

INNOVATIVE NEW PROGRAM IN TELECOMMUNICATIONS ENGINEERING TECHNOLOGY

Austin B. Asgill, Thomas J. Fallon and Walter E. Thain¹

Abstract

The area of Information Technology (IT) has experienced explosive growth in recent years and many academic institutions have begun offering new programs in the IT area to meet the demands of industry for graduates with this expertise. These programs come under a variety of names such as, Information Technology, Information Engineering Technology, Information Technology Management, Telecommunications Technology, Telecommunications Engineering Technology, etc.

This paper discusses one such successful IT program in Telecommunications Engineering Technology (TCET) at Southern Polytechnic State University (SPSU) in Marietta, Georgia. This program offers its students combined experiences in the hardware, software and management of telecommunications networks. The students get hands-on experiences in setting up telecommunications networks and all the various aspects related to the administration and management of such networks. The TCET program is one of the fastest growing programs within the Electrical and Computer Engineering Technology Department, and is slated for its first ABET accreditation visit during the 2002-2003 academic year.

I. Introduction

The tremendous advances in communications technology that is still ongoing has led to an explosive growth in the Information Technology (IT) industry. This growth has led to a corresponding increase in the demand for technical specialists who can become immediately productive upon graduation.

Many corporations have had to rethink the way that they conduct their business because of the telecommunications advances. The Internet has become a ubiquitous tool in the business arsenal. Wide area networks (WANs) are used to share information between organizational entities, and increasingly as a medium for the transport of voice and broadband information. WANs and LANs (local area networks) are used by businesses as information resources as well as for revenue generation. The development of World-Wide web and Internet applications have enabled business services to be delivered directly to the customer's homes and offices without the need for interaction with vendors.

In this new business model, it is essential that there is synergy between previously autonomous groups within the business organization. This requires an employee who has a good understanding of the technical aspects of a computer network, server-based applications, as well as knowledge of to manage and optimize these resources.¹

¹ Electrical and Computer Engineering Technology, Southern Polytechnic State University, 1100 South Marietta Parkway, Marietta, GA 30060..

In order to satisfy the increasing demand for this level of skilled individual, many academic institutions have begun offering new programs in the IT area. These programs come under a variety of names such as, Information Technology, Information Engineering Technology, Information Technology Management, Telecommunications Technology, Telecommunications Engineering Technology, etc. Southern Polytechnic State University (SPSU), in Marietta, Georgia offers a very successful multidisciplinary baccalaureate degree program in Telecommunications Engineering Technology (BSTCET). Recognizing that new business models require synergy between groups within an organization, such as finance, marketing, information services and network operations, the BSTCET program was designed to be predominantly technical with a significant management component. The program received its first visit by the Accreditation Board for Engineering and Technology (ABET) during the fall semester 2002. It is anticipated that the program will receive full accreditation from the ABET board once it has completed the evaluation of the reports from the visit.

II. Motivation and Background

The State of Georgia is actively involved in fostering the growth of the telecommunications industry within the state through its Yamacraw initiative program². SPSU is a partner institution in this initiative and as such, the Electrical and Computer Engineering Technology (ECET) department was presented with a unique opportunity to develop a program that would provide graduates with the essential skills needed to meet some of the state's goals while at the same time satisfying the demands from corporations who are dependent on telecommunications networks.

In developing the new program, one of the key factors was to have a program that would match the unique capabilities and strengths of engineering technology students. In general, these types of students respond well when the course content is less abstract and more practical oriented. Engineering technology programs offer hands-on laboratory experiences that contribute significantly to students' abilities and confidence. Since programs in engineering technology are accredited by ABET³, it was also essential that the new program would satisfy all the requirements for obtaining accreditation from ABET at the time.

Since the inception of the BSTCET program though, there has been a significant increase in the number of IT program offerings by institutions. Many of these programs could not be accredited under the existing ABET criteria because of their focus. There is now significant movement to revamp ABET's accreditation policies (TC2K) to accommodate some of these new programs. This activity is still ongoing and is the impetus for many professional meetings at this time.

The BSTCET program was approved in 1998 and received seed funding through a 2-year grant from the Georgia Board of Regents' Intellectual Capital Partnership Program (ICAPP)⁴, enabling support for curriculum development and laboratory equipment purchases.

III. Program Development

The semester-based curriculum added five new technical courses and four management courses to a core of ECET, mathematics, English, and social sciences courses. The program was structured within the 130 credit-hour limit set by the Board of Regents. Nineteen (19) hours are allocated to the telecommunications-specific courses created for the program; Forty-three (43) hours constitute a core of ECET technical courses; Twelve (12) hours are for the four management courses required by the degree, and Fifty-six (56) hours are for the Mathematics, Physics, English, and Social Science core.^{5, 6}

A significant portion of the ICAPP grant funds was used to purchase laboratory equipment for the telecommunications courses. The equipment choices were intended to support basic laboratory exercises and also provide the opportunity for advanced, special project students to extend their knowledge through

independent research. Some of the acquisitions included routers with firewall and voice-over-IP capability, Ethernet switches capable of virtual LAN configuration, asynchronous transfer mode (ATM) switches for LAN backbone applications, wireless LANs, a frame-relay WAN switch, CSU/DSU interfaces for T1 WAN networks, workstations, servers, network operating system software, specialized web server software, and network protocol analyzer software.

Table 1 lists the ECET courses that are part of the BSTCET degree in order by the semester in which they are taken. The telecommunications courses are identified. The weekly lecture hours, laboratory hours, and total credit hours are also given. Note that laboratory exercises are conducted for 12 out of the 15 weeks in each semester.

Table 1. ECET courses in the BSTCET degree program.

Course Name	Semester Number	Weekly Lecture Hours	Weekly Laboratory Hours	Credit Hours
Orientation	1	2	0	2
Fundamentals	1	1	3	2
Circuits I	2	3	3	4
Digital I	2	3	3	4
Circuits II	3	3	3	4
Electronics I	3	3	3	4
Introduction to Telecommunications*	4	3	0	3
Digital II	4	3	3	4
Electronics II	4	3	3	4
Data Communications	5	3	3	4
High Frequency Systems	5	3	3	4
Applications of C++, JAVA and HTML	5	2	3	3
Digital III	6	3	3	4
Communications Networks and the Internet*	6	3	3	4
Telecommunications Management*	7	3	3	4
Advanced Telecommunications*	7	3	3	4
Telecommunications Project*	8	3	3	4

*Indicates added telecommunications course

Tables 2 through 7 list the main lecture and laboratory topics for the five telecommunications courses and Data Communications. The time allocated for each topic is not shown, and in several instances the topics for laboratory exercises may take more than one laboratory session to finish.

The four management courses included in the BSTCET program and their descriptions are shown in Table 8. These courses were already part of the School of Management's curriculum and did not undergo any revision when included in the BSTCET program.

Table 2. Main topics in the Introduction to Telecommunications course.

Lecture Topic
Noise
Modulation: AM, FM, PCM
Coding
Data link protocols
Telephony
LANs
Internet

Table 3. Main topics in the Data Communications course.

Lecture Topic	Laboratory Topic
Modulation schemes used in modems	Line codes
Line codes	Bit error rate
OSI model	Modem operation
Line codes	Spectrum and bandwidth
Trellis coding, data compression, error detection	Protocol analyzer
LANs	
WANs	
WAN protocols, ISDN, X.25, Frame Relay, ATM, SONET	
TCP/IP	

Table 4. Main topics in the Computer Networks and the Internet course.

Lecture Topic	Laboratory Topic
Internet overview and architecture	TCP/IP operation
TCP/IP	Windows NT network administration
LAN architecture and protocols	Introduction to Linux
WAN architecture and protocols	Network protocol analyzer
Internetworking devices: routers, hubs and switches	TCP ports
Wireless technologies	Javascript and XML
World Wide Web: HTML, web pages, servers, browsers, embedded objects	

Table 5. Main topics in the Telecommunications Management course.

Lecture Topic	Laboratory Topic
Importance of telecommunications to business	Data security
Industry standards	Domain and peer network security
Government regulations	Video conferencing and quality of service
Telecommunications carriers and competition	Network protocol analyzer
Voice and data communication review	Field trip to Bell South data network operation center
Media convergence	LAN network design semester project
Network design and management	
Telecommunications department management	

Table 6. Main topics in the Advanced Telecommunications course.

Lecture Topic	Laboratory Topic
Emerging technologies	Configuring virtual LANs
Ethernet	Basic router configuration
Frame relay	RIP routing protocol
ATM	Router interface IP filters
SONET/SDH	Linux firewall
Distributed applications	
Network security	

Table 7. Main topics in the Telecommunications Project course.

Lecture Topic	Laboratory Topic
Topics involve designing a complete E-commerce solution based on objectives	Depends on instructor's choice of project
Instructor acts as mentor and project director guiding students	

Table 8. Management courses in the BSTCET degree program.

Course Name	Description
Accounting I	A study of the underlying theory and application of financial accounting concepts
Management and Organizational Behavior	Integrates the study of management principles and practices with the study of human behavior within organizations, focusing on organizational effectiveness, efficiency and human resources management
Basic Business Finance	Introduces financial analysis, budgeting, sources and uses of funds, asset management, short and long run financial strategy, and business decision-making based on financial data interpretation.
Project Management	Provides a comprehensive, balanced view of project management, emphasizing both behavioral and quantitative aspects. Includes a study of systems philosophy, systems development process, human organizations and behavior, methods and procedures, and managing systems.

IV. Program Assessment

With the new ABET EC200 and TC2K criteria, considerable attention has been devoted to program assessment in the literature.^{3, 7,8,9,10,11,12,13} A primary objective of assessment is to maintain a rich, relevant program that attracts students and provides them with the appropriate skills necessary to prepare them for employment. With this in mind, the BSTCET program is undergoing a process of continuous assessment and evaluation.

Preliminary assessment has been based on observations of the faculty teaching the courses, informal conversations with some of the students and graduates, surveys of the literature, discussions with some industry representatives, and a survey developed for BSTCET graduates. Some early results from this assessment were the following:

- The Introduction to Telecommunications course was moved from the second semester to the fourth so that students' skills would be greater and the content level could be raised.
- The lack of program electives due to the inclusion of the management courses reduces students' scheduling flexibility and the flexibility of the program.
- More network configuration and design laboratory exercises are needed.
- There is some resistance from students to the inclusion of management courses in the program.
- Although topic redundancy reinforces students' knowledge and confidence, some may be unnecessary.

Based on this assessment, the faculty decided that it was necessary to build more flexibility by including an elective into the program. The required management course in Basic Business Finance has been replaced with an elective option. The elective enables students to customize their programs in either a technical or management direction. Table 9 shows the elective options that are now included in the BSTCET curriculum.

Table 9. BSTCET program electives.

Prefix	Title
ECET	Wireless Communication Systems
ECET	Fiber-optic Communication Systems
ECET	Network Programming and Interfacing
ECET	Any senior-level telecommunications course
MGNT	Basic Finance

In addition, the contents of the Communications Network and the Internet, the Telecommunications Management, and the Advanced Telecommunications courses have been revised in order to minimize some of the redundancies in topics that were thought to be unnecessary. The process is still ongoing. As technology changes and new techniques and protocols are developed for network communications, it will be a continuous challenge to keep IT curricula current and relevant.

V. Current Program Status

The BSTCET program produced its first graduates during the spring semester 2000. The program has grown since its inception and currently has 80+ students enrolled during the spring 2002 semester. Enrollment figures for the program are indicated in Table 10.

Table 10. BSTCET program enrollment.

Semester	Enrollment
Fall 1998	15
Fall 1999	44
Fall 2000	47
Fall 2001	82
Fall 2002*	74

* Increase in number of graduates

As can be seen from the data, the student enrollment has increased significantly since the program's inception. The drop in number for fall 2002 is due to the increased number of graduates from the program during the 2001-2002 academic year. The preliminary numbers for the spring semester 2003 indicate once again the enrollment is above 80 students.

VI. Conclusion

The growth of the telecommunications industry with the inherent advances in technology makes it difficult to choose appropriate topics and organize them in a coherent manner across several courses. As a result, it is expected that the curriculum will continue to evolve, but will eventually stabilize and change at a

much slower pace. It is still a high priority to continue streamlining the curriculum by removing unnecessary redundancy and to continue developing appropriate laboratory exercises.^{5, 6}

The BSTCET program now has 80+ students and continues to grow. Students currently come to the program from companies such as Bellsouth, Lucent, Sprint, and several local IT consultancies and service providers in the Atlanta area. It had its first graduates in the spring 2000 semester. It is anticipated that once the program receives full ABET accreditation, it will be able to attract an even greater number of students who are seeking a degree in the IT area. The location of SPSU close to the Atlanta metropolitan area is also an advantage as Atlanta is ranked among the fastest growing cities in the nation.¹⁴ The state's Yamacraw initiative is also expected to attract more IT related businesses to the metro area. Given this combination, we can only foresee continued growth and success for the BSTCET program.

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Austin B. Asgill

Dr Austin B. Asgill received his B.Eng. (hons) (E.E.) degree from Fourah Bay College, University of Sierra Leone, his M.Sc. (E.E.) degree from the University of Aston in Birmingham and his Ph.D. in Electrical Engineering from the University of South Florida. He is an Associate Professor of Electrical and Computer Engineering Technology at Southern Polytechnic State University. With over 19 years of teaching experience in Electrical/Electronic Engineering and Engineering Technology, he currently teaches in the areas of networking, communication systems, digital signal processing, and analog and digital electronics. He has worked in industry in the areas of telephony, networking, switching and transmission systems, and RF and MMIC circuits and system design. Dr. Asgill also has an MBA in Entrepreneurial Management from Florida State University and is a licensed professional engineer (P.E.) in the state of Florida.

Thomas J. Fallon

Thomas J. Fallon received his BS and MS degrees in Electrical Engineering from the Georgia Institute of Technology and is pursuing his Ph.D. degree in Astrophysics from Georgia State University. He is an Assistant Professor of Electrical and Computer Engineering Technology at Southern Polytechnic State University and is coordinator of the BSTCET program. He has 17 years of telecommunications industry experience, conducts networking workshops, and is author of the book *The Internet Today*. His astrophysics Ph.D. research at Georgia State University involves remote operation of a telescope array via the Internet 2.

Walter E. Thain

Walter E. Thain, Jr. received his BS, MS, and Ph.D. degrees in Electrical Engineering from the Georgia Institute of Technology. He is an Assistant Professor of Electrical and Computer Engineering Technology at Southern Polytechnic State University and teaches in the areas of voice and data networking, communications systems design, analog electronics, antenna design, and digital electronics. He spent 12 years in industry designing mixed analog-digital systems, including short-pulse radars and antennas, low-noise analog circuits, RF circuits, frequency synthesizers, and switching power supplies. He is co-inventor on a patent for the design of electronic instrumentation used to steer oil wells while drilling. He also holds a Cisco Certified Network Associate certification.