CYBERSECURITY, MASTER OF SCIENCE

A focus area must be chosen for this program.

Admission Requirements

Applicants (degree seeking and special student) must meet the general requirements for admission (https://e-catalogue.jhu.edu/engineering/engineering-professionals/admission-requirements/) to graduate study. The applicant's prior education must include the following prerequisites:

1. One year of Calculus (2 semesters or 3 quarters);
2. One semester/term of advanced math (Discrete Math is strongly preferred but Linear Algebra and Differential Equations will be accepted);
3. One semester/term of Java (C++ will be accepted but the student must be knowledgeable in Java);
4. One semester/term of Data Structures;
5. One semester/term of Computer Organization (e.g., assembly language and machine organization).

Applicants whose prior education does not include the prerequisites listed above may still enroll under provisional status, followed by full admission status once they have completed the missing prerequisites. Missing prerequisites may be completed with Johns Hopkins Engineering (all prerequisites are available) or at another regionally accredited institution. Admitted students typically have earned a grade point average of at least 3.0 on a 4.0 scale (B or above) in the latter half of their undergraduate studies. Applicants may submit a detailed résumé if they would like their academic and professional background to be considered.

Program Requirements

Ten courses must be completed within five years. Students are required to choose a focus area to follow. Three foundation courses must be completed. At least five courses must be from the Cybersecurity program, which can include selected courses from other programs as indicated in the course lists below. At least three of the five Cybersecurity program courses must be from the chosen focus area. At least three of the ten courses must be at the 700-level, and at least one 700-level course must be in the chosen focus area. Up to two electives may be selected from courses outside the Cybersecurity program with advisor approval. Transfer courses will be considered electives. Transfer courses must meet all general EP requirements for transfer, must be directly applicable to Cybersecurity, and will be considered on a case-by-case basis. Only **one** C-range grade (C+, C, or C−) can count toward the master's degree. Course selections outside of the foundational and focus area/concentration lists below are subject to advisor approval.

Non-degree students in Cybersecurity should consult with their advisor to determine which courses must be successfully completed before 600- or 700-level courses may be taken.

Courses

Code	Title	Credits
Prerequisite Courses (or approved equivalent) [1]		
EN.625.108	Calculus I	
EN.625.109	Calculus II	
EN.605.201	Introduction to Programming Using Java	3
EN.605.202	Data Structures	3
EN.605.203	Discrete Mathematics	3
EN.605.204	Computer Organization	3
Foundation Courses [2]		
EN.605.621	Foundations of Algorithms [3]	3
EN.695.601	Foundations of Information Assurance [3]	3
EN.695.641	Cryptology [4]	3
Focus Areas		
Select one of the following Focus Areas:		
Analysis (p. 1)		
Assured Autonomy (p. 2)		
Cyber Operations (p. 2)		
Networks (p. 2)		
Space Cyber (p. 2)		
Systems (p. 2)		
Independent Study (p. 2)		

[1] Applicants whose prior education does not include the prerequisites listed under Admission Requirements may still be admitted under provisional status, followed by full admission once they have completed the missing prerequisites. All prerequisite courses are available at Johns Hopkins Engineering. These courses do not count toward the degree or certificate requirements.

[2] One or more foundation courses can be waived by the student's advisor if a student has received an A or B in equivalent graduate courses. In this case, the student may replace the waived foundation courses with the same number of other graduate courses and may take these courses after all remaining foundation course requirements have been satisfied.

[3] EN.605.621 Foundations of Algorithms and EN.695.601 Foundations of Information Assurance should be taken before any other courses.

[4] EN.695.641 Cryptology should be taken after the other two foundation courses and before any other courses in the Analysis focus area.

Courses by Focus Area

The focus areas offered represent related groups of courses that are relevant for students with interests in the selected areas. Students are required to choose a focus area to follow and to take at least three courses from the selected focus area, including at least one 700-level course. The focus areas are presented as an aid to students in planning their course selections and are only applicable to students seeking a master's degree. They do not appear as official designations on a student's transcript or diploma.

The focus areas each have additional requirements. Applicants should have had a course in networking prior to taking courses in the Networks focus area, a course in operating systems prior to taking courses in the Systems focus area, and a course in both before taking courses in the Analysis focus area. If necessary, EN.605.612 Operating Systems and EN.605.671 Principles of Data Communications Networks can be taken and applied toward the master's degree in Cybersecurity.

Analysis

Code	Title	Credits
EN.695.641	Cryptology	3
EN.695.642	Intrusion Detection	3
EN.695.643	Introduction to Ethical Hacking	3
EN.695.646	Engineering Runtime Malware Detection	3

Code	Title	Credits
EN.695.741	Information Assurance Analysis	3
EN.695.742	Digital Forensics Technologies and Techniques	3
EN.695.744	Reverse Engineering and Vulnerability Analysis	3
EN.695.749	Cyber Exercise	3
EN.605.728	Quantum Computation	3
EN.650.656	Computer Forensics [5]	3

[5] EN.650.xxx courses are offered through the Information Security Institute.

Assured Autonomy

Code	Title	Credits
EN.695.634	Intelligent Vehicles: Cybersecurity for Connected and Autonomous Vehicles	3
EN.695.637	Introduction to Assured AI and Autonomy	3
EN.695.715	Assured Autonomy	3
EN.695.737	AI for Assured Autonomy	3
EN.605.613	Introduction to Robotics	3
EN.605.624	Logic: Systems, Semantics, and Models	3
EN.605.636	Autonomic Computing	3
EN.605.649	Introduction to Machine Learning	3
EN.605.746	Advanced Machine Learning	3
EN.705.601	Applied Machine Learning	3

Cyber Operations

Code	Title	Credits
EN.605.731	Survey of Cloud Computing Security	3
EN.695.615	Cyber Physical Systems Security	3
EN.695.622	Web Security	3
EN.695.643	Introduction to Ethical Hacking	3
EN.695.741	Information Assurance Analysis	3
EN.695.742	Digital Forensics Technologies and Techniques	3

Networks

Code	Title	Credits
EN.695.621	Public Key Infrastructure and Managing E-Security	3
EN.695.622	Web Security	3
EN.695.721	Network Security	3
EN.695.722	Covert Channels	3
EN.695.791	Information Assurance Architectures and Technologies	3
EN.605.671	Principles of Data Communications Networks	3
EN.605.674	Network Programming	3
EN.605.675	Protocol Design	3
EN.605.731	Survey of Cloud Computing Security	3
EN.605.771	Wired and Wireless Local and Metropolitan Area Networks	3
EN.601.642	Modern Cryptography [6]	3

[6] EN.601.xxx courses are offered through the full-time Department of Computer Science.

Space cyber

Code	Title	Credits
EN.675.641	Space Systems Cybersecurity	3
EN.695.744	Reverse Engineering and Vulnerability Analysis	3
EN.695.641	Cryptology	3
EN.695.642	Intrusion Detection	3
EN.695.742	Digital Forensics Technologies and Techniques	3
EN.695.721	Network Security	3
EN.650.656	Computer Forensics [5]	3
EN.695.741	Information Assurance Analysis	3
EN.695.791	Information Assurance Architectures and Technologies	3
EN.605.716	Modeling and Simulation of Complex Systems	3
EN.605.674	Network Programming	3
EN.605.728	Quantum Computation	3

[5] EN.650.xxx courses are offered through the Information Security Institute.

SYSTEMS

Code	Title	Credits
EN.695.601	Foundations of Information Assurance	3
EN.695.611	Embedded Computer Systems-Vulnerabilities, Intrusions, and Protection Mechanisms	3
EN.695.612	Operating Systems Security	3
EN.695.614	Security Engineering	3
EN.695.615	Cyber Physical Systems Security	3
EN.695.711	Java Security	3
EN.695.712	Authentication Technologies	3
EN.695.715	Assured Autonomy	3
EN.605.601	Foundations of Software Engineering	3
EN.605.609	DevOps and Secure Software Development	3
EN.605.612	Operating Systems	3
EN.605.621	Foundations of Algorithms	3
EN.605.704	Object-Oriented Analysis and Design	3
EN.605.715	Software Development for Real-Time Embedded Systems	3
EN.605.716	Modeling and Simulation of Complex Systems	3
EN.605.729	Formal Methods	3
EN.601.643	Security & Privacy in Computing [6]	3
EN.635.673	Protecting Critical Infrastructure Against Cyber Attacks	3

[6] EN.601.xxx courses are offered through the full-time Department of Computer Science.

Independent Study

Code	Title	Credits
EN.695.801	Independent Study in Cybersecurity I	3
EN.695.802	Independent Study in Cybersecurity II	3
EN.695.795	Capstone Project in Cybersecurity	3

Please refer to the course schedule (ep.jhu.edu/schedule (https://apps.ep.jhu.edu/schedule/search/)) *published each term for exact dates, times, locations, fees, and instructors*.