Innovative Curriculum Modifications for a Telecommunications Engineering Technology Degree

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Abstract

Southern Polytechnic State University’s Electrical and Computer Engineering Technology (ECET) department possesses a 4-year, multidisciplinary Telecommunication Engineering Technology (TCET) degree program that has evolved via a process of continuous improvement. Internal examination and external pressures (changing technological base and employment marketplace) continue to influence the modification of the curriculum in several innovative ways including: structural changes (prerequisites and elective vs. required course balance), chosen electives, capstone course evolution, and a basic introduction to telecommunications in the Fundamental’s course.

After a periodic re-evaluation of the TCET curriculum two generic telecommunication-specific electives were added, while courses deemed unnecessary to the future success of the program were dropped; wireless systems and network security courses are currently being developed as new electives. In conjunction with the aforementioned course changes certain prerequisites were added, dropped, or modified to better accommodate current course content requirements and associated student registration needs.

A TCET capstone course was created (from a former telecom project course) to immerse students in a team-oriented, multi-layered telecommunications scenario requiring the successful application of skills and knowledge obtained during their degree program. Collectively these modifications were/are being implemented to improve the overall program quality and enhance the prospects of attracting additional students.

Introduction

Eight years ago a multidisciplinary Baccalaureate degree program in Telecommunications Engineering Technology (BSTCET) was approved by the University System of Georgia Board of Regents and offered at Southern Polytechnic State University1. The BSTCET program is a multidisciplinary degree program that has evolved via a process of continuous improvement. The current program is comprised of four major components: Electrical and Computer Engineering Technology (ECET) prerequisites, university core courses, management courses, and the following eight BSTCET-specific courses2,3,4.

ECET 2800 – Introduction to Telecommunications
ECET 3810 – C++, Java, and HTML
With the exception of ECET 2800 all BSTCET courses possess a full compliment of hands-on laboratory exercises involving the use of hardware and software-based telecommunications technologies including: routers, switches, concentrators, workstations, servers, firewalls, operating systems, analyzers, simulators, and so on. ECET 2800, though not lab based, introduces the student to the “big picture” of telecommunications including: protocols, standards, regulations, encoding, noise, modulation, POTS, and LAN/MAN/WAN concepts and technologies. Both theoretical and practical aspects of the program combine to equip the student with a complete set of skills and knowledge required to compete in the modern telecommunications industry.

This paper examines TCET curriculum modifications and their motivation. Specifically the current and previous curriculum flowcharts will be compared to show the modifications in relation to the overall degree program.

**Curriculum Structural Changes**

Although the curriculum has evolved steadily since its inception, we will review the most recent and significant structural changes depicted below in figures 1 (2002-2003) and 2 (2005-2006). In order to provide students with a more flexible degree program an additional TCET elective was added. One of the electives can be satisfied by selection of a course from a list of departmental electives (thermodynamics, dynamics, statics, etc.) derived primarily from the MET (Mechanical Engineering Technology) degree program; the other elective is satisfied by selection of the fiber optics, wireless communications, business finance, or another optional TCET course.

The three hours required for the new elective were created by removing ECET 3220 (Digital III), which also subtracted an hour from the overall curriculum. The subtracted hour was regained by changing ECET 1011 (Fundamentals) from a 2 to 3-hour credit course, a departmental-wide request. Also to satisfy an ABET accreditation requirement -the addition of an hour in mathematics-- Math 2306 (Differential Equations) was added. Of course this required the removal of another course, ACCT 2101 (Accounting I), which could have been applied toward a minor in management. Removal of the latter has generated discussion about the multidisciplinary nature of the TCET program.

To enable non-TCET students who have fulfilled all ECET 4840 (Advanced Telecommunications) prerequisites except ECET 2800 (Introduction to Telecommunications) to register for ECET 4840 as an elective, the 2800 prerequisite was removed.
Figure 1: 2002-2003 TCET Flowchart
Chosen Electives

As described in the previous section TCET electives include two existing telecommunications-related (fiber optics and wireless communications), business finance, departmental-wide courses, and another optional TCET course. The latter, currently designated ECET 48XX, are yet to be designed. However, the following courses are being considered: network security, wireless systems, and router/switching theory.

Although snippets of network security are scattered throughout several of the existing, required TCET courses, no single, holistic course exists. It’ believed that such a course will not only augment the knowledge base of current TCET students, but attract additional non-TCET students interested in this very important topic. The wireless communications course will differ from wireless systems primarily in areas of emphasis: RF-based communications, antennae, modulation schemes and related topics (wireless communications) versus entire telecommunications systems based on cellular, satellite, WiFi, etc.

A router/switching theory course would provide greater depth of the theoretical and practical aspects of the two topics and the inclusion of additional topics in existing TCET
courses. Further other advanced routing/switching topics/projects could be explored and developed.

Capstone Course Evolution

Our current capstone course, ECET 4850, was originally titled “Telecommunications Project,” wherein projects, such as the configuration of a specific router-based network, were initially assigned and then progressively evaluated at built-in milestones. Although a few telecommunications technologies -- e.g. VoIP via a routed network-- might be included in the project course, a holistic format was lacking; a comprehensive, practical course reflecting real-life telecommunications solutions design and implementation was needed.

The Technology Accreditation Commission of ABET Inc. in its accreditation criteria\(^5\) states that “Capstone or other integrating experiences must draw together diverse elements of the curriculum and develop student competence in focusing both technical and non-technical skills in solving problems.” With this in mind, the TCET faculty set about developing its Telecommunications Project course into a full fledged capstone course that would serve as an integrating experience for our graduating seniors.

Using feedback and/or information from several sources including the ECET Industrial Advisory Board (IAB)\(^6\), U.S. Department of Labor Bureau of Statistics\(^8\), graduates of the program, and industrial experience of the faculty, it was determined that in addition to being able to simulate real-life telecommunication solutions design and implementation, individuals with team-oriented, up to date telecommunications experience are a valuable asset to would-be employers. Although some of the BSTCET courses provide such an experience, only the capstone course presents a single, multilayered telecommunications scenario.

In developing the course, several factors were considered essential for making it a meaningful capstone experience that would provide the students with some of the requisite skills desired by industry. Some of these factors included: technical content representative of state-of-the-art technology, team work, technical communications, management, and interpersonal skills.

The first iteration of the capstone course involved the design and implementation of a communication network that utilized the voice over Internet Protocol (VoIP) over an Ethernet based Wide Area Network (WAN). The scope of activities performed by the students included the following:

- Researching VoIP products offered by competing providers, e.g. Cisco and Quintum Technologies
- Designing a network that could utilize VoIP
- Developing a working BOM for the project
- Implementing and configuring the network for the VoIP implementation
Utilizing a network analyzer to capture voice packets and analyze the protocols used in the packets

Analyze the effects of data traffic congestion on VoIP Quality of Service (QoS) and protocol efficiency

The students were also expected to demonstrate their expertise in project management by developing a project management plan with GANTT charts and task lists for the capstone project. Although students were allowed to develop their own sub teams to accomplish various tasks, they received instruction about the overall team structure from the instructor with the following guidelines: i) students were to elect a director, ii) sub teams were organized and assigned specific task(s) by the director, iii) sub teams reported periodically to the director about the progress of various sub goals set by the team towards the completion of assigned tasks, iv) the director facilitated inter-team communications, v) teams facilitated internal communications to determine the exact processes required to meet their goals, and vi) the instructor interfaced with director for overall feedback and with individual teams in the capacity of “consultant.” Students were required to produce a comprehensive report for their project and give an oral presentation to faculty, fellow students, and IAB members.

Telecommunications basics section added to Fundamentals Course

All three ECET (Electrical and Computer Engineering) department undergraduate programs, EET, CpET, and TCET, share a common core of basic courses: orientation, fundamentals, circuits, electronics, digital, etc. ECET 1011 (Fundamentals) provides students with basic knowledge and skills in circuit theory/design and a few common software tools. The addition of a section of telecommunications basics to the course has been discussed in order to provide students with earlier exposure to the topic so that they might feel engaged in their discipline sooner. Also additional material could be included in the TCET introductory course, thus possibly changing subsequent TCET prerequisite structures.

Conclusion

Several TCET curriculum changes have been made to provide students with a more effective degree program and address evolving changes in the telecommunications industry. In order to assess the effectiveness of these changes new and existing assessment tools are being created/used to provide proper feedback. The TCET degree program received its initial ABET accreditation in late 2003 and is up for re-evaluation in 2008. Therefore, it’s important to understand the effect of the four aforementioned changes on curriculum and course outcomes and student enrollment so that a continuous improvement cycle can be maintained.

References


[4] URL: http://ecet.spsu.edu/home/Programs/Programs.php


