responsible citizens that our society needs today, we need to investigate, develop and create new approaches and methods to use in higher education. Only when these approaches cause our current students to leave our classrooms and institutions with a broader, more global and complete understanding of their role in today's society than we had, we will be able to say that we succeeded in our goals.

These new approaches to higher education value our teaching as an integral part of our academic scholarship, while we are also learning. This teaching portfolio explains my teaching philosophy, why I do things the way I do in the classroom and shows my personal reflections on teaching Engineering Technology. In addition, it shows what I have learned during my years teaching at Penn State, while at the same time sets up goals for my teaching and development in this area. Although these concepts are valid for all the courses I teach, I have chosen to focus in depth in two of the courses I teach: *EET 433 (Control Systems: Analysis and Design)* and the combination of *EET 419* and *EET 420 (Project Proposal Preparation*) and (*Senior Electrical Project),* respectively. I have chosen to highlight these courses as they are much different in structure as well as what is expected from the students. Consequently they demand very different approaches to reach similar final educational goals.

The Greek poet Constantine P. Cafay wrote:

> *"When you start your journey to Ithaca,*
> *then pray the road is long,*
> *full of adventure, full of knowledge.*
> …
> *Then pray that the road is long.*
> *That the summer mornings are many*
> *that you will enter ports seen for the first time*
> *with such pleasure, with such joy!*
> …
> *to learn and learn from those who have knowledge.*

Always keep Ithaca fixed in your mind.
To arrive there is your ultimate goal.
But do not hurry the voyage at all.
It is better to let it last for long years;
…
Ithaca has given you the beautiful voyage.
Without her you would never have taken the road.
But she has nothing more to give to you.

And if you find her poor, Ithaca has not defrauded you.
With the great wisdom you have gained, with so much experience,
you must surely have understood by then what Ithacas mean.

[Ithaca, C.P. Cafavy][1]

This document is a reflection of my own journey to Ithaca, a journey full of adventure and excitement, where I try to learn from within myself and from those who know more than I do. As in any long journey, my development as Penn State teacher is a work in progress, where change is not only inevitable, but also expected, welcome and necessary.

2.- TEACHING PHILOSOPHY

My teaching philosophy is based on an integral approach to education, where the educator is a teacher, mentor and a coach, centered not only in the technical aspects of a specific discipline such as Engineering Technology in my own personal case, but also focusing on the human and interpersonal relationships that occur in the classroom, the workplace and the society. In my classes I emphasize to my students that they are responsible for their own learning, while my role as a teacher is to facilitate their learning process and help them to achieve their goals. I also try to expose my students not only to the technical aspects of their future profession but also to economic and social consequences of the technical aspects that we discuss in class.

To achieve these objectives, I am continuously revising the concepts developed in my courses as well as approaches to how I expose students to the most difficult and abstract concepts in these classes. I believe that this constant reassessment based on the feedback that I obtain in day-to-day activities helps me to better design academic activities to challenge my students to achieve their full potential. As I have gained more experience as a teacher, I have introduced more active learning activities in my classes. In some cases these activities can be as simple as asking the students questions and trying to engage them in short term discussions. Some other times these activities may involve groups of students working together for about 10 minutes solving a challenging problems. And in some other cases the active learning activities may take several class periods where the students need to have discussions in their own groups as well as between different groups, the concepts needed to complete the different tasks. This particularly happens during laboratory periods.

Being a faculty member teaching in an Engineering Technology program I strongly value experimental, hands-on activities. I value this work not only as a way to acquire practical knowledge that complements what students have learned from textbooks and other sources, but also as an excellent tool to increase the

[1] *The complete poems of Cavafy.* Rae Dalven (translator). Harcourt Brace & Company, San Diego, CA 1989

amount of cooperative learning in the whole class. I try to develop my own set of laboratory experiments and exercises for all the courses I teach instead of relying on commercial laboratory manuals and workbooks. Although this is a time consuming activity, this allows me to have more control over the experimental parts of my courses by tailoring the work to be done to the course goals and objectives, and to introduce activities that lead to active learning. Furthermore, this allows me to specifically write the laboratory manuals for the instrumentation that the students will use in a specific laboratory, avoiding misunderstandings and mismatches that often happens in commercial laboratory workbooks when the instrumentation to be used is different than the instrumentation the students have available.

Another facet of my teaching activities involves coaching the students in areas such as resume writing, job interview strategies and discussing employment opportunities. I give my opinion and feedback to those students who choose to share their resumes with me. I also have held informal discussion groups with them on how to conduct themselves in an employment interview, what to expect during the course of the interview and how to follow up after the interview is finished. I believe that we have the responsibility to educate students beyond attaining their degree and these activities give me the opportunity to broaden my influence on them beyond the classroom.

In summary, my teaching philosophy is based on a three-facet approach. First, I design my courses and teach my classes in a way that will make our graduates prepared to join the workforce and be competitive in their field. Second, I emphasize to my students the concepts of lifelong learning, by stressing that learning does not stop upon graduation while encouraging them to obtain professional certification or licenses, pursue advance degrees, etc. Finally, I stress the importance for our graduates to be aware and understand the economic and social context where they will practice their professional skills and the social impact of technology in our society. It is my intention that with this approach I can give my engineering technology students and graduates a solid foundation for their personal, intellectual and professional growth.

3.- TEACHING RESPONSIBILITIES AND LEADERSHIP

I am the current local program leader for both the Associate Degree and the Baccalaureate Degree in Electrical Engineering Technology at the Wilkes-Barre Campus. I strongly value the confidence that the campus administrators have deposited in me and my vision and ideas. I value my responsibilities as local program leader for these programs as an integral part of my duties as a Penn State faculty member. I work with our local administrators and faculty members from this and other campuses to ensure that the courses and programs that we offer are adequate for the mission and goals of our campus and the university and reflect the current state of the technology.

I consider my involvement in the re-accreditation visits made by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC of ABET) as a very important part of my role as a Penn State faculty member. ABET is an independent agency that in the United States, is charged with the evaluation of engineering technology programs. Accreditation is a voluntary process in which these programs are peer-reviewed and compared against the benchmark of minimum standards required for accreditation. We take accreditation very seriously as it notifies to all of our constituents (students, parents, our faculty and faculty from other institutions), that our programs have surpassed minimum standards. It also gives us invaluable feedback regarding the areas in which we should improve and tells the employers of our graduates that they are ready to work in today's industry.

I have been deeply involved in the preparation of the TAC of ABET accreditation visit that we had in Fall of 2000 for the Associate degree in Electrical Engineering Technology and the visit that we will have in

November of 2001 for our Baccalaureate degree in Electrical Engineering Technology. I have prepared the program self-study questionnaires (Volume II) for the visiting team in cooperation with the local and SETCE administrators, coordinated the logistics previous to the visit and been the contact person during the visit and exit interviews carried out by the evaluating team. This has been an excellent opportunity for me to become more involved in these academic programs and help to shape their future by defining goals and objectives for the individual courses and programs as well as continuous quality improvement plans and procedures. I have been able to interact with other colleagues at Penn State in similar positions, sharing ideas and vision for the future of engineering technology programs. As the accreditation criteria is shifting towards outcome-based measures with a demand for graduates of accredited programs to have a broader technical and social vision, I believe that my involvement and interaction with other colleagues in similar positions at Penn State and other institutions will significantly increase. Accreditation is important to me, not only for the personal interest being a faculty member with teaching responsibilities in TAC of ABET accredited programs, but in general as an educator in engineering technology programs. For this reason, I volunteer, serving as a program evaluator in TAC of ABET, by visiting and evaluating other institutions with engineering technology programs seeking accreditation. My service in this professional organization has given me the opportunity to visit other institutions, learn about similar programs in engineering technology areas and their approaches to problems similar to those we face. Furthermore, I believe that my experience as a program evaluator has been very useful in preparing the self-study documents, display of materials and the development of the accreditation visit.

In addition to teaching in the courses for both degrees in Electrical Engineering Technology, I also teach courses in the Telecommunications Engineering Technology program. I had also leadership and teaching responsibilities in the Biomedical Engineering Technology program until it was recently discontinued. These teaching responsibilities have given me a broad vision of the academic programs, requirements and needs on campus at the same time that they have expanded my teaching abilities.

Overall, in my almost six years at Penn State I have taught a total of 16 different courses. I have adapted or modified curricular contents, including new experimental teachings in 10 of these courses, and totally created and developed 2 of them. Currently I am teaching a new course that is an introduction to satellite communications for senior-level electrical engineering technology students, that has a strong component of active and cooperative learning activities for the students.

4.- EFFORTS TO IMPROVE MY TEACHING

I consider teaching to be the most crucial part of the responsibilities for a Penn State faculty member teaching in the Commonwealth College. For this reason, since joining the University I have engaged in different activities to evaluate and improve my teaching methods in an effort to increase the learning of my students. Feedback from the students is perhaps the single most important factor that we can use to evaluate our performance as teachers. However, the standard measurement of teaching effectiveness used by the Penn State (the SRTEs) do not provide insight or can they expand into the reasons and causes that students assign a numerical rate to an instructor or a course. For this reason, in addition to the standard SRTE forms administered by the University, I normally include three open questions for the students to answer. These questions are:

> *C1: "Did the course meet your expectations? (please, circle one answer: YES / NO) If the answer is NO, please describe as precisely as possible why it did not met your expectations".*
> *C2: "Evaluate the level of cooperative learning achieved in the course".*

C3: "Do you feel that your instructor was concerned about how you learned the subject, your progress in the course, solving particular problems that you might have had? Please, describe and comment".

These open questions are treated in the same way than the standard SRTE forms, collected and summarized by the local administration. Because of the students have the opportunity to write the reasons of possible problems these questions really help me at the time of designing my delivery methods and evaluating my own performance in that particular course.

Because the SRTE forms and open questions are administered during the last weeks of class and instructors do not know of their results until the semester is finished, they don't give room for improvement during a single semester. For this reason, I give to all my students an anonymous mid-semester evaluation form that consists of a series of 5-6 open questions depending on the course, focusing on the pace of the course, the adequacy of tests to the material covered in class, and what specific aspects of the course the students like and dislike the most. This mid-semester evaluation gives the opportunity to detect and correct possible problems before the semester is finished, which becomes a critical aspect for improvement the student's performance in that course.

Because the strong hands-on and experimental work of the courses I teach, I pay special attention to how the students feel and view this type of activities. Laboratory work can cause a student to love or hate a particular course or discipline, and consequently these activities deserve very careful consideration. For this reason, I try to develop and create my own experimental work for a specific course focused on what I want the students to learn and what we have available in our labs. I try to create experimental activities that are rigorous but fun; I try to create activities that corroborate what students have learned in class at the time that shows them the extra step. But very especially I try to create experimental activities that are not repetitive, monotonous and boring as I had in some cases as a student because I know that this is the best way to diminish the student's interest in that particular area. For this reason, the first time that I ask the students to work on experimental activities that I have just created, once that activity is finished I give them an evaluation form. I ask them to comment on the level of difficulty of that work, the time allowed, identify possible repetitive and monotonous tasks that did not add anything new to their knowledge, etc. Their feedback, together with my observations of their work during this activity and my own reflection after being done once by students, serves me to modify and redesign the aspects of that experimental work that need a different approach.

I also try to learn from those who know more that I do about teaching and have different experiences in their college teaching careers. For this reason, I try to attend the annual conference of the American Society for Engineering Education (ASEE), as it is an excellent forum to interchange ideas and discuss approaches with other colleagues teaching very similar courses. However, I also believe that we benefit from interacting with colleagues from disciplines different from our own. Attending several Chautauqua workshops has been an excellent opportunity for me to interact with these colleagues, share my experiences with them in the type of courses and students that I teach to, and even incorporate specific approaches from these colleagues teaching very different courses such as biology for example, in my own engineering technology courses. My participation in different stages of *Project Empower* has been an instrumental factor in helping me to develop active learning work, and try different approaches using different technological tools for the students to work together in a positive atmosphere. The feedback from my peers is another tool that has given me insight into my own teaching methods. I have regularly sought the feedback from other colleagues who have attended my classes and discussed with them some different approaches that I should try in order to improve my effectiveness as teacher.

5.- INNOVATION IN TEACHING: THE SCHOLARSHIP OF TEACHING

The ability to share with other colleagues our experiences in trying new approaches and techniques to enhance our student's learning is one of the most rewarding facets of my teaching career. Fortunately, these efforts are recognized and encouraged by the Commonwealth College and Penn State as they recognize the critical importance of using diverse approaches in order to reach all of our students. I hope that my educational experiences that I have shared with other colleagues can be useful for them at the time of approaching their own teaching activities. The following annotated bibliography summarizes the innovations in my teaching since I joined Penn State that I have shared with colleagues either by presentations in conferences or in the form of published papers in journals.

Lozano-Nieto, A. 1997. "Incorporating Internet resources in biomedical engineering technology and clinical engineering education." Proceedings of the 19th IEEE-EMBS International Conference, 19: 932-935.

I wrote and presented this paper at the Annual Conference of the Engineering in Medicine and Biology Society of the IEEE, shortly after joining Penn State and starting work with the Biomedical Engineering Technology program at the Wilkes-Barre Campus. This paper explores the use of new technologies, in particular several Internet tools in an Engineering Technology program. This was one of my first experiences in developing activities to increase active learning among my students.

Lozano-Nieto, A. 1998. "Improving biomedical engineering technology and clinical engineering education through Internet resources." Journal of Clinical Engineering, 23: 423-427.

After attending the conference session where I presented the previous paper, the Editor of the Journal of Clinical Engineering invited me to submit a paper to their journal exploring the effect of these new technological tools in clinical engineering education at a deeper level.

Lozano-Nieto, A.1998. "Internship experiences in biomedical engineering technology: an overview of students and prospective employers." Proceedings of the 1998 ASEE Conference.

While teaching a clinical internship course for the Biomedical Engineering Technology program I was interested in studying how the perceptions of my students regarding the reality of their future profession changed after being exposed to the field for the length of the internship. I also surveyed managers of clinical engineering departments in hospitals in order to gain the knowledge of the expectations they had for the type of graduate they wanted to hire.

M. Fernandez, A. Lozano-Nieto and F. Silva. 1998. "Freshman experiences in the electronics lab: A comparison between the approaches at the Polytechnic University of Catalonia (Barcelona, Spain) and Penn State University, Wilkes-Barre Campus." Proceedings of the 1998 ASEE Conference.

I co-wrote this paper with my former colleagues at my previous academic institution. This paper analyzes and compares the approaches used to teach a freshman electronics class between our two institutions, looking for similarities and differences, allowing us to incorporate new techniques.

Lozano-Nieto, A. 1998. "How technology changes the way we teach: Benefits and Risks." Proceedings of the 1998 IEEE International Professional Communication Conference: 75-83.

This paper is a personal reflection on the role of technology in higher education. Certainly technological tools can add an extra dimension to our teaching and facilitate student's learning. The intention of this paper is to alert readers to possible risks linked to the indiscriminate use of technology, in particular the possible excessive focus on the use of technology in those situations where it will not add anything of value to the class.

Lozano-Nieto, A. 1998. "Student perceptions on the use of Interactive Video Conferencing in Biomedical Engineering Technology education." Proceedings of the 1998 ASEE Conference.

In the Biomedical Engineering Technology program I used interactive videoconferences to in order to bring professionals from industry closer to the students without the costs and inconveniences associated with traveling. This conference presentation examines the benefits of using this technique and its drawbacks, as some aspects of the personal contact are lost in the videoconferencing approach.

Lozano-Nieto, A. 1998. "New approaches for Biomedical Engineering Technology & Clinical Engineering education: Interactive video conferencing tools." Journal of Clinical Engineering, 23: 117-121.

This paper is based on the previous conference presentation, expanding the number of sampled students over a longer period of time, and analyzing in deeper details their responses and how they impact on future videoconferencing sessions.

Lozano-Nieto, A. 1999. "Learning the culture of the workplace in an Engineering Technology program." Proceedings of the 1999 ASEE Conference.

This paper explores some of the activities that I have developed in my classes, which focused on learning those aspects of industry that are less based on technical skills, such as ability to write meaningful memos, using electronic resources, etc. These activities were designed to complement out technical teachings in an effort to produce well-rounded graduates, and relate them to other professionals from which they will have to closely interact. This conference presentation was the seed for the next paper.

Lozano-Nieto, A. 1999. "Developing interprofessional skills in a Clinical Engineering program." International Journal of Engineering Education, 15: 227-236.

It is unquestionable that in today's market, our graduates will have to interact with colleagues with different academic backgrounds and interests. This paper explores how I have approached the exposure of my students to the different professionals with which they will have to professionally interact as clinical engineers.

Lozano-Nieto, A. 1999. "Preparing the Clinical Engineers of the Next Millennium." International Journal of Engineering Education, 15: 298-307.

Accepting an invitation from the Guest Editor of a special issue of the International Journal of Engineering Education focused on Biomedical Engineering education, I wrote this paper in which I reflect on the main challenges and foreseeable changes for our biomedical engineering technology graduates as we approached the end of the 20th century.

Lozano-Nieto, A. and W. Ofosu 1999. "Assessing the need to introduce EMC/EMI in Engineering Technology programs." Proceedings of the 1999 ASEE Conference.

This conference presentation analyzes the introduction of Electromagnetic Interference and Compliance issues within an Electrical Engineering Technology program. Following the European Union trend, we can expect that the rules and regulations regarding EMC/EMI in the US will increase in the not so distant future. Therefore, our programs should be ready to incorporate these teaching into their curricula.

Lozano-Nieto, A. and W. Ofosu. 2000. "Electromagnetic compatibility and interference (EMC/EMI) in Electrical Engineering Technology Programs." Journal of Engineering Technology. 17 (2): 32-36.

After the feedback that we obtained in the previous conference presentation, it was obvious that there was an interest within the Engineering Technology community on the EMC/EMI issues that we described in that presentation. This paper is an expansion of the previous conference presentation, while at the same time also included a suggested outline for this course in an Electrical Engineering Technology program.

Lozano-Nieto, A. 2000. "Getting to know your Biomedical Engineering Technologist." American Journal of Nursing, 100 (7): 24AA-24CC.

I decided to write this paper to explain to the nursing staff working in hospitals how they can help the work of biomedical engineering technology professionals and in general how these two professionals work and interact with each other. I have discovered through extensive feedback that this paper has been very well received by nursing professionals.

Lozano-Nieto, A. 2000. "Internship programs in Engineering Technology: some personal thoughts." Proceedings of the 2000 ASEE Conference.

In this paper I share my experiences running a clinical internship for the Biomedical Engineering Technology program with colleagues who may be thinking of developing similar academic activities. Although the academic programs may be different, the paper reflects on the common issues that need to be addressed before, during and after the academic internship.

Lozano-Nieto, A. 2000. "Using Intranet tools to teach a project proposal preparation course in Engineering Technology." Proceedings of the 2000 ASEE Conference.

This paper describes my experiences using Intranet tools based on First Class software to teach a project proposal preparation class. I discuss how this tool facilitates the asynchronous exchange of ideas between the students in the course, eliminating the need to find a common meeting time. It also provides examples of this type of discussions that happened in this class.

6.- FUTURE GOALS AND PROFESSIONAL DEVELOPMENT IN MY TEACHING

I intend to continue working in developing myself towards excellence in undergraduate teaching, continuously redesigning the courses I teach to maximize the student's interest and learning of those subjects. My short-term goals are focused on increasing the level of cooperative learning in the courses that I am currently teaching. I am aware that an important factor for the success of these activities depends on the student expectations for their college experience and past learning experiences. The challenge is not only make them successful in my own courses but also to make them more receptive to teaching methods to foster active learning. I am also interested in incrementing the number of undergraduate students that are involved in research activities directed by me. My experience with this type of activities has been very positive as both the student working with me and I have benefited extremely from this experience. I also want to continue sharing my experiences with my colleagues by attending conferences, seminars and workshops focused on teaching as well as disseminating them through professional journals.

At a medium-range term, I am interested in learning about assessment techniques at a more in-depth level and developing assessment tools at a dual level: for the courses I teach and for the programs for which I am responsible. These course and programmatic assessment techniques will play a major role in the near future when the Technology Accreditation Commission of the Accreditation Board (TAC of ABET) fully implements its outcome-based accreditation criteria. It will be the responsibility of each program to define its goals and objectives as well as the measuring methods to show that goals and objectives are reached. In this area, it is also my goal to be among the first TAC of ABET program evaluators with training and accreditation responsibilities following the new criteria, as it will be gradually implemented.

My longer-term goals are more focused towards increasing my involvement in the University by taking newer responsibilities and challenges, for example in developing new courses for existing curricula or developing new programs to increase those offered by the University. I am also interested in working with minorities and underrepresented groups within the field of Engineering Technology to make it more accessible to the whole society. My teaching goals can be summarized as a steady and continuous increase in my responsibilities and leadership within the University to better serve our constituents.

7.- COURSE SHOWCASE I: EET 433 – CONTROL SYSTEMS: ANALYSIS AND DESIGN

The following pages document how I have implemented the activities and concepts that are outlined in earlier pages for two courses that I teach: *EET 433 (Control Systems: Analysis and Design)* and the combination of *EET 419* and EET *420 (Senior project proposal and senior electrical project).* I have chosen to focus on these two courses in my *Teaching Portfolio* because I believe that their different structure and required approaches show a broad variety of techniques that I have used to implement the concepts described in the previous pages.

7.1 EET 433. Course overview

EET 433 is a senior-level course in the Baccalaureate Degree in Electrical Engineering Technology. I have taught this course for 6 semesters since the Fall of 1997. During the years that I have taught this course, I have slowly moved away from being taught with only traditional lectures to incorporating active learning exercises. Because of its high mathematical content, the traditional approach makes the students feel lost in the mathematical equations without being able to relate these concepts to engineering principles and applications. I have also redesigned the experimental part of this course, which is based on a mixture of analysis of case studies depicting real-life situations using control systems and experimental work on a modular control system. This academic year I have completely redesigned this part based on the modular control system. This course heavily relies on mathematical concepts, which makes it challenging for the students and the instructor although for different reasons. The students are challenged by the different mathematical concepts and tools that are used in this course and especially by their interaction. The challenge for the instructor is in keeping the engineering side of the course without being distracted by the mathematics involved in this course.

Given the complexity of the course, I feel particularly satisfied when in addition to obtaining a passing grade the students tell me that this was an interesting course for them. In this sense, it has been remarkable that, because of the interest in this course one my students is pursuing a Masters degree in Control Systems especially taking into account that very few graduates from engineering technology programs enroll in graduate programs.

7.2 EET 433. Course goals and objectives

The University catalog defines describes this course as *"Classical and modern control analysis and design approaches, such as Laplace and state-space, aided by analog and digital computers"*.

Based on this description, my goals for this course are for the students to:

- Understand the main parts of a control system.
- Understand the terms that are used to characterize a control system.
- Predict the performance of a control system through its Transfer Function.
- Measure and analyze the parameters that describe a control system.

To satisfy these goals, I have developed a series of objectives for each one of the chapters in which this course is divided. The main objectives are:

- Perform transformations between the time and Laplace domains.
- Use the *Partial Fraction Expansion* technique to perform Inverse Laplace Transforms.

- Define the concept of Transfer Function.
- Define and understand *linearit.*
- Identify the order of a given Transfer Function.
- Be able to reduce a block diagram made of multiple subsystems to a single-component system.
- Calculate the *Rise Time* for a first-order system.
- Identify a second-order system as *Overdamped, Underdamped, Critically Damped or Undamped.*
- Calculate the *Rise Time, Overshoot, Settling time and Peak Time* for an underdamped second-order system.
- Identify which higher-order systems can be approximated by second-order systems.
- Identify a system as *Stable* or *Instable*.
- Use Routh's criteria to find stability margins.
- Classify a system based on the number of poles in the origin.
- Predict the steady-state error for a system given its transfer function.
- Draw the Root Locus for a system given its Transfer Function.

The syllabi for this course, shown in Appendix 1 shows, the different educational approaches and techniques that I use to achieve these goals and objectives.

7.3 EET 433. Personal approach to this course.

As I have mentioned earlier, the major risk in teaching this course is to fall deeper in the mathematical concepts and its implications and losing its engineering applications. Obviously, as I learned from my own experience, this is what happened to me the first time I taught this course. After reading the open questions from the student evaluations and through causal conversations with them, I realized that they got lost in the mathematics of the course and were never able to see the whole picture of how this course fits into the engineering concepts that they already had studied. It did not help, either, that the experimental activities, as inherited from a colleague who previously taught this course, were not yet fully developed.

After reflecting on the shortcomings of my approach to this course, I realized that I needed to introduce more applications of control systems, helping the students to realize the need to study these concepts. I decided to introduce these activities in the laboratory section of the course, moving away from the simple experiences that were based on solving mathematical problems without relating to specific applications. By consulting several advanced textbooks and journals on different engineering areas I created a series of *case studies* that balanced both applications of control systems and their analysis. In these case studies the students work on the concepts of a particular chapter to follow the steps needed to solve a complex problem that they know affects individuals and the society. The case studies that the students need to solve this academic year are in essence the same as those that I first developed, after eliminating ambiguous questions and repetitive procedures. These case studies, which are included in Appendix 2, are:

Case Study 1: Introduction to the case studies and simulation tool
Case Study 2: An automatic insulin delivery pump
Case Study 3: An artificial limb
Case Study 4: An electric public transportation system

The work of the students is guided through some concepts that do not belong to this course. The *case studies* focus on the use of the concepts corresponding the course. At the time of writing their report, I ask

the students to evaluate how that particular application can affect human beings and the society. For example, after studying the differences between an open-loop and closed-loop system, the students are asked to give their opinion on the possible risks involved in an implanted system to deliver insulin to patients either at fixed periods of time or after sensing the body's needs, or the risks associated with instability for a system that controls an artificial limb implanted in a patient. With this approach the students are able to evaluate the implications of their work beyond the mere solving of mathematical equations, while evaluating risks and consequences of their work.

These case studies are designed in such a way that students need to work cooperatively in groups to be able to obtain an answer and in most cases they need to exchange information between different groups to have a broader picture. This helps students break the habit of working alone from the beginning of the course and work together with their peers to solve a common problem. Interestingly, this cooperative learning does not stop with the case studies but is encouraged by me as the course instructor, continuing into the other areas of the course and possibly other courses.

After introducing and working with these cases studies in the course, and through concepts developed during different workshops on teaching that I attended, I modified the way that the lectures are developed. Instead of myself lecturing and the students taking notes for the whole period during each session, I try now to balance my lectures with student work in class, solving a problem or questions. Although currently not all my lecture sessions are structured this way, I am introducing this type of activities semester after semester. I have recently introduced experimental activities where the students work with a modular system, which gives them the opportunity to perform experimental work. These activities are included in Appendix 3.

Finally, and as a result of my participation in the Chautauqua workshop that I attended in Spring of 2001, I have incorporated the suggestion from the workshop facilitator, Dr. Craig Nelson from Indiana University regarding *late days policy*. The basic concept of this policy is to give the students certain flexibility within a state of order on the due dates for the submission of laboratory reports or other activities. This policy takes into account that we all have real lives where unpredicted things happen and eliminates the burden of the instructor trying to decide on a case-per-case basis how to deal with the late work of a student. Students can use their *late days* at their own discretion without the need to provide me with a reason for their late work, which gives them an opportunity to truly manage their time. This is my first semester where I am trying this new idea, starting with 15 *late days* and consequently I do not have enough data to make a sound assessment of its effectiveness.

7.4 EET 433. Assessment methods I use for this course.

In developing assessment methods to evaluate how students perform and have understood the main concepts of a particular course, I try to eliminate as much as possible the stress traditionally associated with traditional examinations. A method that I believe works for eliminating this stress is the use of multiple tools, repeated different assessment. This almost continuous assessment reduces the importance of a single event, which makes the students feel more relaxed and consequently increases not only their performance but also their assimilation of the concepts related to the course.

As seen from the course syllabi included in Appendix 1, these are the assessment methods that I use in this course and their relative weight:

Partial exams (one after each chapter expect chapter 1 and 3)	40 %
Final, comprehensive exam	25 %
Quizzes (dropping the lowest score)	10 %
Experimental laboratory component (development and report)	10 %
Case studies work (development and report)	10 %
Homework	10 %
TOTAL	**105 %**

Because in this course we study that in some cases it is not possible to eliminate the error between the desired response of a system and its actual response, I feel that it is necessary to incorporate the same concept at the time of evaluating and grading student's work. For this reason, the sum of all the activities in the course is slightly higher than 100%, which gives them the opportunity to obtain a good grade for this course given how difficult and challenging some of these concepts and activities may be.

The students receive a partial examination after each chapter that contains substantial material. Chapter 1 being the introduction, and Chapter 3, briefly describing an alternative technique for solving similar problems are not included in the partial examinations. I select the date for the exam after I am sure that we have worked in class all the assigned homework problems for that chapter and students seem to understand the concepts outlined in the chapter. These exams are not easy and I tell the students this upfront. Solving all the homework problems is normally necessary to be able to solve correctly the exam, but it is not enough. Parts of the partial exams are challenging and require the students to think and reflect on the implications of concepts and equations worked in class.

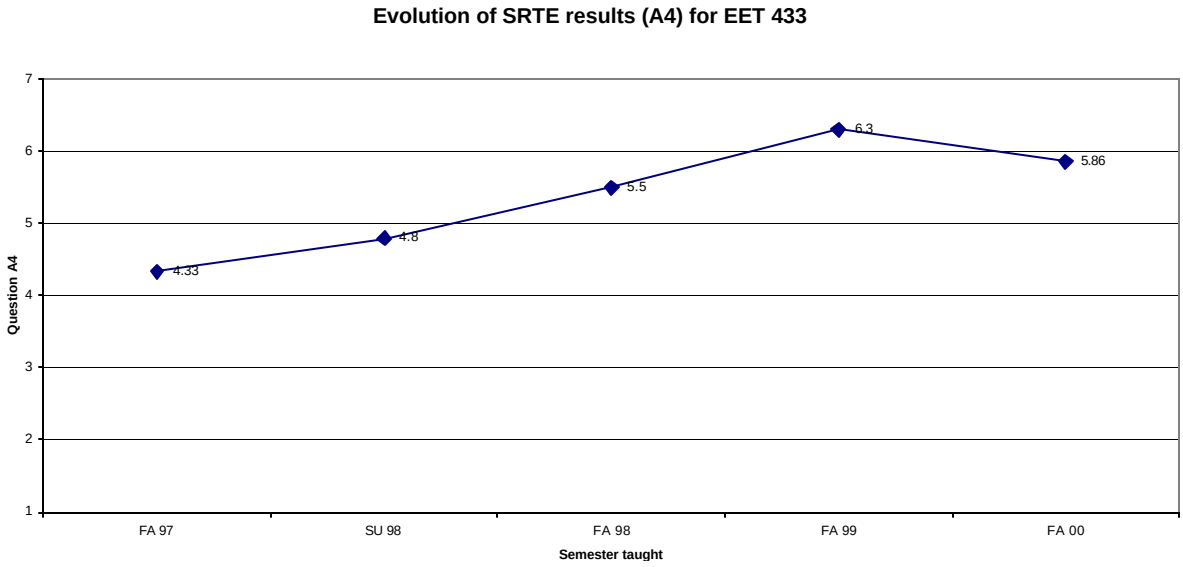
The quizzes are designed to test how the students master a particular technique for the analysis of control systems without additional implications. The number of quizzes in a given chapter depends on the extension of that particular chapter, with an average of approximately 1.6 quizzes per chapter. Dropping the lowest grade for the quizzes helps to reduce the anxiety and accounts for those situations where a low grade may have been obtained by external factors.

For both type of experimental work, case studies and the work with the modular system, students are evaluated on their performance during the activity and the report that they submit. Students are given guidelines for the submission of the report and are aware of the *late days* policy. Because I am in the laboratory with the students while they are doing their work there, I make sure that all the students are involved in the work that their group is developing.

Homework is essential for students to practice the techniques that we have studied in the classroom. It is also an excellent feedback tool for both the students and the instructor of the course. By attempting to solve the homework problems, students find out what areas are the most critical in that specific course and where they may have some misconceptions. As the instructor of the course, I use homework to determine what the level of understanding is for the students of specific areas and to detect the existence of generalized misunderstandings within the student population. If this is the case, I solve homework problem in class, pointing out common mistakes. To give an additional incentive for the students to work on their homework problems the submission of reasonably attempted homework problems has a weight in the final grade. Unless something unexpected happens, I return the homework exercises with feedback and comments to the students one day after being submitted.

7.5 EET 433. Student evaluations and feedback for this course

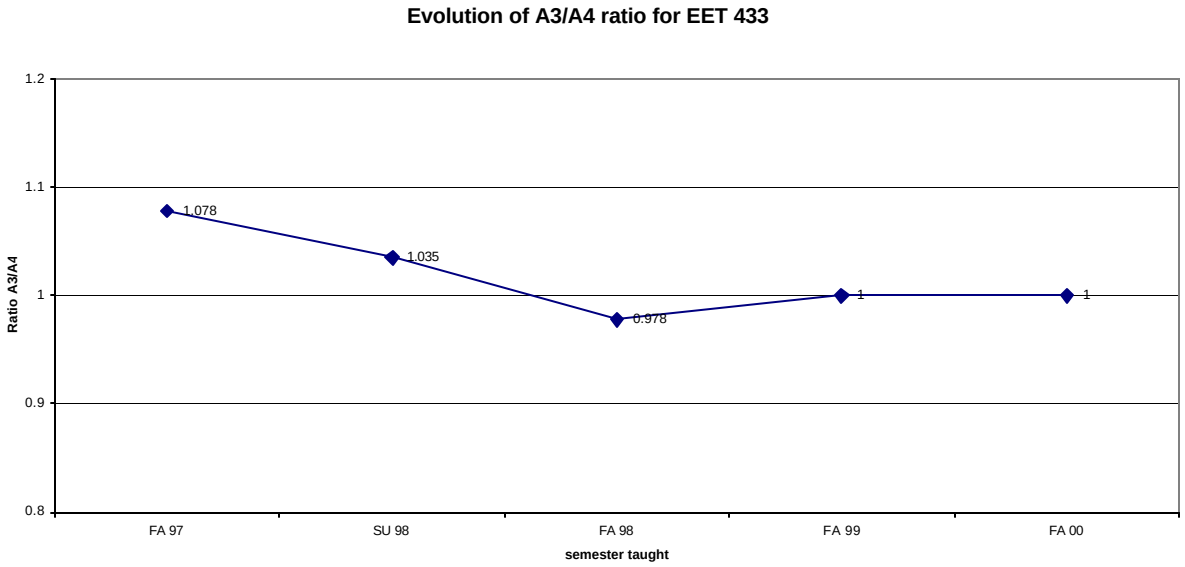
I consider student feedback as the single most important method of self-evaluation of our performance in teaching a particular course. The University provides us with a standardized tool to try to measure this outcome, known as SRTE. The chart below shows the evolution of how students evaluate my effectiveness in teaching this course (*Question A4 from the standard SRTE Form: "Rate the overall quality of the instructor*"):



From this chart it is possible to see how, since I started teaching this course, my teaching effectiveness as perceived by the students has continuously increased with a small decrease in the last semester it was evaluated. This last rating gives still a higher score than in the three previous semesters. I attribute this small decrease to the introduction of newer active learning work in the class that might have not been well received by all the students or simply to the group dynamics of the group in Fall 2000.

Unfortunately, Penn State University does not use these SRTEs in such a way that they could be used to compare my relative performance with colleagues teaching the same course at other campuses. However, my personal feeling is that the ratings obtained in the last three semesters indicate a strong degree of acceptance of my work teaching a difficult, mathematically-based engineering technology course.

At the time of assessing the performance of an instructor it can also be interesting to study the evolution of the ratio between questions A3 (*Rate the overall quality of the course*) and A4 (*Rate the overall quality of the instructor*). An A3/A4 ratio much higher than one may suggest that the students feel the course could have been very interesting but the performance of the instructor was somehow detrimental for this course. Conversely, an A3/A4 ration much lower than one could be interpreted as an indicator of a "free ride", that is an instructor abnormally lowering the standards of the course in an attempt to win the student's evaluations. The table below shows the ratio of A3/A4 for this EET 433 course:



From this table it is possible to see that the ratio between A3 and A4 remain very close to 1. The average score is 1.0182 with a standard deviation of 0.039. This ratio suggests that students perceived my work as instructor in a positive way, feeling that the quality of the course is similar to the quality of me as instructor. Moreover, this chart shows how the decrease in perceived teaching effectiveness in the last semester (Fall 2000) is paired by a perceived decrease in interest in the course. With this in mind, I can conclude that the decreases in A4 in Fall 2000 was not due to my performance as instructor.

In addition to the standard SRTE questions, the students are asked the open questions described in Section 4. When we opt for this type of evaluation it is unrealistic and unhealthy to expect all the comments from the students to be positive. We expect, welcome and value criticism by the students. The following are some of the critical comments from the students together with actions that I have taken to remedy these situations when possible:

- The labs were all theoretical. There was no hands-on. I would like to have actually designed and produced and insulin pump, artificial limb, etc. This would have allowed us to get a practical experience.

My response as instructor: This student should be praised by his or her interest in the course and in being involved in a real, challenging design process. However, the design of these devices that have been oversimplified in the case studies are well beyond the concepts of this class. On the other hand, starting the Fall 2001 semester I have introduced the modular hardware experiments that will give the students hands-on experiences on control systems.

- The laboratories were harder to understand what you wanted done; please explain more of go over before.

This student comment was made in after the Fall 1999 semester. After I learned about this shortcoming of the laboratory outline, I spend some time at the beginning of each laboratory session going over the main points that will be covered in that experiment and stating what is the outcome of each one of them.

- This course was too theoretical and not enough hands on. I thought it would be more interesting and understanding but the teacher made it more difficult by not doing example problems and just writing equations.

This comment was written in the Fall 1998 semester. Since that time, I have tried to relate the course more and more towards real world examples. However, this is a difficult course that relies heavily on mathematical concepts.

- The instructor didn't really care. I had to go and get a tutor in order to understand how to do the calculations for the problems that were covered in the course.

I can only hope that the student realized that being tutored by a peer was probably one of the best actions that could have been taken by him. I encourage this type of learning from peers where students are not as afraid of making mistakes. I believe this is one of the benefits of introducing cooperative learning the in the class. However, this response also shows the dangers of this type of work, especially with students that are reluctant to work on their own and expect the instructor to carry all the class.

Below are some of the positive comments made by the students on this class and the instructor. It is important to note that the number of negative responses has declined after each semester, while the number of positive responses has increased. In addition to having solved some of the most critical issues in this course, I attribute part of the positive response to the work of my colleagues, as students are exposed to cooperative learning activities in more courses.

- There was a healthy level of cooperative learning in this class. The instructor established a good balance between helping students and encouraging them to establish independent thought.
- The instructor showed a high level of concern for the course and the students.
- This class helped my classmates and I study better together and helped each other out where we were on the subject matter.
- Cooperative learning was encouraged for laboratory and homework exercises.
- Yes, the instructor was concerned.
- The laboratories were very deep. They required a lot of thinking and group discussion.
- I would have to say that this is one of the best courses that I have taken.
- The instructor was very interested in the progress of the students. After the midterm evaluation was taken he made changes in the course to benefit the students.
- The cohesive bonds of the group grew deeper as the effective entropy increased.
- This class seemed to stress how important it is to work together.
- The course was very difficult; it was great that I was challenged and used my mind. He is one of the best teachers on campus.
- The instructor seemed to be concerned with how the subject was learned, the progress in the course and solving particular problems.
- My understanding of the course material was accelerated through cooperative learning in the labs.

8.- COURSE SHOWCASE II: EET 419/420 - PROJECT PROPOSAL PREPARATION and SENIOR ELECTRICAL PROJECT

8.1 EET 419/420. Overview of courses

Students enrolled in the baccalaureate degree in Electrical Engineering Technology need to complete a senior project as part of their course requirements. This requirement is fulfilled by the courses EET 419 and EET 420. EET 419 is entitled *Project Proposal Preparation*. In this course, students are expected to write a formal proposal up to the level of design for a project that will be built in the course EET 420, *Senior Electrical Project*.

Since I took responsibility for this course sequence, I have adapted their outlines to increase the communication between instructor and students. Previously, the students worked on their own, reporting to the instructor only at the end of each semester when they submitted their proposals or the actual designs. I have also introduced activities to reinforce the working of each one of the groups and the use of technology, in this case the creation of one Web page for each group to disseminate information to the instructor and other groups.

I have taught these two courses (EET 419 in the Fall semester and EET 420 in the Spring semester) every year since Fall of 1998 with the exception of this current semester. With another faculty member on Campus we have agreed to teach these courses in alternate years, what will allow us to approach them in a more refreshed fashion. Teaching capstone project courses is very rewarding because students are exposed to the reality of the design process and are basically open within some constrains. On the other hand, each one of the projects chosen by a group of students can be considered as a course in itself in terms of preparation of different topics, which contributes to their challenge.

8.2 EET 419/420. Course goals and objectives

The University catalog describes the course EET 419 as " *Performing the initial research needed for the senior project course, and the preparation of the written project proposal*" and the course EET 420 as "*Design, construction, and testing of a project either selected by the students with approval or assigned by the instructor*".

The goals that I have established for these courses, in order to satisfy these requirements are:

- EET 419. The students should be able to:
    - Write a formal proposal describing a project to be designed.
    - Effectively work in groups.
    - Verbally communicate their intended project.
    - Use traditional and electronic presentation tools.

To reach these main goals for the course EET 419, I have developed a series of academic goals for this course. At the end of the course, students should be able to:

- Work in groups to generate topics of interest for the members of the group.
- Work with the course instructor to evaluate each one of the possible topics.
- Gather background information on the topic of choice.
- Perform a "top-down" design and analysis of options.
- Understand the complexities of their choice of design.
- Identify key components in their design.
- Create and update a website to disseminate their proposal with the instructor and peers.
- Use Powerpoint to create an audiovisual presentation.
- Present their proposal to the rest of the class.

- EET 420. The students should be able to:

  - Build the project that they designed in EET 419.
  - Effectively working in groups to develop their projects.
  - Evaluate their performance regarding their designs.
  - Present their designs to the instructors and their peers.

To reach these goals for this course, I have developed a series of learning objectives for the students to achieve. At the end of this course, students should be able to:

- Divide their design system into a series of sub-modules.
- Create a circuit design on a testing board.
- Perform tests to evaluate the performance of each module.
- Re-evaluate design decisions as necessary.
- Interconnect single modules to create their desired system.
- Evaluate the performance of their design as a whole.
- Create and update a website to disseminate their proposal with the instructor and peers.
- Use Powerpoint to create an audiovisual presentation.
- Present their proposal to the rest of the class.

8.3 EET 419/420. Personal approaches for these courses.

As we can expect, the approaches used in teaching these course have to be very different from the approaches used in more traditional courses. For EET 419/420 there are not formal lectures or recitations or a textbook to follow. Before I started teaching these courses, the instructor met with the students at the beginning of the semester and basically the students worked alone until the end of the semester when they submitted their reports to the instructor. After evaluating this procedure, I realized that the student's learning would be increased if they had to meet the instructor at regular and shorter intervals and had to show evidence of working to achieve their final goals. With this idea in mind, I redesigned the syllabi for EET 419 in an attempt to make it more interactive and give the students a frame from which they could develop their projects. The syllabi for EET 419 course can be found in Appendix 4.

One of the critical modifications that I introduced in this course was the creation of 10 tasks that the students need to complete in the course. Each one of these tasks, which are shown in Appendix 5, has associated a deadline, what helps students to keep themselves on track. In the first years that I introduced these activities I used FirstClass for groups of students to communicate with other groups, while in the last year, the students had to develop a Web page and post all the information online, using the Web as

the tool for communication. The following is a summarized version of the tasks with the expected outcomes that the students need to approach for this course:

1 INTRODUCTION
Outcome Task1: List in the Group's Webpage 3 to 4 topics of interest for your project.

2 DISCUSSION OF POSSIBLE TOPICS
Outcome Task 2: Each group should select their topic based on other students input.
Each student should have discusses at least 4 topics suggest by other students.

3 BACKGROUND HISTORY SEARCH
Outcome Task 3: Description of the results of your background search on your Webpage List also the hyperlinks that you have found that are adequate to the project.

PRELIMINARY PRESENTATION

4 DEFINITION OF YOUR PROJECT
Outcome Task 4: Block diagram added to the group's Webpage.
Discussion on the group's Webpage how your project improves previous designs, what parts are original and what parts have been taken from existing work, etc.

5 PLANNING THE PROJECT |
Outcome Task 5: Time chart added to your Webpage with proposed accomplishments.

6 BUILDING THE PROJECT: THE FIRST APPROACH
Outcome Task 6: Complete system block diagram.
Add the proposed testing process for your project in the Website.
Describe how you will physically build the system and what materials will be needed.

7 ELECTRICAL SCHEMATICS OF THE PROJECT
Outcome Task 7: Upload the full schematics into the group's Webpage.
Identify the components and parts that will be used in your project.

8 LOCATE CRITICAL PARTS
Outcome Task 8: List of phone numbers, contact persons with information that you need.
Copies of email, letters for donations, etc provided to the Instructor.

9 WRITE AND UPLOAD DEFINITE PROPOSAL
Outcome Task 9: Technical document suitable for use in the Project Design (EET 420).

10 PROJECT PROPOSAL ORAL PRESENTATION
Outcome Task 10: Oral presentation of the Project Proposal.

The course EET 420 is focused on the actual design and construction of the projects planned in the previous course. For this reason, this course is less structured because each one of the projects is different in itself and needs the use of different resources. As the instructor, I works closer with the students as they move through the different steps needed to fully develop each project. The syllabi for the EET 420 course is included in Appendix 6. In any case the students are required to update their Website at least on a bi-weekly basis as it is used to keep in contact with the instructor and other student groups.

I maintain an online database with the information that students have uploaded onto their Web pages for their projects, as they can serve as examples of the type of work for new students. Appendix 7 contains more detailed information and examples of these projects that are summarized below:

2000-2001:

Multi Effect Guitar Processor
Remote Operated Vehicle
D.J. Lightning System

1999-2000:

An Automatic Welcoming system
Internet Accessible PLC
Programmable Reservoir
Car Alarm System
Lie Detector
Tele-computer Controller

1998-1999:

Traffic light system for model trains
Tan filling and pH monitoring system
Control system for solar heat
System to measure the speed of vehicles
Water clock
Subsidiary Communications Authorization (SCA) receiver
Control for garage door opener
Swipe-Card reader

8.4 EET 419/420 Assessment methods I use for these courses.

Being that these two courses are taught in a non-traditional way, without lectures or recitations, the assessment methods used need to be different from the ones we normally use. In this case, these courses are carried out in a highly interactive way between instructor and groups of students as well as between groups of students themselves, and this interaction is used as one of the tools for assessment of academic performance.

In particular, for EET 419, I use the following assessment tools:

- Evaluation of each one of the first 8 tasks. As described in section 8.3 each one of these tasks focuses on a very specific area of work and consequently the assessment and evaluation is very diverse. Some tasks value student participation and involvement in the evaluation of the work from other groups, while other tasks require preliminary approach to their design.
- Linked to the previous tool, I also value very importantly the interaction and communication of each group or student with myself as instructor, as I believe this kind of work to be essential to successfully designing their project.
- The submission of a written report either in paper or electronic format that describes each one of the tasks and how they are linked together to create the final design

- The final oral presentation, that values how effectively a group of students can convey the information about their own design to other groups. It also values the correct use of presentation tools such as Power Point, for example.

To evaluate the course focused on the design of their project, EET 420, I use the following assessment methods:

- Interaction of each group of students with the instructor, and instructor's observation of how students try to solve the problems that appear in the course of their intended design.
- Use of progress reports to disseminate the information on the course of their intended design.
- Technical merits of their design balancing their approaches with the difficulty and complexity of their projects.
- Professional appearance of the final document submitted by the students.
- Final and preliminary presentations, valuing how effectively a group of students can convey the information about their own design to other groups. It also values the correct use of presentation tools such as Power Point in the final presentation, for example.

8.5 EET 419/420. Student Evaluations and feedback for these courses

It is difficult to evaluate these courses and the instructor's performance using the standard SRTE forms as they are designed to evaluate courses using traditional instruction methods. Although on several occasions I have distributed these forms and asked the students to interpret how each one of the questions may be approached for this type of course, I believe that the data obtained this way cannot be effectively used to assess the course or the instructor.

For this reason, I am in the process of developing an alternate evaluation method for these courses, asking the students specific questions regarding this course and how it could be improved. However, this process is still at the initial developmental stages and will require additional tools used simultaneously to obtain a better image of how students perceive this course. At the present time, the anonymous questionnaire that I have used to gather feedback for this course is shown in Appendix 8.

The following are portions of the analysis that I performed after giving this questionnaire during the last two years that I taught this course. My comments or actions taken as a response to generalized student comments are included in italics:

- Course 1999-2000:

The majority of the students felt that the course met their expectations although some of them were not clear about what to expect from this type of course. The idea of project design and teamwork seems to be the main attraction for this course. Only one student responded that the course did not meet expectations, as the student wanted more interaction between groups and the instructor and a more formalized meeting time and submission of reports.

In response to this comment that I believe could be shared by more students, I increase the frequency of meetings with students, being on the same day of the week and time for the course taught in 2000-01. I also formalized the submission of progress reports in a bi-weekly format.

The interaction between students has been identified by them as the best part of this course. Students realize the importance of interaction and teamwork even before being brought up by me as instructor. At a lower level, the students also identified the need to give presentations as the best part of the course.

This is an interesting response as the students are caught in the middle of their fear of public speaking and their knowledge that they will be required to give presentations on an ongoing basis during their professional careers. This is also an encouraging result as it shows that other courses that include student presentations as well as the speech communications course that they take have a positive impact on them just before graduation.

The answers to worst part of the course are not so well defined. Less students provide definite answers and these are more vague. Their answers seem to point in the direction of managing conflicts in groups and attitudes of their peers. In general, the students feel that they would like a higher level of instructor involvement in their group, telling them what to do.

Certainly, we all need to do a better job in training students to work in groups and personally I have attended seminars and workshops focused on helping students to learn how to work in groups. I try to balance my guidance as instructor with a certain amount of independence within each group. Although I provide answers when they ask me, I require my students to be independent and come forward with questions rather than me telling them what to do.

- Course 2000-2001:

All the students agreed that the course (EET 419 and EET 420) met their expectations. Most of them cited the fact that the course had "real-life experience" and they had to take the project from the beginning to the end. Most of the students cited, as the most satisfactory part of these courses, the designing and building experiences that lead to a product that worked according to their specifications.

On the other hand, the students cited as the worst part of the courses having to give the presentations to the rest of the class. I am not surprised by this response, and in fact, presentations were introduced in these courses, as we know that students do not feel comfortable with public speaking. They quoted that after all, "the presentations were not so bad", which may suggest that they will feel more confident when they have to speak in public in the future. Other issues that the students noted as the *worst part of the courses* were issues of time management. They are not familiar with time management issues, and I believe that this was the first time that they were exposed to bi-weekly deadlines for tasks to be completed and reported.

Since I started teaching these courses I have struggled trying to find out what should be my involvement as instructor. I have wanted to reach a middle ground in which the students know that I am available for consultation at any time that they need it, trying to be away from a complete *hands off* approach where I would only evaluate the final product, and telling the students what to do on a week per week basis. One of my goals for this course was for the students to learn to take initiative, be self-sufficient and know that they can consult with me when necessary. The students' responses to this question was, as expected, varied depending on each student's personality and their preferences. However, a large majority of students responded that my level of involvement was adequate. I still need to figure out how to reach out to the students that may need more supervision and direction without being too intrusive to those who want to work in a more independent manner.

The attitudes regarding working in groups are also varied. Students know that group work is inevitable in the workplace and they categorize their experience in these courses as positive. It is also

interesting to note that although they would not like to work in groups assigned by the instructor, they would understand it as a learning experience. All the literature on group work recognizes that the worst option is to let the members of the group select themselves, and this is how these groups are formed. In other circumstances I would have selected the groups for these projects myself. However, the long duration of this project (2 semesters) makes me reticent to assign groups by myself. We all need to learn more about how to manage group work especially for long-term group-work on these kind of projects that last for more than one semester.

It was satisfactory for me to learn that although most of the students had none to minimal experiences in the development and building of Web pages prior to the course, they did an excellent job at the time of building the Web page for their own projects. Most of the groups were above and beyond what I required in terms of characteristics of their Web pages and incorporated pictures and sounds on them. It is also satisfactory to learn from their responses that the vast majority recognize the importance of a well designed page in today's industry and how this experience may benefit them in their professional future. This is especially important because this is the only exposure to developing Web pages in the BS EET program and it is not required at all in its curricula.

Appendix 1 - Course syllabi for EET 433

Appendix 2: Selected case studies for EET 433

Appendix 3: Experimental laboratories for EET 433

Appendix 4: Course syllabi for EET 419

Appendix 5: Tasks to be completed for EET 419

Appendix 6: Course syllabi for EET 420

Appendix 7: Examples of projects for EET 419/420

Appendix 8: Feedback questionnaire used for EET 419/420

Appendix 9: Compilation of unsolicited comments from former students