Course Descriptions

Internet Architecture and Protocols
This course introduces the student to some basic local area networking technologies and protocols in a set of lectures and laboratory experiments. Link level protocols. Local area networks: CSMA/CD, Token Ring, IEEE standards and protocols. The Internet protocol suite: IP, ARP, RARP, ICMP, UDP, and TCP. LAN interconnection: bridges, routers and gateways. Application protocols: SNMP, PTP, SMTP and NPS.

Principles of Digital Communication

Wireless Communications

Local and Metropolitan Area Networks
The objective of the course is to teach established and emerging protocols and technologies used in both wireline and wireless local and metropolitan area networks. Basic knowledge of networks, standard LAN technologies such as Ethernet, and TCP/IP is assumed. Topics to be included are: IP route lookup, packet forwarding, classification, and switching learned in the class are included. Switching node location, network reliability analysis, application of minimum spanning tree and shortest path algorithms to problems in network design, distributed network design, case studies.

High-Speed Networks
This course addresses the basics, the theory, architectures, and technologies to implement high-performance, high-speed, large-scale routers and switches. The fundamental concepts and technologies of packet forwarding, classification, and switching learned in the class are useful and practical when designing IP routers, ethernet switches, and optical switches. Topics to be included are: IP route lookup, packet classification, packet scheduling, buffer management, basics of packet switching, input-buffered switches, shared-memory switches, crosspoint buffered switches, input-buffered switches, cross-network switches, multi-stage buffered switches, two-stage load-balanced switches, optical packet switches, and ASIC for IP routers.

Project Management
Half-semester course provides students with practical and best practice project management theory, concepts and hands-on practical experience to effectively contribute in and lead multi-cultural team projects framed for the new global economy. The practical component includes a team-based project that runs throughout the duration of the course.

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Communications Networks I
The purpose of this course is to introduce students to the analytical techniques used in the design and performance analysis of networks. Building on their knowledge of networking technology and applied mathematics, especially probability, students will start by learning basic queuing theory. This will be applied to the performance analysis of multiplexers, switches, and multiple access networks. Newer techniques such as network calculus, the study of non-Poissonian long-range dependent traffic sources, and applications to TCP, admission control, advanced packet switches and IEEE 802.11 networks will be introduced.

Communications Networks II
Principles of network design, network design algorithms, centralized network design, static and dynamic routing algorithms, concentration and switching node location, network reliability analysis, application of minimum spanning tree and shortest path algorithms to problems in network design, distributed network design, case studies.

High-Performance Routers and Switches
This course introduces the student to some basic local area networking technologies and protocols in a set of lectures and laboratory experiments. Link level protocols. Local area networks: CSMA/CD, Token Ring, IEEE standards and protocols. The Internet protocol suite: IP, ARP, RARP, ICMP, UDP and TCP. LAN interconnection: bridges, routers and gateways. Application protocols: SNMP, PTP, SMTP and NPS.

Principles of Digital Communication

Wireless Communications

Local and Metropolitan Area Networks
The objective of the course is to teach established and emerging protocols and technologies used in both wireline and wireless local and metropolitan area networks. Basic knowledge of networks, standard LAN technologies such as Ethernet, and TCP/IP is assumed. Topics to be included are: IP route lookup, packet forwarding, classification, and switching learned in the class are included. Switching node location, network reliability analysis, application of minimum spanning tree and shortest path algorithms to problems in network design, distributed network design, case studies.

High-Speed Networks
This course covers the basics, architectures, protocols, and technologies for high-speed networks. Topics to be included are: synchronous optical network (SONET), asynchronous transfer mode (ATM), ATM adaptation layer (AAL), DS-1 (DS1), 10Gbps Ethernet, Ethernet over SONET (EOS), quality of service control, packet scheduling, network processor, flow and congestion control, TCP, high-speed TCP and XCP. Routing and IP forwarding, WDM networks, MPLS and GMPLS. Each student is also required to complete a project that could be reading, software design or hardware design.
Master of Science & Certificate Degree Program at Westchester

Overview
Telecommunications is a rapidly growing field. From the military communications networks of the early 1950s, telecommunications technology has evolved to find applications in almost all areas of modern society including, banking, reservation systems, office information systems, corporate networks and the Internet and World Wide Web. Recent challenges include gigabit optical networks, multimedia communications and wireless network access. The rapid evolution of telecommunications technology demands a broad educational background including today’s technological breakthroughs. Polytechnic’s master’s program in telecommunication networks contains a wide variety of courses ranging from fundamental topics to recent technological advances.

The Master of Science in Telecommunication Networks trains students to understand, design, manage and operate telecommunication networks. The unique features of the program are an exceptionally wide range of course offerings in telecommunications and graduate laboratory courses in networking offering hands-on experience.

Admissions Requirements
Admission to the Master of Science in Telecommunication Networks Program requires an undergraduate degree in computer science, computer engineering or electrical engineering, with a superior undergraduate record from an accredited institution. The Graduate Record Exam (GRE) is recommended. Applicants having comparable degrees in other fields will be considered for admission on an individual basis. Generally, entering students are expected to have a basic knowledge of computer fundamentals, such as programming in C++, data structures and computer architecture.

Students having superior academic credentials but lacking sufficient background are admitted with conditional status pending satisfactory completion of several individually specified preparatory courses. These preparatory courses include CS 5303 Introduction to Programming CS 5303 Data Structures and Algorithms.

No credit will be awarded for any of the preparatory courses toward the degree.

Graduate Certificate in Telecommunication Network Management

The explosive growth of data networks has brought with it the need for effective network management. The widespread deployment of standards-based solutions (e.g., SNMP) is but a first step in dealing with the complexity of network management. A thorough knowledge of network protocols and network management standards is necessary for any practitioner in this area. The program consists of four required courses. This certificate can be finished partially or completely online.

Certificate in Cyber Security

As a National Security Agency designated Center of Academic Excellence in Information Assurance, Polytechnic is offering NSA-approved certificates in information assurance. The certificates are awarded to students who are pursuing a bachelor’s or master’s degree in computer science, computer engineering, telecommunication or electrical engineering at the University and have completed specific course requirements.

MS Telecommunication Networks Required Core Courses

EL 5363 Principles of Communication Networks

In addition, students are required to take four out of the course choices listed below.

EL 5373 Internet Architecture and Protocols or
CS 6843 Computer Network Protocols and Applications or
EL 6373 Local and Metropolitan Area Networks or
EL 6383 High-Speed Networks or
CS 6133 Computer Architecture I or
CS 6233 Operating Systems I or
EL 6273 Performance Evaluation of Computer Systems or
EL 7353 Communications Networks I or
CS 6823 Network Security

Project Requirement

A project course, either CS 6873 Project in Telecommunication Networks or EL 9953 Advanced Project I is required.

Program Elective Courses

Students are required to take four courses from the following:

CS 6003/6043 Design & Analysis Algorithms I/II
CS 6133/6143 Computer Architecture I/II
CS 6233/6243 Operating Systems I/II
CS 6063 Software Engineering I
CS 6083 Principles of Database Systems
CS 9053 Introduction to Java Programming
EL 6013 Principles of Digital Communication
EL 6023 Wireless Communications
EL 6063 Information Theory
EL 6103 Probability
EL 6383 High-Speed Networks
EL 6394 Advanced Network Security
EL 7353 Communications Networks I
EL 7363 Communications Networks II
EL 7374 High-Performance Routers and Switches
MG 8203 Project Management

Graduate Certificate in Telecommunication Network Management

Certificate Course Requirements

Students are required to take four courses as shown:

CS 6843 Network Protocols I
CS 6853 Information, Privacy and Security or
CS 6823 Network Management and Security
EL 5363 Principles of Communication Networks
EL 5373 Internet Architecture and Protocols or
EL 6373 Local and Metropolitan Area Networks

Certificate in Cyber Security

NSTISSI 4011: Information Security Professional Course Requirements

Students are required to take the following nine courses:

CS 5403 Data Structures and Algorithms
CS 6133 Computer Architecture
CS 6233 Operating Systems
CS 6373 Programming Languages
CS 6843 Computer Networks
CS 6813 Information, Privacy and Security
CS 6823 Network Management and Security
CS 6904 Information Security Management
EL 5363 Principles of Communication Networks

Course Descriptions

Performance Evaluation of Computer Systems

Modeling and performance analysis of computer systems. Introduction to queuing network models and elements of queuing analysis. Exact and approximate analytical techniques, simulation and operation analysis. Examples in modeling multiprocessing operating systems, interactive networks and flow control in computer networks.

Information Security Management

The primary goal of this course is to present a system and management view of information security: what it is, what drives the requirements for information security, how to integrate it into the systems design process, and life cycle security management of information systems. A second goal is to cover basic federal government information systems policies and methodologies. Topics covered include information security risk management, security policies, security in the systems engineering process, laws related to information security, and management of deployed systems.

Information, Privacy and Security

Introduction to security and privacy issues associated with information systems. Cost-risk tradeoffs. Technical, physical and administrative methods of providing security. Control of access through technical and physical means. Identification and authentication. Encryption, including the Data Encryption Standard (DES) and public key systems. Management of encryption systems, including key protection and distribution. Privacy legislation and technical means of providing privacy.

Network Management and Security

Human aspects of network management; performance measures; classical and vendor network management systems; unified systems; OSI network management; fault and performance; configuration control; security; encryption.

Network Security

This course first covers attacks and threats in computer networks, including network mapping, port scanning, sniffing, DoS, DDoS, reflection attacks, attacks on DNS, and leveraging P2P deployments for attacks. The course then covers the topics in cryptography that are most relevant to secure networking protocols. These topics include block ciphers, steam ciphers, public key cryptography, RSA, Diffie-Hellman, certificate authorizations, digital signatures, and message integrity. After surveying the basic cryptographic techniques, the course examines a number of secure networking protocols, including PGP, SSL, IPSec, and wireless security protocols. The course also examines operational security, including firewalls and intrusion detection systems.

Computer Network Protocols and Applications

This course takes a topdown approach to computer networking. After providing an overview of computer networks and the Internet, the course covers the application layer, transport layer, network layer and link layers. Topics at the application layer include client server architectures, P2P architectures, DNS, and HTTP and web applications. Topics at the transport layer include multiplexing, connectionless transport and UDP, principles of reliable data transfer, connection-oriented transport and TCP, and TCP congestion control. Topics at the network layer include forwarding, router architecture, the IP protocol, and routing protocols including OSPF and BGP. Topics at the link layer include multiple access protocols, ALOHA, CSMA/CD, Ethernet, CSMA/CA, wireless 8.11 networks, and link layer switches. The course includes simple quantitative delay and throughput modeling, socket programming and network application development, and Ethereal labs.

Principles of Communication Networks


Source: Polytechnic University
Overview

Telecommunications is a rapidly growing field. From the military communications networks of the early 1950s, telecommunications technology has evolved to find applications in almost all areas of modern society including, banking, reservation systems, office information systems, corporate networks and the Internet and World Wide Web. Recent challenges include giant optical networks, multimedia communications and wireless network access. The rapid evolution of telecommunications technology demands a broad educational background including today’s technological breakthroughs. Polytechnic’s master’s program in telecommunication networks contains a wide variety of courses ranging from fundamental topics to recent technological advances. The Master of Science in Telecommunication Networks trains students to understand, design, manage and operate telecommunications networks. The unique features of the program are an exceptionally wide range of course offerings in telecommunications and graduate laboratory courses in networking offering hands-on experience.

Admissions Requirements

Admission to the Master of Science in Telecommunication Networks Program requires an undergraduate degree in computer science, computer engineering or electrical engineering, with a superior undergraduate record from an accredited institution. The Graduate Record Exam (GRE) is recommended. Applicants having comparable degrees in other fields will be considered for admission on an individual basis. Generally, entering students are expected to have a basic knowledge of computer fundamentals, such as programming in C++, data structures and computer architecture.

Students having superior academic credentials but lacking sufficient background are admitted with conditional status pending satisfactory completion of several individually specified preparatory courses. These preparatory courses include CS 5303 Introduction to Programming, CS 6403 Data Structures and Algorithms. However, no credit will be allowed for any of the preparatory courses toward the degree.

Graduate Certificate in Telecommunication Network Management

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MS Telecommunication Networks

Required Core Courses

EL 5363 Principles of Communication Networks

In addition, students are required to take four out of the choice courses listed below.

EL 5373 Internet Architecture and Protocols
CS 6843 Computer Network Protocols and Applications
EL 6373 Local and Metropolitan Area Networks
EL 6383 High-Speed Networks
CS 6133 Computer Architecture I or
CS 6233 Operating Systems I
EL 6273 Performance Evaluation of Computer Systems or
EL 7353 Communications Networks I
CS 6823 Network Security

Project Requirements

A project course, either CS 6873 Project in Telecommunication Networks or EL 9953 Advanced Project I is required.

Program Elective Courses

Students are required to take four courses from the following:

CS 6003/6043 Design & Analysis Algorithms I/II
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CS 6233/6243 Operating Systems I/II
CS 6063 Software Engineering I
CS 6083 Principles of Database Systems
CS 9003 Introduction to Java Programming
EL 6013 Principles of Digital Communication
EL 6023 Wireless Communications
EL 6020 Information Theory
EL 6203 Probability
EL 6380 High-Speed Networks
EL 6393 Advanced Network Security
EL 7353 Communications Networks I
EL 7363 Communications Networks II
EL 7373 High-Performance Routers and Switches
MG 8203 Project Management

Certificate in Cyber Security

NSTISSI 4011: Information Security Professional Course Requirements

Students are required to take the following nine courses:

CS 5403 Data Structures and Algorithms
CS 6133 Computer Architecture
CS 6233 Operating Systems
CS 6373 Programming Languages
CS 6843 Computer Networks
CS 6853 Information, Privacy and Security
CS 6853 Network Management and Security
CS 6904 Information Security Management
EL 5363 Principles of Communication Networks

Course Descriptions

Performance Evaluation of Computer Systems

Modeling and performance analysis of computer systems. Introduction to queuing network models and elements of queuing analysis. Exact and approximate analytical techniques, simulation and operation analysis. Examples in modeling multi-programming operating systems, interactive systems and flow control in computer networks.

Information Security Management

The primary goal of this course is to present a system and management view of information security: what it is, what drives the requirements for information security, how to integrate it into the systems design process, and life-cycle security management of information systems. A second goal is to cover basic federal government information security policies and methodologies. Topics covered include information security risk management, security policies, security in the systems engineering process, laws related to information security, and management of deployed systems.

Information, Privacy and Security

Introduction to security and privacy issues associated with information systems. Cost/risk tradeoffs. Technical, physical and administrative methods of providing security. Control of access through technical and physical means. Identification and authentication. Encryption, including the Data Encryption Standard (DES) and public key systems. Management of encryption systems, including key protection and distribution. Privacy legislation and technical means of providing privacy.

Network Management and Security

Human aspects of network management; performance measures; classical and vendor network management systems; unified systems; OSI network management; fault and performance; configuration control; security, encryption.

Network Security

This course first covers attacks and threats in computer networks, including network mapping, port scanning, sniffing, DoS, DDoS, reflection attacks, attacks on DNS, and leveraging P2P deployments for attacks. The course then covers the topics in cryptography that are most relevant to secure networking protocols. These topics include block ciphers, stream ciphers, public key cryptography, RSA, Diffie-Hellman, certification authori- ties, digital signatures, and message integrity. After surveying the basic cryptographic techniques, the course examines a number of secure net- working protocols, including PGP, SSL, IPSec, and wireless security protocols. The course also examines operational security, including firewalls and intrusion detection systems. The course involves reading some recent research papers on network security.

Computer Network Protocols and Applications

This course takes a topdown approach to computer networking. After providing an overview of computer networks and the Internet, the course covers the application layer, transport layer, network layer and link layers. Topics at the application layer include client server architectures, P2P architectures, DNS, and HTTP and Web applications. Topics at the transport layer include multiplexing, connectionless transport and UDP, principles or reliable data transfer, connection-oriented transport and TCP, and TCP congestion control. Topics at the network layer include forwarding, router architecture, the IP protocol, and routing protocols including OSPF and BGP. Topics at the link layer include multiple access protocols, ALOHA, CSMA/CD, Ethernet, CSMA/CA, wireless 802.11 networks, and link layer switches. The course includes simple quantitative delay and throughput modeling, socket programming and network application development, and Ethereal labs.

Principles of Communication Networks

An introductory course in data communications, computer communications and networking. Examples of networks. Data communications principles: transmission, digital and analog data and signalling and encoding. Data communication techniques: asynchronous and synchronous transmission, error detection, data link control and multiplexing, Circuit switching and packet switching, local metropolitan area networks, ISDN and Broadband ISDN, frame relay and other high-speed networks. Introduction to protocols, architecture, and Internet working.

(continued on back cover >)
Course Descriptions

Internet Architecture and Protocols
This course introduces the student to some basic local area networking technologies and protocols in a set of lectures and laboratory experiments. Link level protocols. Local area networks: CSMA/CD, Token Ring, EEE standards and protocols. The Internet protocol suite: IP, ARP, RARP, ICMP, UDP and TCP. LAN interconnection: bridges, routers and gateways. Application protocols: SNMP, TFTP, SMTP and NFS.

Principles of Digital Communication

Wireless Communications

Local and Metropolitan Area Networks
The objective of the course is to teach established and emerging protocols and technologies used in both wireline and wireless local and metropolitan area networks. Basic knowledge of networks, standard LAN technologies such as Ethernet, and TCP/IP is assumed (see course prerequisites below). Topics covered include emerging MAN technologies such as RPR, LAN enhancements such as VLANs, and routing protocols. Wireless protocols covered include the IEEE802.11 family of protocols, wireless security, and emerging wireless IEEE protocols. Note: Wide-area network (WAN) technologies and protocols are covered in EL392.

High-Speed Networks
This course covers the basics, architectures, protocols, and technologies for high-speed networks. Topics to be included are: synchronous optical network (SONET), asynchronous transfer mode (ATM), ATM adaptation layer (AAL). SDH/SONET/SS7, Ethernet, Ethernet over SONET (EOS), quality of service control, packet scheduling, network processing, buffer management, flow and congestion control, TCP, high-speed TCP and XCP, Routing and IP routing, WDM networks, MPLS and GMPLS. Each student is also required to complete a project that could be reading, software design or hardware design.

Communications Networks I
The purpose of this course is to introduce students to the analytical techniques used in the design and performance analysis of networks. Building on their knowledge of networking technology and applied mathematics, especially probability, students will start by learning basic queuing theory. This will be applied to the performance analysis of multiplexers, switches, and multiple access networks. Newer techniques such as the network calculus, the study of non-Poissonian long-range dependent traffic sources, and applications to TCP, admission control, advanced packet switches and IEEE 802.11 networks will be introduced.

Communications Networks II
Principles of network design, network design algorithms, centralized network design, static and dynamic routing algorithms, concentrator and switching node location, network reliability analysis, application of minimum spanning tree and shortest path algorithms to problems in network design, distributed network design, case studies.

High-Performance Routers and Switches
This course addresses the basics, the theory, architectures, and technologies to implement high-performance, high-speed, large-scale routers and switches. The fundamental concepts and technologies of packet forwarding, classification, and switching learned in the class are useful and practical when designing IP routers, ethernet switches, and optical switches. Topics to be included are: IP route lookup, packet classification, packet scheduling, buffer management, basics of packet switching, output-buffered switches, shared-memory switches, crosspoint buffered switches, input-buffered switches, cross-network switches, multi-stage buffered switches, two stage load-balanced switches, optical packet switches, and ASIC for IP routers.

Project Management
Half-semester course provides students with practical and best practice project management theory, concepts and hands-on practical experience to effectively contribute in and lead multi-cultural team projects framed for the new global economy. The practical component includes a team-based project that runs throughout the duration of the course.

Communications Networks III
This course addresses the basics, the theory, architectures, and technologies to implement high-performance, high-speed, large-scale routers and switches. The fundamental concepts and technologies of packet forwarding, classification, and switching learned in the class are useful and practical when designing IP routers, ethernet switches, and optical switches. Topics to be included are: IP route lookup, packet classification, packet scheduling, buffer management, basics of packet switching, output-buffered switches, shared-memory switches, crosspoint buffered switches, input-buffered switches, cross-network switches, multi-stage buffered switches, two stage load-balanced switches, optical packet switches, and ASIC for IP routers.

Fundamentals of Digital Communications
This course covers the basics, architectures, protocols, and technologies for high-speed networks. Topics to be included are: synchronous optical network (SONET), asynchronous transfer mode (ATM), ATM adaptation layer (AAL). SDH/SONET/SS7, Ethernet, Ethernet over SONET (EOS), quality of service control, packet scheduling, network processing, buffer management, flow and congestion control, TCP, high-speed TCP and XCP, Routing and IP routing, WDM networks, MPLS and GMPLS. Each student is also required to complete a project that could be reading, software design or hardware design.

Communications Networks I
The purpose of this course is to introduce students to the analytical techniques used in the design and performance analysis of networks. Building on their knowledge of networking technology and applied mathematics, especially probability, students will start by learning basic queuing theory. This will be applied to the performance analysis of multiplexers, switches, and multiple access networks. Newer techniques such as the network calculus, the study of non-Poissonian long-range dependent traffic sources, and applications to TCP, admission control, advanced packet switches and IEEE 802.11 networks will be introduced.

Communications Networks II
Principles of network design, network design algorithms, centralized network design, static and dynamic routing algorithms, concentrator and switching node location, network reliability analysis, application of minimum spanning tree and shortest path algorithms to problems in network design, distributed network design, case studies.

High-Performance Routers and Switches
This course addresses the basics, the theory, architectures, and technologies to implement high-performance, high-speed, large-scale routers and switches. The fundamental concepts and technologies of packet forwarding, classification, and switching learned in the class are useful and practical when designing IP routers, ethernet switches, and optical switches. Topics to be included are: IP route lookup, packet classification, packet scheduling, buffer management, basics of packet switching, output-buffered switches, shared-memory switches, crosspoint buffered switches, input-buffered switches, cross-network switches, multi-stage buffered switches, two stage load-balanced switches, optical packet switches, and ASIC for IP routers.

Project Management
Half-semester course provides students with practical and best practice project management theory, concepts and hands-on practical experience to effectively contribute in and lead multi-cultural team projects framed for the new global economy. The practical component includes a team-based project that runs throughout the duration of the course.

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Communications Networks I
The purpose of this course is to introduce students to the analytical techniques used in the design and performance analysis of networks. Building on their knowledge of networking technology and applied mathematics, especially probability, students will start by learning basic queuing theory. This will be applied to the performance analysis of multiplexers, switches, and multiple access networks. Newer techniques such as the network calculus, the study of non-Poissonian long-range dependent traffic sources, and applications to TCP, admission control, advanced packet switches and IEEE 802.11 networks will be introduced.

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