

M.S. with a Major in Telecommunications and Network Engineering

Candidates must satisfy a total of 30 credit hours (CH) with a minimum G.P.A. of 3.000 on a 4.000 scale.

All students must complete 9 credit hours (CH) of the core curriculum.

EETS 7301 Introduction to Telecommunications

Overview of public and private telecommunications systems, traffic engineering, switching, transmission, and signaling. Channel capacity, media characteristics, Fourier analysis and harmonics, modulation, electromagnetic wave propagation and antennas, modems and interfaces, and digital transmission systems. DSL technologies, digital microwave, satellites, fiber optics and SONET, and Integrated Services Digital Networks.

EETS 7304 Network Protocols

This course is an introductory graduate course on the protocol architecture of the Internet, following a bottom-up approach to the protocol layers. The objective of this core course is to provide an understanding of the internetworking concepts in preparation for advanced networking courses. The first part of the course covers networking technologies such as local area networks, packet switching, and ATM. The second part of the course examines the Internet protocol (IP) and TCP/UDP in-depth. The last part of the course is an overview of important application protocols such as HTTP, client/server computing, SMTP, FTP, and SNMP.

Prerequisite: EETS 7301 or equivalent.

EETS 8303 Switching and Routing

Explains switching and routing architectures, protocols, and functions. For switching, covers Spanning Tree Protocol (STP) and virtual LANs (VLANs). Examines dynamic routing protocols, including RIP (versions 1 and 2), OSPF, IS-IS, BGP, and Cisco's EIGRP. Analyzes IP subnetworks with and without classes. Also, uses simulation tools to analyze the operation and performance of different protocols. *Prerequisite:* EETS 7304 or permission of the instructor.

All students must complete 21 credit hours (CH) of advanced electives.

EETS 7305 Telecommunication Regulation

This course reviews the evolution of telecommunications in the United States and investigates current regulatory topics, including Internet and international regulation. It relates regulatory decisions to real-world issues such as telecommunications services acquisition and pricing. Also, investigates topics that include both domestic and international components, including regulation of the electromagnetic spectrum and standards organization.

EETS 7316 Wireless, Cellular and Personal Telecommunications

A comprehensive course in the fast-developing field of wireless mobile/cellular and personal telecommunications. Topics include mobile/cellular communications; frequency allocations; base station site selection; cellular structures; channel trunking; analog cellular signaling; handover; data over cellular; multipath fading; diversity reception; modulation techniques; speech coding; digital cellular design, including GSM and TDMA; spectral efficiency considerations; spectral management and regulations; roaming; and current world systems and standards. Topics on personal communications include basic concepts and terminology for PCS; PCS technology; design based on GSM, TDMA, and CDMA; spectrum sharing with other services such as FMS; PCS standards; intelligent networks for PCS; global challenges for PCS; third-generation wireless, number portability, and roaming; and satellites in wireless. *Prerequisites:* EETS 7301 and EE 5370 or EE7370, or permission of the instructor. This course is primarily for the telecommunications program but can also be very useful for EE students who plan to specialize in this field.

EETS 7341 Fiber Optic Telecommunications

This is an introductory course designed to familiarize students with practical concepts involved in optical fiber communications systems. Basic optical principles are reviewed. Dielectric-slab waveguides, fiber waveguides, and integrated optics devices are discussed. The major component of a fiber communications link, including optical sources, detectors, and fibers, are covered.

EE 8304 Multiprotocol Label Switching

This course examines the Multiprotocol Label Switching (MPLS) protocol and its applications in networks and has three parts. Part I part introduces the basics of MPLS as well as MPLS Traffic Engineering (TE), DiffServ Quality of Service and network survivability. Part II investigates Layer 2 and Layer 3 MPLS Virtual Private Networks (VPNs). Part III covers MPLS management, access networks, MPLS-Transport Profile (MPLS-TP) and GMPLS. *Prerequisite:* EETS 7304.

EETS 8305 Telecommunications Software Design

Comprehensive course to familiarize telecommunications professionals with the state-of-the-art software concepts and technology in modern telecommunications applications. Focus on software process modeling, user interface design, CASE Tool, reusability, quality assurance, reliability, distributed computing, real-time operating system and database and understanding of Real Time Object-Oriented Modeling (ROOM) in analysis and design, high-level programming language design concepts such as C++ as required in telecommunications software development. Heavy emphasis on real-world applications topics including Central Office (CO) or Private Branch Exchange (PBX) switch, Computer Telephone Integration (CTI), LAN-to-WAN Node Processor, Advanced Intelligent Network (AIN), Cellular/Personal Communications Service (PCS), Asynchronous Transfer Mode (ATM), Integrated Services Digital Network (ISDN), and demonstration of ObjecTime, a Real-Time Object-Oriented Modeling software tool. *Prerequisites:* EETS 7301 or permission of the instructor, plus knowledge of one high-level programming language, preferably Pascal, C, or C++.

EETS 8311 Intelligent Networks

A comprehensive course in providing broad knowledge in IN by exploring the theoretical network/call models of the ITU-T and ANSI and practical experiences of implementing IN technologies and services. Important IN elements such as the Service Creation Environment (SCE), Service Management Systems (SMS), Service Control Point (SCP), Signal Transfer Point (STP), Service Switching Point (SSP), Intelligent Peripheral (IP) will be explained in details. Implementation scenarios for IN elements starting with the ITU-T Service Independent Building Blocks (SIB) to actual service deployment will be described. Harmonization in IN with Telecommunications Management Network (TMN), the future of IN with migration to Telecommunication Information Networking Architecture (TI-NA), and hurdles to IN—e.g., feature interaction, Local Number Portability (LNP) example, and IN/IP/CTI integration—will be covered. Live demos of IN service creation and execution will be available. *Prerequisite:* EETS 5301 or permission of the instructor.

EETS 8313 Internet Telephony

Provides a comprehensive introduction to the background, protocols, standards, and issues related to Internet telephony. Describes the changing telecommunications environment that motivates the transition from today's telephone network to voice over IP and strategies being used by companies and individuals to implement VoIP. Covers the umbrella protocol Session Internet Protocol and its partner, Session Description Protocol. In addition to SIP and SDP, H.323, RSVP, RTP, DNS, TRIP, ISUP, and SS7 are covered. Issues include emergency services, security, mobility, and quality service. On-campus students—and off-campus students with high-speed Internet access—have access to SIP lab equipment. *Prerequisite:* EETS 7301 or permission of the instructor.

EETS 8315 Advanced Topics in Wireless Communications

This course focuses on third generation systems, wireless data, and emerging wireless systems and technologies. It covers the IMT2000 requirements, proposals and evolution path for CDMA and TDMA technologies towards 3G. Detailed study of Radio Access network for the GPRS (General Pack Radio Services), EDGE (Enhanced Data for Global TDMA Evolution), WVDMA and CDMA2000 as well as core network evolution. It will also cover second generation wireless data systems such as CDPD (Cellular Digital Packet Data), and SMS (Short Message Services). Mobile IP and Wireless Application Protocol (WAP) are also covered in this class. Some other topics that may be covered include LMDS, WLL, Indoor systems, cordless phones, and WLAN.

EETS 8316 Wireless Networks

Provides a comprehensive introduction to various transport layer protocols, especially focusing on wireless networks. The course begins with a study of various traffic scenarios in different elements of a wireless networks, then looks at various applications using 3G, and finishes with a discussion of methods for performance monitoring and network testing. *Prerequisite:* EETS 7316 (Formerly EETS 7306).

EETS 8317 Switching and QoS Management in IP Networks

Comprehensive course on Internet Protocol (IP) switching and Quality of Service (QoS) management technology, protocols and applications.

EETS 8321 Telecommunications Network Security

Graduate-level survey of the technologies underlying network security. The first part of the course covers the principles of private and public key cryptography and describes a number of examples encryption algorithms, including DES and AES. Next, the use of encryption with hash functions for digital signatures and certificates, followed by perimeter security, including firewalls, intrusion detection systems, viruses, and worms. The last part of the course encompasses a number of secure protocols, including secure email, secure HTTP, IPSec, and virtual private networks. Topics that are part of general security but peripheral to network security are not covered, e.g., physical tamper resistance, security policies, digital rights management, and biometrics.

EETS 8322 Data Compression for Multimedia Applications

Provides an introduction to techniques for efficient compression and coding of audio and video signals for multimedia applications. Topics covered include speech and vision models, sampling and quantization of one- and two-dimensional signals, coding techniques for audio and video signals, and existing and evolving standards for audio and video coding. *Prerequisite:* Permission of the instructor.

EETS 8331 Network Analysis, Architecture and Design

A focus on the systematic process of network design. The course explains the process of gathering network requirements and covers data flow analysis and the selection of network architectures. Also, addressing and routing, network management, network performance criteria, and security and privacy architecture selection methods. These techniques are merged to create a complete network design framework. *Prerequisite:* EETS 7304 or permission of the instructor.

EETS 8332 Advanced Network Design

This capstone course provides a holistic view of network design practices. It begins with a review of network design fundamentals such as conventional and VoIP voice networks, data networks, and queuing theory, MPLS, and optical network design methods. These methods are integrated to accomplish and analyze networks from a multilayer network design perspective. A significant portion of the course focuses on completing a complex network design using state-of-the-art software tools. *Prerequisite:* EETS 8331.

EETS 8337 Telecommunications Network Management

Comprehensive course in the important issues in telecommunications network management. Overview of the underlying principles—operations, administration, maintenance, and provisioning—that are often the most expensive and labor-intensive aspects of telecommunications. Includes different paradigms of network management such as the Internet Simple Network Management Protocol (SNMP, SNMPv2) and the Open System Interconnection Common Management information protocol. Covers the object-oriented modeling approach such as the ITU-T Telecommunications Management Network and Bellcore's Information Networking Architecture. Also, implementation issues of architectural concepts into network products and systems such as the translation from ISO Guidelines for the Definition of Managed Objects in C++. Network simulation, configuration, fault, security, accounting, performance management, and the quality of service concepts. Addresses drivers for network management and its traditional practice, as well as future needs, and includes case studies in Intelligent Network and Synchronous Optical Network. *Prerequisites:* EETS 8305 or permission of the instructor, plus knowledge of one high-level programming language, preferably Pascal, C or C++.

EETS 8341 Optical and DWDM Networks

Discusses the operation of the following network types: Synchronous Optical Network, Synchronous Digital Hierarchy, and Optical Transport Network. Also, optical core and access network configurations. Introduction to WDM network elements and control and management of optical networks, plus an overview of network survivability using optical technologies. Covers future optical technologies, including photonic packet switching. Students use simulation software in laboratory experiments to analyze the performance and operation of optical networks. *Prerequisite:* EETS 7304 or permission of the instructor.

All students can select additional electives depending on the specialization.

Network Design
Engineering Management

Wireless Networks
Software Engineering