

Foundations of Cybersecurity

The Foundations in Cybersecurity certificate provides a strong foundation and detailed technical knowledge in security, privacy, and cryptography applied to computer systems, networks, and web applications. This is a 12-credit certificate.

Who would be suited to take this program?

Students and professionals interested in the area of Cybersecurity. The development and operation of security techniques and cryptographic systems require both a deep understanding of theoretical security concepts and detailed knowledge of security practices. Graduates of the program will be well positioned to understand and mitigate existing and emerging security threats.

What are the prerequisites?

Applicants should have a bachelor's degree from an accredited institution in either Computer Science, Information Sciences, Information Technology, Computer Engineering, Mathematics, Physics, or have relevant experience.

NJIT's standard admission requirements apply to this graduate certificate.

What will I learn?

The certificate provides expertise to analyze new and existing security threats and devise solutions against them. Graduates of the program use in-depth knowledge of network-based and system-level attacks and appropriate countermeasures to ensure that the software and the infrastructure is designed and implemented with the best security practices in mind. This requires the ability to perform sophisticated security design review, coupled with the ability to investigate security breaches and perform forensic analysis. It also requires the ability to develop and maintain tools and technologies to enhance the security of applications and infrastructure.

Why Study Cyber Security at NJIT?

NJIT is situated in Newark, minutes from Newark Penn Station. Jersey City and New York City are also a short train ride away, providing easy access to these commercial areas with many companies that employ cybersecurity specialists. NJIT is a top 100 university, classified as R1 very high research activity, with faculty performing cutting-edge research and publishing in top venues. NJIT also consistently ranks highly on added-value and diversity.

Into what industries might holders of this program find employment?

Modern industries need the kind of information assurance that comes from trained cybersecurity professionals who can monitor and protect user accounts, networks, and data. Positions in the industry include:

- Information Security Manager
- Information Assurance Engineer
- IT Security Consultant
- Information Security Specialist
- Information Security Analyst

Related Degree Programs

Credits from this graduate certificate can be applied toward the NJIT MS in Cyber Security and Privacy degree.

COURSE DESCRIPTIONS

CS 608. Cryptography and Security. 3 credits

This course involves computational methods providing secure Internet communication. Among the topics covered are: Security threats in communication systems; conventional cryptography: substitution and transposition codes; distribution of secret key over the Internet; principles of public-key cryptography; RSA and other public-key cryptographic methods; and digital signature protocol.

CS 631. Data Management System Design. 3 credits

Prerequisites: knowledge of C and data structures. Acquaintance with fundamental notions of relational database technology. Mathematical properties and usage of database programming languages. Methods of database design and conceptual modeling. Methods of physical storage for database information. Fundamental notions of concurrency control and recovery in database systems.

CS 634. Data Mining. 3 credits

This course covers the principles of data mining system design and implementation. It presents methods for association and dependency analysis as well as classification, prediction, and clustering. Optional topics may include time series and graph mining, current trends in data mining, and data mining for scientific, medical and engineering applications.

CS 643. Cloud Computing. 3 credits

Prerequisites: CS 633 (<https://catalog.njit.edu/search/?P=CS%20633>) or CS 656 (<https://catalog.njit.edu/search/?P=CS%20656>). This course presents a top-down view of cloud computing, from applications and administration to programming and infrastructure. Its main focus is on parallel programming

techniques for cloud computing and large scale distributed systems which form the cloud infrastructure. The topics include: overview of cloud computing, cloud systems, parallel processing in the cloud, distributed storage systems, virtualization, secure distributed computing, and multicore programming.

CS 645. Security and Privacy in Computer Systems. 3 credits

Prerequisites: Students are expected to enter this course with a basic knowledge of operating systems, networking, algorithms, and data structures. Also, students should be able to program in Java and C/C++. The course covers fundamental principles of building secure systems and techniques to ensure data security and privacy. Topics include access control mechanisms, operating systems security, malicious code threats and software security, trusted computing, content protection, and database security. The course will also study existing technical approaches to protecting privacy, including Web anonymizers and ant-censorship tools, as well as policy and legal aspects of privacy.

CS 646. Network Protocols Security. 3 credits

Prerequisites: CS 656 (<https://catalog.njit.edu/search/?P=CS%20656>) or ECE 637 (<https://catalog.njit.edu/search/?P=ECE%20637>), and ability to program in Java and C/C++. This course covers the security of network protocols currently used on the internet. It seeks to familiarize students with common threats and network attacks, and provides an in-depth study of methods used to secure network communication. The course includes an applied component, which will help students gain practical experience in attacking and defending networked systems. Topics include authentication systems, and routing security, firewalls, intrusion detection, honeypots, wireless network security, malware, propagation and detection, and web security.

CS 656. Internet and Higher-Layer Protocols. 3 credits

The course introduces the protocols and standards of the TCP/IP suite that govern the functioning of the Internet. The material covered in class is a top-down approach on introduction, discussion, and analysis of protocols from the data-link layer to the application layer. Alternative protocols to the TCP/IP suite and new protocols adopted by this suite are discussed. Numerical examples related to network planning and protocol functioning are analyzed.

CS 673. Software Design and Production Methodology. 3 credits

Prerequisite: CS 631 (<https://catalog.njit.edu/search/?P=CS%20631>). Modern techniques and methods employed in the development of large software systems, including a study of each of the major activities occurring during the lifetime of a software system, from conception to obsolescence and replacement. Topics include cost/performance evaluation, documentation requirements, system design and production techniques, system verification techniques, automated aids to system development, and project organization and management.

CS 696. Network Management and Security. 3 credits

Prerequisites: CS 652 (<https://catalog.njit.edu/search/?P=CS%20652>) or CS 656 (<https://catalog.njit.edu/search/?P=CS%20656>) or ECE 637 (<https://catalog.njit.edu/search/?P=ECE%20637>) or ECE 683 (<https://catalog.njit.edu/search/?P=ECE%20683>) Thorough introduction to current network management technology and techniques, and emerging network management standards. In-depth study of the existing network security technology and the various practical techniques that have been implemented for protecting data from disclosure, for guaranteeing authenticity of messages, and for protecting systems from network-based attacks. SNMP family of standards including SNMP, SNMPv2, and RMON (Remote Monitoring), OSI systems management. Various types of security attacks (such as intruders, viruses, and worms). Conventional Encryption and Public Key Cryptology. Various security services and standards (such as Kerberos, Digital Signature Standard, Pretty Good Privacy, SNMPv2 security facility). Same as ECE 638 (<https://catalog.njit.edu/search/?P=ECE%20638>).

IS 601. Web Systems Development. 3 credits, 3 contact hours.

Prerequisites: NONE Students will gain experience in open source web development through an intensive hands-on project, applying real-world problem-solving skills to meeting information systems requirements. Students will learn Web development principles, as well as professionally relevant skills including industry standards, conventions, and procedures within large-scale programming projects. Also covered are the communication tools, technologies, and practices that individuals use to coordinate and collaborate within the open source software development community.

IS 650. Data Visualization and Interpretation. 3 credits, 3 contact hours.

The course will focus on training students in data visualization techniques and relevant tools. They will learn theoretical aspects of visualization design, and gain practical experience in interpreting data as well as critiquing and comparing visualization techniques. They will develop interactive visualization interfaces as part of a class project. Students will also gain a broad understanding of how visualization can enhance data interpretation and play a key role in the data science pipeline. Finally, recent advances will be presented in the areas of information visualization, visual analytics, and human-data interaction.

IS 657. Spatiotemporal Urban Analytics. 3 credits, 3 contact hours.

Prerequisite: IS 665 (<https://catalog.njit.edu/search/?P=IS%20665>) or equivalent. This course teaches essential concepts and skills needed to efficiently develop spatiotemporal thinking, create a spatiotemporal model, and visualize/model the urban spatiotemporal relationships in the open source environment. Students will learn about big data analytic skills that integrate large open source data and traditional data by investigating the relationship between virtual and physical worlds in the built environment.

IS 665. Data Analytics for Info System. 3 credits, 3 contact hours.

Prerequisite: IS 601 (<https://catalog.njit.edu/search/?P=IS%20601>) This course gives a graduate level introduction to data analysis, probability and statistics from an information systems perspective, including many of the techniques that are most relevant to the profession of Data Scientist for business, data and web analytics, as well as current data sets. We will learn and conduct Python, MATLAB and R based manipulation of data. Course topics include the rudiments of probability and random variables, estimation, special distribution and sampling, Markov processes, hypothesis testing, graphics and visualization.

MATH 661. Applied Statistics. 3 credits, 3 contact hours.

Prerequisite: MATH 112. Role and purpose of applied statistics. Data visualization and use of statistical software used in course. Descriptive statistics, summary measures for quantitative and qualitative data, data displays. Modeling random behavior: elementary probability and some simple probability distribution models. Normal distribution. Computational statistical inference: confidence intervals and tests for means, variances, and proportions.

Linear regression analysis and inference. Control charts for statistical quality control. Introduction to design of experiments and ANOVA, simple factorial design and their analysis. MATH 661 (<https://catalog.njit.edu/search/?P=MATH%20661>) and MATH 663 (<https://catalog.njit.edu/search/?P=MATH%20663>) cannot both be used toward degree credits at NJIT.

What are the Required Courses?

Code	Title	Credits
Core Courses – Take these courses:		6
CS 608	Cryptography and Security	
CS 645	Security and Privacy in Computer Systems	
Electives – Choose two courses:		6
CS 631	Data Management System Design	
CS 634	Data Mining	
CS 643	Cloud Computing	
CS 646	Network Protocols Security	
CS 656	Internet and Higher-Layer Protocols	
CS 673	Software Design and Production Methodology	
CS 696	Network Management and Security	
IS 601	Web Systems Development	
IS 650	Data Visualization and Interpretation	
IS 657	Spatiotemporal Urban Analytics	
IS 665	Data Analytics for Info System	
MATH 661	Applied Statistics	
Total Credits		12