## CYBER SECURITY ENGINEERING (CYSE)

### 100 Level Courses

**CYSE 101: Introduction to Cyber Security Engineering.** 3 credits.
Provides comprehensive introduction to the principles, applications, and practice of cyber security engineering. Students learn the basic concepts and terminology of cyber security and how cyber security is commonly addressed after the design and implementation phases. Students are introduced to the systems engineering and design processes and learn to integrate and apply cyber security tools and techniques in these processes. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

### 200 Level Courses

**CYSE 205: Systems Engineering Principles.** 3 credits.
Introduction to systems engineering with a focus on cyber security engineering. Emphasize development of analytical, technical, management, and teamwork skills through exercises in planning, documentation, presentation, and the creative process of IT engineering design. Analyze case studies involving systems engineering role in cyber security. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 211: Operating Systems and Lab.** 3 credits.
Addresses basic issues such as virtual memory, kernel and user mode, system calls, threads, context switches, interrupts, interprocess communication, coordination of concurrent activities. May also address: concurrency, processes and multi-threading, context switching, synchronization, scheduling, and deadlock. Memory management, dynamic memory allocation, address translation. Management of file systems, storage devices, directories, protection, scheduling and crash recovery. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 220: Systems Modeling.** 3 credits.
Introduces modeling of dynamical systems. Formulation of mathematical models from system descriptions, including computer, economic, transportation, electrical power and mechanical systems. Analytical and numerical methods for solving models and studying their behavior. Discrete-time and continuous time systems. Linear and nonlinear systems. Introduction to computer modeling using MATLAB. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

### 300 Level Courses

**CYSE 301: Digital Systems.** 3 credits.
Introduces digital circuits, systems and computers. Topics include binary systems and codes, digital logic gates and circuits, microelectronics and integrated circuits, coding and multiplexing, multi-vibrators, shift registers, counters, analog-to-digital converters, and elementary computer architecture. Offered by Volgenau School of Engineering. Limited to two attempts. Equivalent to ECE 301.

**Registration Restrictions:**
Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 325: Discrete Events Systems Modeling.** 3 credits.
Introduces basic modeling of the dynamics of discrete event systems. Both analytical and simulation techniques for the modeling and analysis of such systems are considered. Relevant concepts from discrete mathematics are included and appropriate software tools are used to examine different engineering applications. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Students with the terminated from VSE major attribute may **not** enroll.
Required Prerequisite: STAT 344\textsuperscript{C}.
\textsuperscript{C} Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 330: Introduction to Network Security.** 3 credits.
Introduces cryptography and its applications in networks. Reviews basic firewalls architectures and VPNs. Overview of current network security protocols, security of routing protocols, the DNS, and e-mail security. Discuss threat of attacks that use viruses, worms, rootkits, botnets and countermeasures; distributed denial of service attacks and spam countermeasures. Introduces basic concepts of security of wireless networks. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Required Prerequisites: CYSE 101\textsuperscript{C}, CS 222\textsuperscript{C} and CYSE 230\textsuperscript{C}.
\textsuperscript{C} Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**400 Level Courses**

**CYSE 411: Secure Software Engineering.** 3 credits.
This course provides a foundation for building secure software by applying security principles to the software development lifecycle. Topics covered include: security in requirements engineering, secure designs, risk analysis, threat modeling, deploying cryptographic algorithms, defensive coding, penetration testing, fuzzing, static analysis, and security assessment. Students will learn the practical skills for developing and testing secure software. Notes: This course may be of interest to students specializing in software aspects of cyber security engineering. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Required Prerequisite: CS 222\textsuperscript{C}.
\textsuperscript{C} Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 421: Industrial Control Systems Security.** 3 credits.

**Registration Restrictions:**
Required Prerequisites: CYSE 220\textsuperscript{C}, 230\textsuperscript{C} and 301\textsuperscript{C}.
\textsuperscript{C} Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 424: Embedded and Real Time Systems.** 3 credits.
Presents design methodology, principles and practice for the development of real-time embedded systems and their application to robotics, mechatronics, sensing, signal processing, and control. They include automated sensors, switches and PLCs. Topics include system decomposition, multi-tasking, task communication and synchronization, system modeling, time analysis, principles of filter and controller implementation, ‘fuzzy’ engineering, and multimicrocontroller systems. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Required Prerequisite: CYSE 301\textsuperscript{C}.
\textsuperscript{C} Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 425: Secure RF Communications.** 3 credits.

**Registration Restrictions:**
Required Prerequisites: CYSE 230\textsuperscript{C} and CS 222\textsuperscript{C}.
\textsuperscript{C} Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.
Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 430: Critical Infrastructure Protection.** 3 credits.
Consists of a four week lecture course followed by ten weekly seminars presented by students. The lecture part provides a description of US Designated Critical Infrastructure Sectors and a corresponding list of federal sector specific agencies (SSAs). Each student selects a sector, develops and presents a seminar talk on critical cyber security issues involved in a given sector. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 445: System Security and Resilience.** 3 credits.
Focuses on modeling and evaluation of the engineering systems that are expected to operate in a contested cyber environment. Covers architectures and modeling, uses a variety of techniques, establishing measures of performance that are relevant to the domain of operation, evaluating the security or vulnerability of the system to cyber exploits, and then assessing its resilience. Offered by Volgenau School of Engineering. Limited to two attempts.

**Recommended Corequisite:** CYSE 450.

**Registration Restrictions:**
Required Prerequisites: CYSE 325 C or 330 C.
C Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 450: Cyber Vulnerability Lab.** 1 credit.
Lab for CYSE 445. Provides hands-on experience in security issues of network systems. Issues in ethical hacking, penetration testing, forensics and incident handling and response will be discussed. Notes: This is a hands-on lab course, with short lecture introductions. Offered by Volgenau School of Engineering. Limited to two attempts.

**Recommended Corequisite:** CYSE 445.

**Registration Restrictions:**
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Laboratory

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 460: Power Systems and Smart Grid.** 3 credits.
Covers fundamentals of power systems; basics of electricity, electricity generation, economics of supply and demand, and electricity market operations in regulated and deregulated environment. The other part of the course will cover Smart Grid and its impact on the energy industry. Also includes Energy policy modeling and analysis. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 461: Power Grid Security.** 3 credits.
Overview of integrating smart grid into the current system. Includes the seven domains (bulk generation, transmission, distribution, customer, operations, markets, and service providers) as well as the electrical and communication interfaces that connect the layers and domains. Focuses on monitoring equipment in the smart grid. Provides an overview of security principles and approaches for applying them to the smart grid. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Required Prerequisite: CYSE 460 C.
C Requires minimum grade of C.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 462: Mobile Devices and Network Security.** 3 credits.
Embedded security features of hand-held wireless devices. Data link layer encryption and authentication protocols applied in mobile devices. Security factors in the decisions on configuring wireless mobile devices and network infrastructure. Robust cryptography that is needed to attain the highest levels of integrity, authentication, and confidentiality. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 465: Transportation Systems Design.** 3 credits.
Discusses common elements and differences among problems that occur securing road, rail, air and sea transportation systems. Covers

...
Cyber Security Engineering (CYSE)

threats to control systems. Introduces control measures. Discusses past, present and future of in-vehicle and on-road safety systems, and cyber threats to emerging autonomous cars. Analyzes cyber threats to aviation and sea transportation security and available countermeasures. Offered by Volgenau School of Engineering. Limited to two attempts.

Registration Restrictions:
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

CYSE 467: GPS Security. 3 credits.
Provides background in long-range navigation developments; early global systems; space based systems; GPS and GLONASS systems; system architecture; spacecraft and earth station characteristics; design concepts of the CA and P GPS signal modes; frequencies, modulation, and other design aspects; clock issues; range and accuracy calculations and limitations; advanced concepts. Explains advanced concepts in global navigation satellite systems. Offered by Volgenau School of Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisite: CYSE 425C.
C Requires minimum grade of C.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

CYSE 470: Human Factors and Cyber Security Engineering. 3 credits.
This course explores the human factor in cyber security engineering. The focus is on understanding human performance characteristics and limitations, and the various research, design, and evaluation methods needed to address them when engineering secure systems. Topics include, for example, perception, cognition, memory, situation awareness, decision making, stress, automation, and human-computer display and interaction design principles. Offered by Volgenau School of Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisites: CYSE 205C and STAT 344C.
C Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

CYSE 475: Cyber Physical Systems. 3 credits.
Introduces cyber physical systems as an integration of physical processes, computation, and networking. Discusses modeling and simulation of cyber physical systems, system design and implementation. Analyze such systems based on abstractions for modeling physical systems and abstractions for modeling data transformations. Covers security issues in cyber physical systems and applications selected from infrastructure, energy, transportation, robotics, manufacturing, and communications domains. Offered by Volgenau School of Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisites: CYSE 330C, 421C and 450C.
C Requires minimum grade of C.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

CYSE 476: Cryptography and Computer Network Security. 3 credits.
Covers basic concepts of crytology, types of cryptosystems, implementation of security services, key management, public key certificates, public key infrastructure, e-mail and web security. Discusses modern secret-key ciphers, modes of operation, hash functions, message authentication codes, public key cryptography, and digital signature schemes. Covers cryptographic standards and secure internet protocols. Introduces educational and public domain software implementing modern cryptographic algorithms. Offered by Volgenau School of Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisites: (CYSE 101C and 330C) or ECE 465C.
C Requires minimum grade of C.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

CYSE 477: Intrusion Detection. 3 credits.
The objective of this course is to provide an in-depth introduction to the science and art of intrusion detection. The course covers methodologies, techniques, and tools for monitoring events in computer systems or networks, with the objective of preventing and detecting unwanted process activity and recovering from malicious behavior. Offered by Volgenau School of Engineering. Limited to two attempts.

Registration Restrictions:
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

CYSE 478: Cyber Security Audit and Compliance. 3 credits.
Fundamental concepts of the Cyber Security Compliance and Testing process. This will revolve around defining a control framework, the attendant control objectives and the reporting system for an organization. Covers the process of creating a control structure with goals and objectives, audit a given cyber infrastructure against it, and if
found inadequate, establish a systematic remediation procedure. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisite:** CYSE 421<sup>C</sup>.<br>\( \text{C} \) Requires minimum grade of C.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 479: Methods of User Authentication.** 3 credits.
Discusses limitations of passwords and PINs and introduces alternatives. Covers user authentication based on security tokens and smart cards. Introduces basics of biometric systems, based on information such as fingerprints, facial features, iris, and voice. Discusses the use and security of electronic ID cards and passports. Covers methods of distinguishing human from internet bots over the network, such as CAPTCHA’s. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisites:** CYSE 211<sup>C</sup>, 301<sup>C</sup> and 330<sup>C</sup>.<br>\( \text{C} \) Requires minimum grade of C.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 480: Malicious Software and Hardware.** 3 credits.
Introduces various types of malicious software (malware). Discusses malware analysis using virtual machines, sandboxes, process monitors, packet sniffers, obfuscation, etc. Introduces hardware Trojans and other forms of malicious hardware. Discusses prevention techniques at the design, fabrication, and post-fabrication level. Introduces various countermeasures against malicious software and hardware. The course has a lab with Windows and Android operating systems. Offered by Volgenau School of Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisites:** CYSE 211<sup>C</sup> and 301<sup>C</sup>.<br>\( \text{C} \) Requires minimum grade of C.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 491: Engineering Senior Seminar.** 2 credits.
This course covers a variety of responsibilities of cyber security engineers including: engineering ethics, government policies, laws and regulations affecting cyber security engineering, industry practices, entrepreneurship. Effective technical communications. Incorporates global implications of cyber security engineering. Speakers include faculty, invited guests from industry and government, as well as students. Offered by Volgenau School of Engineering. Limited to two attempts.

**Specialized Designation:** Writing Intensive in the Major

**Recommended Corequisite:** CYSE 492.

**Registration Restrictions:**
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 492: Senior Advanced Design Project I.** 2 credits.
First semester of a two semester capstone course in the Cyber Security Engineering program. Development of a design project by a team of students. Conception of the project and determination of its feasibility. Work includes developing preliminary design and implementation plan. Projects will aim at the integration of the technical material learned in several courses and incorporation of industry input. Offered by Volgenau School of Engineering. Limited to two attempts.

**Recommended Corequisite:** CYSE 491.

**Registration Restrictions:**
Enrollment is limited to students with a major, minor, or concentration in Cyber Security Engineering.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 493: Senior Advanced Design Project II.** 3 credits.
Second semester of a two semester capstone course in the Cyber Security Engineering program. Project includes designing a cyber-physical security system, writing required software, assembling hardware if needed, conducting experiments or studies, and testing the complete system. Requires oral and written reports during project and at completion. Offered by Volgenau School of Engineering. Limited to two attempts.

**Mason Core:** Capstone

**Registration Restrictions:**
**Required Prerequisite:** CYSE 492<sup>C</sup>.<br>\( \text{C} \) Requires minimum grade of C.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**CYSE 499: Special Topics in Cyber Security Engineering.** 3 credits.
Special Topics in the Cyber Security Engineering area, with different content in different terms. Offered by Volgenau School of Engineering. May be repeated within the term for a maximum 6 credits.

**Recommended Prerequisite:** 60 credits towards BS in Cyber Security Engineering.

**Registration Restrictions:**
Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**Additional Course Details:** Title varies by section and/or semester