Session 1448

# Notes on Modifying an EET Associate Degree Curriculum to Improve Graduate Placement

**James Stewart, William Lin**

**DeVry College of Technology**
**North Brunswick, New Jersey /**
**Purdue School of Engineering & Technology**
**Indiana University Purdue University at Indianapolis, Indiana**

## Abstract

This paper reviews the experience of moving topics in communications from what were BS-level courses at other DeVry campuses into the AAS-level course sequence at the New Jersey campus. The curriculum change was motivated by a growing demand by employers for graduates able to work in information technology based positions in the New York / New Jersey area.

## I. Introduction

DeVry College of Technology at North Brunswick New Jersey had been granting the AAS degree in Electronics Engineering Technology before they were approved to grant the BS-EET in 1999. The curriculum in that program was basically centered on two major tracks, analog and digital, similar to those in the typical associate-level Electrical/Electronic Engineering Technology programs at other schools.

A main goal of higher education in technology is to help students mature into skillful and employable problem-solvers. For years, potential employers of our graduates have expected their new hires to be prepared and ready upon graduation to use the technology found in the work-place. The rapid growth of information technology was creating a greater demand for graduates with more knowledge of data communications technology. That demand became a "driver" in curriculum design.

Since the New Jersey school was the only campus that was not granting the BS-EET degree, its curriculum was unique in the DeVry system. It had become apparent that, in order to meet the needs of local and regional employers, some topics that were normally covered in BSEET communications courses had to be integrated in the existing AAS curriculum in New Jersey. In early 1995, the North Brunswick EET department proposed an associate-degree curriculum that would include such communications topics in its five-trimester EET program. Implemented started later that same year.

## II. Program development and consideration

The new curriculum was designed to provide the AAS graduates some exposure to both AM/FM and digital/data communications. The original curriculum was concentrated on fundamentals of analog and digital electronics with an emphasis on microprocessors and their applications, and included both calculus and physics courses up to the second level. The program was structured within a 68 credit hour limit imposed by the Higher Education Commission of the State of New Jersey. Of these 68 credits, 29 were required to be in the areas of verbal and written communication skills, humanities, social sciences, mathematics, and science. The other 39 credits were spread across circuits, devices, linear amplifiers, digital and microprocessor systems, and computer programming. Graduates from the program were well suited for traditional EET employment.

Since the New York / New Jersey job market is a heavy user of communications technology, the lack of preparation in that field was seen as hindering the employability of AAS EET graduates. That opinion was based on input from both our Career Services (placement) office and from the EET program's Industrial Advisory Board (IAB) of representatives from local employers. So the EET faculty recommended that no EET student should complete their formal training without at least one course in electronic communications technology. With the goal set, a faculty committee was charged, and the work was begun to move material from what were BS level at other DeVry campuses into the AAS course sequence at the New Jersey campus.

During the initial stage of the curriculum development, some key technical topics were identified as necessary and critical to the overall knowledge of the graduates. These topics are summarized in Table 1.

Table 1. Key Topics for the Communications course in the AAS program

| |
|---|
| Basics of electronic communication systems |
| Signal representation and analysis |
| Modulation and demodulation |
| Analog communication systems |
| The telephone system |
| Digital data systems and transmission |
| Multiplexing |
| Computer network configurations and infrastructure components |
| Data communications protocols |
| Computer network operating systems |
| Advanced communication topics: satellite communications, optical fiber communications, etc. |

Perhaps not surprisingly, the list of topics grew as the enthusiasm mounted. After much debate, the decision was made to remove the second physics course (PHYS 230) to create room for a single comprehensive communications course. But a single course was found to be insufficient to cover the required number of topics. So the second calculus course (MATH 225) was also removed to create room for a beginning communications course in the fourth trimester followed by a data communications course in the fifth term of the program. Both MATH225 and PHYS230 would have to be taken in subsequent work at the BS EET level. That arrangement complied with the requirements both of TAC of ABET and of the New Jersey Higher Education Commission.

Initially the one communications course (EET 262) was created and moved into the slot vacated by PHYS230. This first version of the course was taught in the last trimester of the AAS EET program. The objectives were to be met in a survey-course approach, but not at a superficial level. The course began with an overview of electronics communications together with a brief history of the technology. It then proceeded to a coverage of AM and FM fundamentals as a groundwork for what would follow. (Those teaching the course had to resist the temptation of expanding the AM/FM section into a course onto itself, as well as the temptation to dwell on mathematical analysis.) Digital and data communications technology with an emphasis on protocols and computer networking were then introduced in a more detailed manner. The spirit of that first version of the course can be exemplified by the following two objectives taken from its Curriculum Guide:

- Given a generic block diagram of a communications system, label and explain the function of the input and output, transducers, modulator, demodulator, and channel.

Suggested Instructional Objectives

A. Introduce the concepts of carrier, signal, symbol, transmission, bandwidth, and information.
B. In a semi-qualitative way (i.e. with minimum math), explain modulation and demodulation as necessarily non-linear processes.
C. Draw block diagram of a typical communication system, including transmitter, channel, and receiver.
D. Explain the functions of critical sub-systems such as transducers, modulators, demodulators.
E. Explain the effects and sources of noise, and the significance of S/N ration.
F. Explain the significance of the channel capacity equation:
$C = (BW) \times \log_2 (1 + S/N)$.

- Given a generalized time-domain equation of a sinusoidal signal
$$v(t) = A(t) \sin[ w(t) \times t + Q(t) ]$$
identify what terms of the equation correspond to AM, FM, or PM. Identify the significant components in the frequency domain for AM and FM.

Suggested Instructional Objectives

A. Introduce students to the concept of non-periodic signals in contrast to periodic signals.
B. Introduce students to concepts of baseband, broadband, modulation index, and signal bandwidth.
C. Compare and contrast AM and FM communications systems in terms of ease of modulation and demodulation as well as performance in presence of noise.
D. In qualitative terms, discuss typical applications of AM and FM communication systems.

Course objectives were drafted under the constraint of the limited electronic and calculus background of AAS-level students as compared to BS-level students. Details of the course flowchart are discussed in the next section. Perhaps the most challenging task was the design of laboratory exercises. With their limited experience, students were not agile in designing and/or implementing the necessary circuits. So starting with the first implementation, we took advantage of the "user-friendly" features of the graphical programming language LabVIEW and designed lab exercises using computer simulation. That approach saved a considerable amount of time. And the students not only confirmed what they had learned in the lectures, they also picked up a powerful programming tool which consequently enhanced their employability. (The value of LabVIEW familiarity on the job was attested to in feedback from graduates.) To achieve the desired breadth of coverage within the time constraints of a single course, students were also asked to do a survey paper on selected subjects of advanced communications over the 15 weeks of the term. The paper was also meant to provide additional experience in technical. Students were advised to consult with the on-campus writing lab which was offered and supervised by faculty of the General Education department.

Based on the experience of trying to do everything in one course, it was decided to move AM/FM into an introductory course (EET 260) in the fourth trimester of the program. By spreading the material across two courses, the depth and breadth of coverage was increased. As depicted in the program flowchart, EET 260 was devoted to basic communication systems at the circuit and subsystem level. Topics included modulation, demodulation, transmitters, receivers and a complete analog system using IC technology. This first course of the communications sequence introduced the student to the concepts of electronic communications. The course was designed to be practical but quantitative, using mathematics and computer software to provide both verify the theory and to solve problems. It gave students the opportunity to correlate and apply the concepts learned earlier in the math, physics, circuits, and devices course sequences. The course provided a thorough coverage of fundamental concepts such as electromagnetic signals, noise, modulation, demodulation, transmitters and receivers.

Once EET260 was implemented as a full-fledged first communication course, EET262 was reworked and expanded in its coverage of data and advanced communications. Aspects of computer networking administration were added to the laboratory of the new EET262, based on feedback both from Career Services and the IAB.

## III. Curriculum details

The first version of the new curriculum spanned a period of one year. During that time the terminal course objectives were discussed, tested, and refined resulting in the subsequent two-course communications sequence. Table 2 lists the complete courses in order by trimester. The weekly contact and credit hours are also given. A program flowchart is provided in Table 3 to see how the communications courses fit into the program.

**Table 2. EET Complete curriculum**

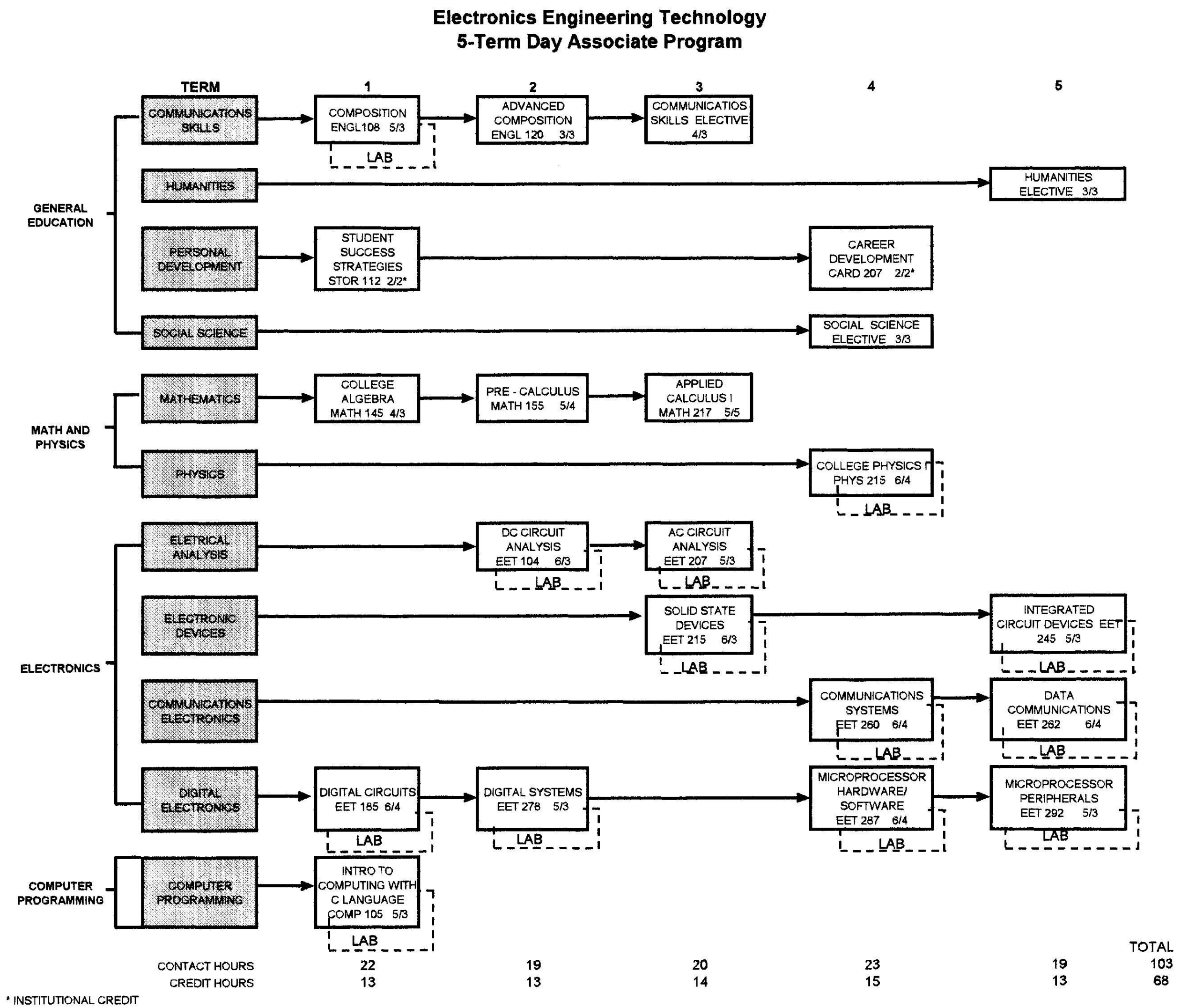
| | Contact | Credit |
|---|---|---|
| **First Semester** | | |
| COMP-105 Introduction to Computing with C Language (with laboratory) | 5 | 3 |
| EET-185 Digital Circuits (with laboratory) | 6 | 4 |
| ENGL-108 Composition (with laboratory) | 5 | 3 |
| MATH-145 College Algebra | 4 | 3 |
| STOR-112 Student Success Strategies* | 2 | 2 |
| | 22 | 13 |
| **Second Semester** | | |
| EET-104 DC Circuit Analysis (with laboratory) | 6 | 3 |
| EET-278 Digital Systems (with laboratory) | 5 | 3 |
| ENGL-120 Advanced Composition | 3 | 3 |
| MATH-153 Pre-calculus | 4 | 3 |
| | 18 | 12 |
| **Third Semester** | | |
| EET-207 AC Circuit Analysis (with laboratory) | 5 | 3 |
| EET-215 Solid State Devices (with laboratory) | 6 | 3 |
| MATH-215 Applied Calculus I | 4 | 4 |
| Communication Skills Elective | 4 | 3 |
| | 19 | 13 |
| **Fourth Semester** | | |
| CARD-207 Career Development* | 2 | 2 |
| EET-260 Communications Systems (with lab) | 6 | 4 |
| EET-287 Microprocessor Hardware/Software (with laboratory) | 6 | 4 |
| PHYS-215 College Physics I (with laboratory) | 6 | 4 |
| Social Science Elective | 3 | 3 |
| | 23 | 15 |
| **Fifth Semester** | | |
| EET-245 Integrated Circuit Devices (with lab) | 5 | 3 |
| EET-262 Data Communications (with laboratory) | 6 | 4 |
| EET-292 Microprocessor Peripherals (with lab) | 5 | 3 |
| Humanities Elective | 3 | 3 |
| | 19 | 13 |

**Program Totals:**
**Semesters: 5**
**Weeks: 75**
**Credit Hours: 66**
**Contact Hours: 1515**

*This course earns institutional credit, which is not considered in the cumulative grade point average or as credit earned toward a degree.

Main Menu

# Table 3. EET Associate program flowchart



## IV. Conclusion

The development and implementation of the modified AAS-EET program proved to be challenging and fulfilling. This lone AAS-EET program in the DeVry system provided a unique environment for experimenting with a fast implementation of curriculum changes necessitated by a quickly changing job market. Feedback for assessing the results was obtained quickly from employers as well as from faculty and from the students themselves. Based on employer feedback, and on starting-salary data, the curriculum did meet the objective of enhancing employability of the graduates. Also, the experience gained by faculty involved with the project was helpful in the subsequent implementation of a BS-EET curriculum.

**NOTE:** Supporting data will be presented during presentation of this paper.

**JAMES STEWART**
Jim Stewart is a Senior Professor in the Electronics Technology Department at DeVry College of Technology in North Brunswick, New Jersey. He was Dean of the Electronics Department at the time of the curriculum changes described in this paper. Prof. Stewart has a BS degree in Electrical Engineering from Newark College of Engineering and an MS degree in Computer Science from New Jersey Institute of Technology. He is the author and co-author of several textbooks.

**WILLIAM T. LIN**
William Lin is currently a faculty member in the Purdue School of Engineering & Technology at Indiana University, Purdue University at Indianapolis. Prior to IUPUI, Bill served as faculty member at The Pennsylvania State University, Wayne State University, and DeVry Institute of Technology. Before joining IUPUI, he was a Full Professor in EET at DeVry College of Technology in North Brunswick, New Jersey. During his tenure at DeVry, he has taught and developed courses in technical areas. Dr. Lin received his Ph.D. in Electrical Engineering from The Pennsylvania State University, a M.S. degree in Physics from the University of Southern Mississippi, and a B.Ed. in Science Education from Taiwan.




Main Menu