

## **A Master of Science Program in Telecommunications Engineering Technology**

**Warren L G Koontz  
Rochester Institute of Technology**

### Introduction

About 35 years ago, Bell Telephone Laboratories, the research and development arm of the Bell System, provided a program to train newly hired Members of Technical Staff. A new MTS, who usually joined Bell Labs just after receiving a BS degree in either electrical or mechanical engineering, was first sent off to get a Master of Science in EE or ME. But even this was not enough. Upon completing the MS, the still unripe MTS had to complete a series of “Bell System Technology” courses before he or she was considered ready to work effectively on telecommunications projects. That is, Bell Labs used its own resources to fill what it perceived to be a gap in the engineering curricula.

Bell Labs was in a unique position to offer telecommunications education to its employees. It was part of a regulated monopoly and faced no significant competition. All of this changed around the time of the break-up of the Bell System in 1984. Bell Labs, which was now part of the new AT&T Corporation, became one of many telecommunications companies competing for people who could become productive quickly without elaborate company-provided training. Thus the advent of competition in telecommunications led to growth in demand for telecommunications professionals.

Several universities have responded to this demand by establishing programs in telecommunications engineering or telecommunications engineering technology. Southwestern Tennessee Community College has offered an AS degree in Telecommunications Engineering Technology since 1971 and there are currently 6 bachelors programs and 3 associates programs accredited by the Accreditation Board for Engineering and Technology (ABET)<sup>2</sup>.

RIT launched a Bachelor of Science program in Telecommunications Engineering Technology in 1990 and in 1994 the program became the first of its kind to be accredited by the Technology Accreditation Commission of ABET. In 1992 RIT added three certificate programs to its telecommunications offering. In the late 1990s, the RIT’s Telecommunications Industrial Advisory Board recommended that the telecommunications faculty at RIT develop a graduate program. Around the same time, the RIT admissions office reported a surge of inquiries about such a program. Program development got underway in 2000. The program was approved by the

State of New York in December 2002 and the first students began their graduate studies in the spring quarter of 2003.

This paper provides an abbreviated description of the program, an overview of program goals and metrics and a discussion of some innovative methods of instruction that are being introduced along with the program.

### MSTET Program Description

The MSTET program at RIT is a 48 quarter credit hour program consisting of four elements:

- Telecommunications core courses
- Technical electives
- Management electives
- Capstone project

The core courses, which account for 24 of the required 48 quarter credit hours, cover basic telecommunications technology, networks and protocols, policy and regulation and project management. All students must complete the core courses or have completed equivalent courses.

Table 1 lists the core courses.

**Table 1**

|   |
|---|
| Telecommunications Concepts               |
| Principles of Telecommunications Networks |
| Telecommunications Network Protocols      |
| Telecommunications Project Management     |
| Operating Systems for Telecommunications  |
| Telecommunications Policies and Issues    |

The core program was developed by faculty with extensive experience with the undergraduate TET program. It includes graduate versions of the basic undergraduate courses and is designed to challenge both graduates of undergraduate telecommunications programs as well as technically grounded individuals who are new to telecommunications. Indeed, the current student population is a mix of graduates of RIT's BSTET program and BSEE graduates from other institutions.

Technical electives are currently offered in three areas:

- Network planning and design
- Fiber optic technology and systems
- Wireless telecommunication

*“Proceedings of the 2004 American Society for Engineering  
Education Annual Conference & Exposition  
Copyright © 2004, American Society for Engineering Education”*

It is expected that more electives will be added to the program in these and other areas.

A student may also include up to three management courses, which are offered by RIT's College of Business.

Finally, the MSTET program includes a capstone project, which may be a thesis (8 quarter credit hours) or a project (4 quarter credit hours). Students who choose the project option must complete an additional elective, which can be a fourth management course.

Table 2 summarizes the MSTET program requirements for both the thesis and the project option.

**Table 2**

| Thesis Option        |       |   |        |
|----------------------|-------|---|--------|
| Core courses         | 6     | 4 | 24     |
| Technical electives  | 1 – 4 | 4 | 4 – 16 |
| Management electives | 0 – 3 | 4 | 0 – 12 |
| Thesis               |       | 8 | 8      |
| Total                |       |   | 48     |
| Project Option       |       |   |        |
| Core courses         | 6     | 4 | 24     |
| Technical electives  | 1 – 5 | 4 | 4 – 20 |
| Management electives | 0 – 4 | 4 | 0 – 16 |
| Project              |       | 4 | 4      |
| Total                |       |   | 48     |

### Prerequisites

The MSTET program is geared mainly toward graduates of a baccalaureate program in engineering or engineering technology. However, the program is also open to graduates of other baccalaureate programs who have work or other experience in telecommunications. In this case, the applicant is asked to document his or her experience and provide supporting references. In some cases, an applicant may be accepted subject to completion of a bridge program that includes one or more undergraduate telecommunications courses.

Applicants should have the equivalent of an undergraduate GPA of 3.0 or higher. Applicants who do not meet this requirement may be admitted, however, on the basis of GRE scores.

## Market For The Program

The MSTET program is clearly a good choice for people who have completed an undergraduate program in telecommunications engineering technology and want to learn the basic technology in greater depth and to develop expertise in one or more specialties. Several of the current students are in fact graduates of RIT's BS program in TET.

The MSTET program is also a good fit for graduates of other technical BS programs, such as electrical engineering or electrical engineering technology, who would like to prepare further for a career in the telecommunications industry. A number of our current students are graduates of BSEE programs that included courses in communications, signals and systems and wave propagation.

People currently or recently working in the telecommunications or related industries comprise another important market segment. Program admission requirements are flexible and consider the applicants total experience rather than only academic credentials. A person whose undergraduate degree is not directly aligned with telecommunications can still gain admission based on work experience. Also, courses from the RIT undergraduate program can be used as bridge courses to eliminate gaps in a prospective student's background.

The option to enroll as a part-time student and the availability of evening and online courses makes the MSTET program a practical choice for working people.

## Goals Of The Program

The goals of the MSTET are expressed in terms of Intended Program Outcomes (IPOs). Table 3 lists a set of IPOs that have been established for the program. The goal of the program is to develop students into graduates that have these characteristics and capabilities:

**Table 3**

| Intended Program Outcomes |   |
|---------------------------|---|
| 1                         | Demonstrate an appropriate mastery of the knowledge, methods and skills associated with the core program of telecommunications engineering technology |
| 2                         | Demonstrate in-depth mastery of the knowledge, methods and skills associated with a specific area of telecommunications engineering technology        |
| 3                         | Demonstrate the capability to assume a technical or managerial leadership position in the telecommunications industry                                 |
| 4                         | Think critically to identify and solve problems using analytical and experimental tools   |
| 5                         | Communicate in a clear and concise manner using both written and oral communications  |
| 6                         | Develop life long learning skills that ensure technical competency and professional growth  |

In addition, each course in the program has a set of Intended Learning Outcomes (ILOs) that are specific to that course. Most ILOs map into one or more of the IPOs listed in Table 3. For example, one of the ILOs of the Fiber Optic Telecommunications Technology course (a technical elective) is

- Explain qualitatively the operation of light-emitting diodes, laser diodes, photodiodes, optical amplifiers and selected other components of fiber optic telecommunication systems

This ILO supports the second IPO in Table 3.

The faculty in the ECTET Department have recently adopted two methods for measuring success in achieving ILOs:

- Soliciting students' opinion via an end-of-course survey
- Associating exam questions with ILOs and calculating a metric for each ILO based on exam results

If results over time show a consistency between the two methods, we will drop the more complicated second method in favor of surveys.

#### Instructional Formats

It is expected that many students in the MSTET program will be people who are already working in the telecommunications or related industries. Many of these students will be unable to spend significant time on campus because of work requirements or their location. For this reason, the MSTET program is offered in three formats:

*“Proceedings of the 2004 American Society for Engineering  
Education Annual Conference & Exposition  
Copyright © 2004, American Society for Engineering Education”*

- Traditional, on-campus classroom instruction
- Online learning
- Blended format

The first two formats are well-known and RIT has been a leader in online learning for many years. The blended format, however, is a less familiar course delivery environment and merits more discussion.

Blended or hybrid courses typically mix distance learning technology with traditional classroom approaches. For example, one form of a blended course might include a weekly face-to-face meeting in the classroom plus additional contact time via the Internet. The classroom time provides the opportunity for lecture, discussion, questions and answers, laboratory exercises, tests, problem solving or any other activity traditionally done in the classroom. During the remainder of the week, students can use the Internet to interact with the instructor and/or other students, exchange information, receive and submit assignments, etc. In summary, blended learning is an attempt to achieve “the best of both worlds”.

Another version of the blended learning format consists of up to one week of intensive classroom instruction followed by nine weeks of online learning. This might be called the “lumped” rather than “distributed” model of blended learning. The lumped model seems particularly attractive in conjunction with RIT’s plan to offer the MSTET program through Pontificia Universidad Católica MADRE Y MAESTRA (PUCMM) in the Dominican Republic. RIT faculty could spend a short period of time on campus at PUCMM to launch courses and then complete the courses from their offices (or homes) in Rochester (or elsewhere).

#### Comparison With Other Programs

At the time the RIT MSTET program was proposed, the Survey of Telecommunications Programs in the United States listed 24 telecommunications masters degree programs. Two features of RIT’s program contribute to making it unique:

- It is an in-depth, technology-oriented program
- It has evolved from RIT’s undergraduate program in telecommunications engineering technology

Many existing telecommunications programs emphasize management courses as much as or even more than technology courses. Although RIT’s program offers elective courses in management, the bulk of the program is technical. The core courses and technical electives have been developed by the Telecommunications Engineering Technology faculty, resulting in a cohesive offering rather than the multi-disciplinary mix offered by some existing programs.

The link to RIT’s ABET-accredited undergraduate telecommunications program provides several advantages. RIT has more than ten years’ experience in developing and offering

*“Proceedings of the 2004 American Society for Engineering  
Education Annual Conference & Exposition  
Copyright © 2004, American Society for Engineering Education”*

telecommunications courses. In part because of ABET requirements, the program faculty has collected data from students and alumni and used this data to expand and improve the curriculum. Several members of the MSTET program faculty have extensive experience in the undergraduate program and all faculty members have experience in the telecommunications or closely related industries.

In addition, the RIT MSTET program is offered in multiple formats from the traditional classroom to online learning, including the innovative blended format. Thus the program can accommodate students worldwide and be tailored to their personal and professional circumstances.

### Summary And Future Development

The RIT MSTET program is “up and running” and it is likely that by the date of the ASEE 2004 Conference the first RIT Masters Degree in Telecommunications Engineering Technology will have been awarded. Nevertheless, there are still challenges ahead including

- Migrating remaining courses to online or blended format
- Developing new courses
- Establishing assistantships to help support graduate students
- Establishing a BS/MS option for outstanding undergraduates who wish to pursue both degrees simultaneously

The TET faculty are vigorously addressing these challenges and look forward to sharing our experience and learning from others as we proceed.

### Acknowledgements

Many thanks to the RIT TET faculty for their contributions to the MSTET program, especially to Carol Richardson, ECTET Department Chair and Mark Indelicato, chair of the undergraduate TET program. Thanks also to Anthony Trippe for his helpful comments on this paper.

### Bibliography

1. *Proposal for Master of Science in Telecommunications Engineering Technology*, RIT Internal Document, February 15, 2002.
2. Listing of ABET Accredited Programs in Telecommunications Engineering Technology, [www.abet.org](http://www.abet.org)

## Biographical Information

WARREN L. G. KOONTZ is an associate professor in the Department of Electrical, Computer and Telecommunications Technology at Rochester Institute of Technology. Dr. Koontz joined the faculty of RIT after completing a 32-year career with Bell Laboratories.