Program Descriptions

Besides the MS in Telecommunications, we offer accelerated BS/MS degree programs and a number of graduate certificate programs. Each of these programs is described below. The following program descriptions appear in the University Catalog [1]. The catalog is the authoritative source of information for this and any other degree program. It is each student's responsibility to understand the degree requirements and plan their courses accordingly. Students are encouraged to discuss their plan of study with their advisor to ensure that their course selection will meet the degree requirements.

Telecommunications, MS

The innovative, interdisciplinary MS in Telecommunications Program provides a blend of cutting-edge engineering-oriented courses in wireless and fiber communications systems, networks, computers, and Internet protocols, combined with courses on telecommunications policy, law, business, international aspects, and other fields. The interdisciplinary program is designed for students who wish to enter the field of telecommunications or are working in the field and want to advance their knowledge of telecommunications. It concentrates on practical applications of telecommunications rather than on the theoretical approach. It focuses on the engineering and IT aspects of telecommunications, in combination with the interdisciplinary knowledge offered by some of the courses in the former MA in Telecommunications Program, now incorporated in the School of Public Policy's new master's in telecommunications policy. More than 30 new engineering and IT courses have been designed specially for this program, including five certificate programs that may be incorporated into, and taken concurrently with, the MS in telecommunications. Two of the certificates are at an advanced level: the telecommunications forensics and security certificate and the advanced networking protocols for telecommunications certificate.

A novelty of the program is its structure, which consists of five specialty modules corresponding to areas of emphasis. The program offers a mix of 3-credit full-semester courses together with 1.5-credit half-semester courses. This structure allows students to identify more clearly the various specialties in telecommunications technology. Students enjoy considerable flexibility because they are able to design their master's programs to fit their technical preferences, including the option of taking courses in other programs at Mason.

A majority of the course material comes from the Electrical and Computer Engineering (ECE) Department and the Systems Engineering and Operations Research (SEOR) Department. Courses offered by ECE focus on network technologies, such as fiber optics, ATM, and Internet protocols; network applications, such as networked multicomputer systems, client-server architectures, and network management; and wireless communications, such as digital communications, satellite communications, mobile communications, PCS, and GPS.

Unique courses in the telecommunications program, such as Border Gateway Protocols, Interior Gateway Protocols, MPLS, GPS, and Advanced Link Design, complement courses given in ECE programs. In addition to the many new telecommunications courses developed for this program, ECE already offers a number of other graduate courses in communications as part of the graduate electrical engineering and computer engineering programs. Those courses may also be taken for credit under the MS in Telecommunications Program, provided students have the prerequisite background. Courses related to systems engineering, project management, capacity modeling, and business of telecommunications (including the design and optimization of large, complex communication networks) are offered by SEOR. Both SEOR fields, systems engineering and operations research, play significant roles in all aspects of the design, operation, and business of telecommunications, and this knowledge is important for students of telecommunications.

The blend of in-depth knowledge of specific elements of telecommunications technology, combined with knowledge of
broader issues in telecommunications, is increasingly necessary for people who intend to work in a management or decision-making position within the telecommunications industry, telecommunications-related businesses, or government institutions dealing with telecommunications. The MS in telecommunications provides that blend.

Format

The program consists of 9 credits of mandatory engineering and technology core courses (TCOM 500, 521, and 530); 6 credits of electives drawn from an interdisciplinary group of core courses common with the former MA in telecommunications (PUBP 726, LAW 181, and TELE 750 or TCOM 750), and a basic switching lecture and laboratory course (TCOM 514) or an Internet protocol routing lecture and laboratory course (TCOM 515); and five specialty modules (areas of emphasis). Students who enter the program with an undergraduate degree that shows evidence of successfully completing LAN and WAN technologies may substitute TCOM 530 for TCOM 535 in their mandatory core program, respectively. Students must complete 30 credits of course work through a combination of core courses and specialty modules. The core consists of 15 credits, with the remaining 15 credits earned in specialty modules. The specialty modules are subareas of telecommunications that provide the necessary depth in the selected areas of emphasis. Students are usually expected to take courses from at least two specialty modules. Up to 6 credits from the core program may be carried forward into the specialty modules, thus permitting up to 6 credits of electives to be taken inside or outside the prime specialty module chosen by the student. TCOM 530 may be carried forward into specialty module 1, 2, or 3; TCOM 521 may be carried forward into specialty module 4 or 5. Double counting is not permitted, but the courses carried forward into a given module may permit that module’s credit requirement to be satisfied, thus allowing elective courses to be taken outside that module. Usually, a minimum of 6 credits is needed to satisfy one specialty module. Credit for each specialty module can be obtained by taking an appropriate combination of full-semester courses (3 credits) and half-semester courses (1.5 credits). In many cases, a pair of coordinated, half-semester courses (for example, TCOM 608) on fiber optic communications and networks permits students to take a half-semester course to get an introduction to the field or a full-semester course for a more complete knowledge of that topic.

Admission Requirements

Courses are open to students who hold a BS or BA degree from an accredited college or university in engineering, math, science, computer science, business (with a quantitative background), economics, or other analytical disciplines, and students who have equivalent work experience indicating analytical aptitude. Depending on their background, some applicants may be required to complete 3 to 6 credits of preliminary course work before they are allowed to enroll in any of the core courses or specialty courses in the program. Applicants who have not studied mathematics beyond the equivalent of algebra II/trigonometry at high school or introductory calculus classes (such as those offered in business or database management programs) will be required to take TCOM 575, the foundation course that prepares students for TCOM 500, prior to being allowed to take TCOM 500. A minimum undergraduate GPA of 3.00 is usually required.

Students may be admitted to the MS program as degree-seeking students, or they may be admitted for nondegree study within the program, which allows them to take individual courses. Students in the nondegree program may apply to the regular program, provided their GPA within the MS in Telecommunications Program is 3.00 or above. Up to 12 credits earned in nondegree study may be transferred into the regular program, provided each of the courses to be transferred in was passed with a grade of B or above.

Degree Requirements

Students must complete a minimum of 30 graduate credits with a GPA of 3.00 or higher. Students must earn a B (3.00)
or above in core courses TCOM 500, 521, and 530. Up to 6 credits of a combination of C or B- grades may be carried within the program from the remaining core courses or from the specialty module courses, provided the overall GPA is 3.00 or higher. The plan of study includes the following:

Core Courses:

15 credits from the following 21 credits of core courses: Mandatory courses:

- TCOM 500 Modern Telecommunications (3 credits)
- TCOM 521 Systems Engineering for Telecommunications Management (3 credits)
- TCOM 530 Data Communications Fundamentals (3 credits)
- TCOM 535 The TCP/IP Suit of Internet Protocols (3 credits)

*Students must receive prior permission to make the substitution(s). Elective courses (6 credits selected from the following):

- TCOM 547 Project Management in Telecommunications (3 credits)
- PUBP 726 Telecommunications Policy and International Strategies (3 credits)
- TCOM 514 Basic Switching Lecture/Laboratory (3 credits) or TCOM 515 Internet Protocol Routing Lecture/Laboratory (3 credits)*
- TCOM 750 Coordinating Seminar (3 credits)

*Both may be taken for credit, but only one may be used to satisfy the core elective requirement.

Emphasis

Students must take a minimum of 15 credits of courses listed under the following areas of emphasis:

Students usually take 15 credits from at least two of the four emphasis areas, or they may elect to take all 15 credits from the systems engineering of telecommunications area (emphasis 4). Students electing to carry forward a core course (TCOM 530 or TCOM 521) into an appropriate emphasis area have the option of taking an elective course in that area or an alternate area to bring the total number of credits in the emphasis area to 15.

An area of emphasis can be completed by courses listed under the emphasis or considered applicable to that area for a total of at least 6 credits. Some emphasis courses are in more than one area; for example, TCOM 535 is in emphasis 1, network technologies, and emphasis 2, network applications.

Basic courses in each emphasis have been specially designed for the telecommunications program. These courses do not require completion of prerequisites from other MS programs in the Volgenau School. Other courses, which are marked with asterisks, are from other MS programs in the Volgenau School and represent viable options for students who have appropriate prerequisites in some technical areas. Although these courses assume certain prerequisites from their specific MS programs, advanced students who already know the prerequisite material can seek instructor permission to enroll in those courses.

Alternatives to completing each emphasis area by using appropriate combinations of courses not listed under a given module may be admissible subject to prior approval by the program director. In addition, independent study, reading, and research courses may be taken in all five areas. These courses permit students to make use of their work experiences to undertake non-classroom courses for credit within the program.
Mason has negotiated an articulation agreement with the University of Virginia that allows up to 12 credits of the Informational Systems Management Certificate Program from the University of Virginia to be transferred into emphasis area 4 of the TCOM Program. In addition, graduate students from the National Defense University (NDU) may transfer up to 9 credits from NDU’s Information Security Certificate Program.

A capstone project course, **TCOM 699** [2], is required under the systems engineering of telecommunications area (emphasis 4) should the student elect to take all 15 credits in this area.

**Specialty Modules**

Courses marked with asterisks are courses from other graduate programs in the Volgenau School that can be taken for credit in this program if the student has the appropriate prerequisites. Other courses from other programs may be taken for credit, with prior approval. **Module 1, Network Technologies** TCOM 504, 505, 510, 515, 535, 551, 561, 562, 608, 609, 610, 631, 660, 661, 663; ECE 513*, 542*, 565*, 642*, 643*; CS 571*, 656*, 756* **Module 2, Network Applications** TCOM 505, 510, 515, 535, 540, 541, 555, 561, 562, 603, 608, 609, 610, 611, 631, 660, 662, 663; ECE 646*; CS 656*, 756*; INFS 612*, 640*, 762* **Module 3, Wireless Communications** TCOM 506, 517, 518, 551, 552, 562, 606, 607, 608, 660, 707; ECE 732*, 739*, 763*, 741* **Module 4, Modeling of Telecommunications Systems** TCOM 540, 541, 542, 545, 546, 547, 561, 562, 699; OR 641*, 642*, 644* **Module 5, Systems Engineering of Telecommunications** This module can be taken as one of two specialty modules or as one 15-credit module. No more than two SYST courses can be taken within this module. TCOM 520, 546, 561, 699; SYST 510*, 513*, 520*, 542*, 562; INFS 612*, 614*, 640*; ITRN 772*

**Accelerated MS in Telecommunications Programs**

These degree program may be taken as part of an accelerated MS in Telecommunications Program with three undergraduate degree programs: BS in systems engineering, computer science, information technology, and integrative studies. The four accelerated MS/BS programs are described below.

**BS in Systems Engineering/ Accelerated MS in Telecommunications**

Students in the BS in Systems Engineering Program may elect to enter an accelerated MS in Telecommunications Program while they are undergraduate students. The program is designed for qualified undergraduate students in the systems engineering program who would like to proceed directly into the MS program, completing the two degrees with 144 credits. Students must satisfy requirements for the BS (120 credits) and the MS (30 credits), with 6 credits of overlap permitted. The MS is on an accelerated track, with 6 credits taken as an undergraduate and 24 credits completed as a graduate student. The 6 undergraduate credits must be selected from those given in the listing that follows. Applicants must be Mason undergraduate students who preferably have chosen to take the systems engineering of telecommunications elective sequence. Other students will be considered on their individual merit. Students may apply for the accelerated program during a semester after which they will have completed 90 or more credits applicable toward the BS in systems engineering as an undergraduate. Students must have an overall GPA of at least 3.25 to apply for the program. Students who have not yet finished 90 credits may be accepted provisionally subject to satisfactory completion of 90 credits. Criteria for admission are identical to criteria for admission into the MS in Telecommunications Program, except that students do not need to have completed an undergraduate degree prior to admission into the accelerated program. Accepted students must maintain a minimum 3.25 GPA in the undergraduate segment of the accelerated program and a 3.00 GPA in the graduate segment. That is, students who have been accepted into the program must maintain a 3.25 average until they have satisfied all requirements for the BS in systems engineering. They must then maintain a minimum 3.00 GPA in the graduate segment. Should their GPA
BS in Information Technology/ Accelerated MS in Telecommunications

Students in the BS in Information Technology Program may elect to enter the Accelerated MS in Telecommunications (MS in TCOM) Program while they are undergraduate students. The accelerated program is designed for qualified undergraduate students in the information technology program who would like to proceed directly into the MS in TCOM Program, completing the two degrees with 144 credits. Students must satisfy requirements for the undergraduate degree (120 credits) and the MS degree (30 credits), with 6 credits of overlap permitted. The MS in TCOM is on an accelerated track, with 6 credits taken as an undergraduate and 24 credits as a graduate student. The 6 undergraduate credits must be selected from those given in the listing that follows and will be substituted for BS degree concentration electives, subject to prior approval by an advisor.

Students may apply for the accelerated program during the semester after which they will have completed 90 or more credits applicable toward the BS degree. Students must have an overall GPA of at least 3.25 to apply for the program. Students who have not yet finished 90 credits may be accepted provisionally subject to satisfactory completion of 90 credits. Criteria for admission into the accelerated program are identical to criteria for admission into the MS in TCOM Program, except that students do not need to have completed an undergraduate degree prior to admission. Accepted students must maintain a minimum 3.25 GPA in the undergraduate segment of the accelerated program and a 3.00 GPA in the graduate segment. That is, after students have been accepted into the accelerated program, they must maintain a 3.25 GPA until they have satisfied requirements for the undergraduate degree. They must then maintain a minimum 3.00 GPA in the graduate segment of the accelerated program. Should their GPA fall below 3.00 while a graduate student, they will be dropped from the accelerated program to the regular program. If students are dropped from the accelerated program and have taken and applied TCOM core courses toward the BS degree, then they need not repeat those courses for the regular MS in TCOM Program if they obtained a grade of B or higher in those courses. But they will need to take elective courses in their place to satisfy the 30-credit requirement for the regular MS in telecommunications.

Note: Up to 6 credits of a combination of C or B- grades may be carried in portions of the regular telecommunications program. A minimum GPA of 3.00 is required to graduate with an MS in telecommunications. Students must complete all requirements for the BS in systems engineering. Students in the accelerated program must apply to have the BS degree conferred the semester before they expect to complete the BS requirements. The MS in telecommunications is granted on completion of all requirements for the accelerated degree. Telecommunications courses that may be taken as a systems engineering undergraduate student as part of the accelerated program are TCOM 500, 530; OR 541; and SYST 530 and 573. SYST 573, if taken, replaces TCOM 521 in the telecommunications core requirements.
listing below. **Note:** All of the prerequisite courses indicated below must be passed with a grade of B or higher.

**Telecommunications courses:**

- TCOM 500 Modern Telecommunications
- TCOM 504 Asynchronous Transfer Mode Network (prerequisites: TCOM 530, IT 341, or equivalent)
- TCOM 505 Networked Multicomputer Systems (prerequisite: TCOM 530, IT 341, or equivalent)
- TCOM 510 Client Server Architectures and Applications (prerequisite: TCOM 505)
- TCOM 530 Data Communications Fundamentals (prerequisite: acceptance into the Accelerated BSIT/ MS TCOM Program)
- TCOM 535 The TCP/IP Suit of Internet Protocols (prerequisites: TCOM 530, IT 341, or equivalent)
- TCOM 551 Digital Communication Systems (prerequisite: TCOM 500 or equivalent)
- TCOM 607 Satellite Communications (prerequisite: TCOM 551, ECE 463, or equivalent)
- TCOM 608 Optical Communications Systems (prerequisite: TCOM 500 or equivalent)
- TCOM 631 Voice over IP (prerequisites: TCOM 535, IT 341, or equivalent)

**Note:** Students in the accelerated program who have passed IT 341 with a grade of B or higher will not be required to take TCOM 530 in the MS in TCOM core and may take an elective instead.

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**BIS/ Accelerated MS in Telecommunications**

Students who are in the Bachelor of Individualized Study (BIS) Program may elect to enter an Accelerated MS in TCOM Program while they are undergraduate students. The accelerated program is designed for qualified undergraduate students in the BIS Program who would like to proceed directly into the MS in TCOM Program, completing the two degrees with 144 credits. Accelerated students must satisfy requirements for the BIS (including 120 credits) and the MS (30 credits), with 6 credits of overlap permitted. The MS in TCOM is on an accelerated track, with 6 credits taken as an undergraduate and 24 credits as a graduate student. The 6 undergraduate credits must be selected from those given in the table that follows and will be substituted for BIS concentration courses, subject to prior approval by a BIS advisor. Note: Accelerated students must take ECE 301 or 303 as one of their BIS concentration courses. Applicants must be Mason undergraduate students in the BIS Program. Students may apply for the accelerated program during the semester after which they will have completed 90 or more credits and 15 Mason resident credits applicable toward the BIS as an undergraduate. Students must have an overall GPA of at least 3.25 to apply for the program. Students who have not yet finished 90 credits may be accepted provisionally subject to satisfactory completion of 90 credits. Criteria for admission are identical to criteria for admission into the MS in TCOM Program, except that students do not need to have completed an undergraduate degree prior to admission into the accelerated program. Students who have been accepted into the accelerated program must maintain a minimum 3.25 GPA in the undergraduate segment of the accelerated program and a 3.00 GPA in the graduate segment. That is, after students have been accepted into the accelerated program, they must maintain a 3.25 GPA until they have satisfied all requirements for the BIS degree. They must then maintain a minimum 3.00 GPA in the graduate segment of the accelerated program. Should their GPA fall below 3.00 while a graduate student, they will be dropped from the accelerated program to the regular program, and those graduate TCOM courses taken and applied to their BIS Program will no longer be admissible for their MS in TCOM degree. If students are dropped from the accelerated program and they have taken and applied TCOM core courses toward their BIS degree, then they do not need to repeat those courses for the regular MS in TCOM Program if they obtained a grade of B or above in those courses. But they need to take elective courses in their place to satisfy the 30-credit requirement for the regular MS in TCOM. Similarly, if students are dropped from the accelerated program and they have taken and applied noncore TCOM courses toward their BIS degree, they do not need to repeat those courses for the regular MS in TCOM Program if they obtained a C grade or above for those courses. Elective courses will be required to replace TCOM courses already taken and applied to the BIS Program. **Note:** Up to two C grades may be carried in the regular TCOM Program in nonmandatory core courses. A minimum GPA of 3.00 is required to graduate with an MS in TCOM. Students must complete all requirements for the BIS degree. Students in the accelerated program must apply to have the BIS degree conferred the semester before they expect to complete BIS requirements. The MS in TCOM is granted on completion.
of all requirements for the accelerated degree. TCOM courses that may be taken by a BIS undergraduate student as part of the accelerated program are given in the table below. **Note:** All of the prerequisite courses indicated below must be passed with a grade of B or higher. **Telecommunications courses:**

- TCOM 500 Modern Telecommunications
- TCOM 504 Asynchronous Transfer Mode Network (prerequisites: TCOM 530, IT 341, or equivalent)
- TCOM 505 Networked Multicomputer Systems (prerequisites: TCOM 530, IT 341, or equivalent)
- TCOM 510 Client Server Architectures and Applications (prerequisite: TCOM 505)
- TCOM 530 Data Communications Fundamentals (prerequisite: acceptance to accelerated program)
- TCOM 535 The TCP/IP Suit of Internet Protocols (prerequisites: TCOM 530, IT 341, or equivalent)
- TCOM 551 Digital Communication Systems (prerequisite: TCOM 500 or equivalent)
- TCOM 607 Satellite Communications (prerequisites: ECE 463, TCOM 551, or equivalent)
- TCOM 608 Optical Communications Systems (prerequisite: TCOM 500 or equivalent)
- TCOM 631 Voice over IP (prerequisites: TCOM 535, IT 341, or equivalent)

**Note:** Accelerated students who have passed IT 341 with a grade of B or higher will not be required to take TCOM 530 in the MS in TCOM core. They may take an elective instead. Other TCOM courses may be approved on a case-by-case basis. **Required Credits:**

- BIS Concentration: 34–46
- BIS 300/390/490/491: 10
- ECE 301 Digital Electronics or ECE 303: 3
- IT 212 How Computers Work: 3
- IT 341 Network/Operating: 3
- TCOM 500 Modern Telecommunications: 3
- Additional 500-level TCOM course: 3

Plus an additional 9 to 21 credits to reach required number.

**Telecommunications Certificates**

Four 15-credit certificates are offered by the MS in TCOM Program. Students may take these certificates as stand-alone items or as part of their degree program. For the former, they are required to enroll in a certificate program; for the latter, because they are already enrolled in a degree program, they need only apply for the appropriate certificate after they have satisfied requirements. The courses within the certificates are drawn directly from the MS in TCOM Program. If a student initially signs up for only a certificate program, it is possible to apply to the degree program later, if accepted to the program, students may transfer up to 12 credits into the degree program as long as the coursework previously taken doesn't exceed six years. Students must therefore ensure they are admitted to into the degree program prior to starting course work beyond 12 credits in the certificate program to ensure that all credits from the certificate program transfer into the degree program. Students may transfer in one 3-credit course from another program or institution toward their TCOM certificate, provided the course in question was passed with a B grade or higher. Students are permitted to carry one C grade within their certificate program, provided the overall GPA is 3.00 or above.

**Certificate in Advanced Networking Protocols for Telecommunications**

CERG-ANPT This certificate provides an in-depth understanding of advanced protocols used in a variety of
telecommunications networks. To obtain the certificate, students must complete the following for a total of 15 credits:

**Core Courses** Choose 9 credits from the following:

- TCOM 515 Internet Protocol Routing (3 credits) or TCOM 535 Data Communications Fundamentals (3 credits)
- TCOM 609 Interior Gateway Protocols (IGP) (3 credits)
- TCOM 610 Border Gateway Protocols (BGP) (3 credits)

**Elective Courses** Choose 6 credits from following:

- TCOM 515 Internet Protocol Routing (3 credits)
- TCOM 535 Data Communications Fundamentals (3 credits)
- TCOM 611 Multiple Protocol Label Switching (MPLS) (3 credits)
- TCOM 631 Voice Over IP (3 credits)
- TCOM 662 Advanced Secure Networking (3 credits)

*Note:* TCOM 515 and TCOM 535 cannot be taken twice for credit. If any of these courses is taken in the core element, it cannot be taken again in the elective element.

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**Certificate in Network Technologies and Applications**

**CERG-NETT** The certificate provides a broad understanding of the technologies used in telecommunications networks and the various applications of telecommunications networks. To obtain the certificate, students must complete the following, for a total of 15 credits: **Core Courses** Choose 9 credits from the following:

- TCOM 504 Asynchronous Transfer Mode Networks (1.5 credits)
- TCOM 505 Networked Multicomputer Systems (1.5 credits)
- TCOM 510 Client-Server Architectures and Applications (1.5 credits)
- TCOM 535 The TCP/IP Suit of Internet Protocols (3 credits)
- TCOM 555 Network Management (3 credits)
- TCOM 631 Voice over IP (3 credits)

**Elective Courses** Six credits are required. Students may elect to take any additional 6 credits from specialty modules 1, 2, and 3, including those in the mandatory course list that are not part of the 9 credits of core courses for the certificate.

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**Certificate in Telecommunications Forensics and Security**

**CERG-TFAS** The objective of this certificate is to provide an in-depth understanding of security and forensics as they apply to networks and digital storage media. Students must complete the following for a total of 15 credits: **Core Courses** Choose 9 credits from the following:

- TCOM 515 Internet Protocol Routing (3 credits) or TCOM 561 Security, Privacy, and Applied Cryptography for Telecommunications (3 credits)
- TCOM 562 Network Security Fundamentals (3 credits) or ISA 562 Information Systems Security (3 credits)
- TCOM 660 Network Forensics (3 credits), TCOM 661 Digital Media Forensics (3 credits), or TCOM 663 Operations of Intrusion Detection for Forensics
Elective Courses Choose 6 credits from the following:

- ISA 562 Information Systems Security (formerly ISA 662, and prior to that INFS 762; 3 credits)
- TCOM 660 Network Forensics (3 credits)
- TCOM 661 Digital Media Forensics (3 credits)
- TCOM 662 Advanced Secure Networking (3 credits)
- TCOM 663 Operations of Intrusion Detection for Forensics (3 credits)

Note: TCOM 660, 661, and 663 cannot be taken twice for credit. If any of these courses is taken in the core element, it cannot be taken again in the elective element.

Certificate in Wireless Communications

CERG-WIRE This certificate provides a broad understanding of the technologies, applications, and systems used in all forms of wireless communications. Students must complete the following, for a total of 15 credits: Core Courses

Choose 9 credits from the following:

- TCOM 551 Digital Communications Systems (3 credits)
- TCOM 552 Introduction to Mobile Communication (3 credits)
- TCOM 606 Advanced Mobile Communications
- TCOM 607 Satellite Communications (3 credits)
- TCOM 653 Global Positioning System (GPS) (3 credits)

Elective Courses Six credits are required. Students may earn the credits from specialty modules 1, 2, and 3, including those in the mandatory course list that are not part of the 9 credits of core courses for the certificate.

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