VILLANOVA UNIVERSITY

Department of Electrical and Computer Engineering

Minor in Cybersecurity

19 Feb. 2018

This proposal was originally generated by the provost cybersecurity initiative in 2017. Sections IV-VII have been revised.

The proposed new technical minor in cybersecurity will be offered jointly across the College of Liberal Arts and Sciences and the College of Engineering, and will be focused on preparing our graduates to successfully fill the current talent gap in cybersecurity. Given the demand for cybersecurity talent in industry, student demand for more cybersecurity offerings, and the central role cybersecurity will play in a global community connected by technology, we believe now is the time to increase the university's offerings in the field.

I. Program Objectives

The cybersecurity minor has three overarching objectives that define the program structure and guide student outcomes throughout the program:

a. Provide a solid foundation in the principles of cybersecurity: the program will provide students with a strong technical grounding in the principles that guide the implementation and management of cybersecurity in IT systems
b. Prepare students to enter the workforce of cybersecurity professionals: while the need for security experts in industry is increasing, students will need experience in applying cybersecurity principles to the needs of industry if they are to successfully fill this talent gap.
c. Promote independent study and self-reliance: with the rapid pace of technological advancement, it will be critical to prepare students to educate themselves on the latest tools and technology available, as well as the associated security risks and mitigation techniques.

II. University Mission and Strategic Plan

The creation of a cybersecurity minor contributes to the university strategic plan in three specific ways. First, the program will strengthen the undergraduate offerings by providing a competitive educational program in a cross-disciplinary specialization between computing sciences and computer engineering. As cybersecurity failures continue to mount in industry, the top universities in the world are focusing more on training students to fill the increasing need for cybersecurity specialists. This program will allow Villanova to compete with other top institutions for students who are interested in pursuing this specialization.

Second, increasing the cross-college collaboration and sharing expertise will make allow for increased opportunities for expanding faculty scholarship in cybersecurity. As more students become skilled in the fundamental principles of cybersecurity, this program will allow them to connect with faculty mentors and become engaged in improving the university's scholarly presence in the cybersecurity research community. This will allow Villanova to improve its national reputation through outstanding research and by graduating skilled researchers into the academic community.

Finally, the program will provide students with motivation and talents to contribute to the global community. As the world becomes increasingly connected through technology and the internet, the need for experts who are committed to protecting the rights and privacy of online citizens will be of paramount importance. New technology and convenience has also brought about new avenues for crime and exploiting community members, a trend that our students will be prepared to combat in order to promote a just and peaceful global community. Future global policy decisions will shape the growth and development of communication technology, so producing students who understand both the technical and ethical implications of these policies will allow Villanova to contribute significantly to shaping the future of technology and the global community.

III. Market Analysis

We consider the market analysis in three components: industry demand, student demand, and competing university offerings. In a 2014 study, Cisco estimated over 1 million cybersecurity positions worldwide were unfilled. The following year, the $(ISC)^2$ Global Information Security Workforce Study (GISWS) conducted by Frost & Sullivan for the $(ISC)^2$ Foundation projected that number to increase to 1.5 million by 2020, given current trends. A 2016 employment study by ISACA stated that cybersecurity job growth is three times the rate of IT job growth. The situation is particularly dire in US Federal civil service, which cannot adjust salaries to match market demand in industry. Given this lack of expertise, a cybersecurity program for Villanova undergraduates would position students to be able to fill a much-needed gap in the workforce.

Student demand for cybersecurity course offerings has also grown with the increase in high-profile media coverage of cybersecurity breaches in government and in private industry. In computing sciences, a growing number of prospective students are directly inquiring about cybersecurity offerings at Villanova, with increasing enrollment in the cybersecurity courses that are offered within the department. In computer engineering, cybersecurity is now a part of the core degree requirements, with an increasing number of specialized courses being added to the course offerings.

Finally, to meet the growing demand from industry for trained cybersecurity professionals, as well as the demand from students for cybersecurity curriculum, many competing regional and national universities are developing cybersecurity-specific certifications and degree programs. Within the immediate region, Drexel University, Rutgers University, The University of Maryland, and the University of Delaware all offer either cybersecurity minors or cybersecurity specializations in association with their computer science or engineering degree programs. In addition to these undergraduate programs, schools like Carnegie Mellon University, Johns Hopkins University, New York University, and Villanova's own College of Engineering offer master's degree programs in information security or cybersecurity. To compete with these schools in recruiting talented students, this cybersecurity minor will provide a security-specific course offering with the potential to equip students to meet the growing industry demand for security professionals.

IV. Program Structure

The program will be structured into three components totaling 18 credits. The first component is the completion of 3 core courses on security. The second component will be a selection of 2 technical electives to establish a rigorous understanding of several application areas for cybersecurity. Finally, the program will conclude with a 3-credit capstone course; students - with the help of their academic advisor - will choose a hands-on project that has a security focus and complete it during their senior year. This project will allow them to study special topics and tools used in practice.

Component I: Core courses (choose 3)

VIA 2111&2112 - Digital Life Technology
CSC 3080 Information Security & Protection
CSC 4450 Digital Forensics
ECE 5476 Computer & Network Security
ECE 5478 Engineering Secure Cyber-Physical Systems

Component II: Elective courses (choose 2)
CSC 1600 Operating Systems
CSC 2405 Computing Systems II
ECE 3445 Computer Architecture
ECE 4470 Computer Networks
CSC 4480 Principles of Database Systems
CSC 4700 Software Engineering
CSC 4800 Web Application Development
CSC 4900 Computer Networks

Component III: Capstone Project (choose 1)
CSC 4790 Senior Projects
ECE 4971 Senior Design Project
ECE 5970 Cybersecurity projects (*)

* ECE 5970 is a new course number for projects that fall outside the constraints of the existing CSC and ECE senior project courses (which have prerequisites). E.g. ECE students could use it for a second project in addition to their required senior project, and CSC students could use it if they do not have the Software Engineering prerequisite for the CSC senior project.

Sample Curriculum Sequence

An example course sequence for the completion of this minor is:

CSC 1600 Operating Systems
CSC 3080 Information Security & Protection
ECE 4470 Computer Networks
CSC 4450 Digital Forensics
ECE 5476 Computer & Network Security
ECE 4971: Senior Design Project

V. Program Delivery

The program will be delivered in on-campus course offerings only. While the minor will be available for students university-wide, participation is anticipated primarily from computer science and computer engineering majors. Future expansion opportunities include VBS and Criminal Justice. As the program grows, the Joint Task Force on Cybersecurity Education guidelines will be studied in order to include more interdisciplinary courses to cover different knowledge areas on cybersecurity:

https://www.csec2017.org/copy-of-csec2017-v-0-75

Since this minor will be offered jointly across the College of Liberal Arts and Sciences and the College of Engineering, one of the two participating departments will be responsible for administering and maintaining the program. The College of Engineering is already offering a graduate cybersecurity program, so naturally the Electrical and Computer Engineering department can assume this task. A cybersecurity minor curriculum committee will be formed with two members from Computing Sciences and two members from Electrical and Computer Engineering. The charge of this committee is to administer, maintain and monitor the cybersecurity minor.

VI. Impact on Existing Curricula

Because all courses are drawn from existing course offerings in both Computing Sciences and Computer Engineering, the only foreseeable increase in faculty load will result from the increase in demand for security related capstone ideas and advisors. This increase in load will be divided between the two sponsoring departments.

VII. Implementation Timetable

The anticipated launch for the minor is Fall 2018. The popularity of the CSC 4790: Senior Projects course may increase as Computing Sciences students show interest in the minor. Computer Engineering students are already required to complete a capstone project, but students interested in the minor will have to choose a security-related project for that to count. Both departments need to make reasonable accommodations in their project lists to include different aspects of security.

VIII. Budget Analysis

Dedicated equipment for virtual access is desired.

IX. Admission and Completion Requirements

Any student in good standing is eligible to work towards the minor and will complete it as long as all three components are fulfilled - along with respective course prerequisites.

X. Third-Party, Vendor and Corporate Relationships

Given the hyper-growth of the cybersecurity space and the demand for talent, (See section III) the opportunities for corporate and vendor partnerships tremendous. In June 2017 Cybersecurity Minor Committee presented our program model to a focus group comprised of cyber security experts from over two dozen businesses. Representatives from corporations such as Vanguard, GE, SEI and the FBI, were exited to hear that Villanova was seeking to incorporate cyber training into a cross discipline program. Partnership opportunities may include: Internships, hiring, knowledge sharing from industry experts, funding and equipment donations.

XI. Adequacy of Student Academic Support Areas

Existing classroom and labs are adequate for the proposed curriculum; as the program matures and adds new classes, dedicated lab space will be desirable.

XII. Accreditation

Follow new ABET guidelines when they are finalized.

Sources:

-http://blog.isc2.org/isc2_blog/2015/04/isc-study-workforce-shortfall-due-to-hiring-difficulties-despite-rising-salaries-increased-budgets-a.html
-https://www.cisco.com/c/dam/en/us/products/collateral/security/cybersecurity-talent.pdf
-http://www.leviathansecurity.com/cloudsecurity
-https://www.cisco.com/c/dam/m/digital/1198689/Cisco_2017_ACR_PDF.pdf
-http://www.isaca.org/cyber/PublishingImages/Cybersecurity-Skills-Gap-1500.jpg

Form to Propose New or Change Academic Programs

Type of program (check one): **Major** ☐ **Minor** ☑ **Concentration** ☐ **Certificate** ☐ **Degree** ☐

Other (specify) ☐ _____

New program/curriculum? ☑ **Revision of existing program/curriculum?** ☐

Suspension of existing program/curriculum? ☐ **Termination of existing program/curriculum?** ☐

Department(s) or Program offering this proposal:

Electrical and Computer Engineering

Audience of program (check one or more): **Undergraduate** ☑ **Graduate** ☐ **Non-degree** ☐ **Non-credit** ☐

Modality (check one): **On-Campus** ☑ **Other Location** ☐ **100% Online** ☐ **Hybrid** ☐

Budget Model (check one): **Entrepreneurial Program** ☐ **Traditional University Program** ☐

Title and Formal Catalog Description of Program:

Title: Minor in Cybersecurity
Catalog description: Technical minor in cybersecurity offered jointly across the College of Liberal Arts and Sciences and the College of Engineering. It is focused on preparing our graduates to successfully fill roles in various cybersecurity-related fields. Students are introduced to the major security areas of information security, network security and systems security. Requirements: six courses, including at least three security core courses, two electives and one capstone project.

Effective Date Program Begins, Suspends or Terminates (semester and year):

Fall 2018

Instructions:

Minor Changes (e.g. adding or deleting required courses from the program): Attach an explanation of the change and secure all required signatures under "Minor Changes" on the following page.

Terminated or Suspended Programs: Attach an explanation of why the program is being terminated or suspended including the number of affected students and associated teach out plans. In addition, provide details of impacted staff and how their responsibilities are being reassigned as well as associated faculty and any anticipated impact on their load. Also provide a list of affected courses by college and department. Secure all required signatures under "Terminated or Suspended Programs" on the following page.

New or Substantially Revised Programs: Follow the directions for steps one through three on the third page.

Note: If the creation of new courses, or modification of old courses, is required to implement a new or modified program, please use the Changes to Course in the Course Catalog form, either in conjunction with this form or subsequent to the approval of the new or modified program.

REQUIRED SIGNATURES

By signing below, the individual indicates that his/her office has been consulted and has no material reservation about their willingness and ability to support the proposal.

STEP 1 APPROVALS, MINOR CHANGES AND TERMINATED OR SUSPENDED PROGRAMS:

#1 Department Chair: _____ **Date:** _____

#2 Cooperating Department Chair*: _____ **Date:**_____

#3 College Dean: _____ **Date:** _____

#4 Cooperating College Dean*: _____ **Date:** _____

#5 Associate Vice Provost, Fin & Admin:_____ **Date:** _____

#6 Vice Provost for Academics: _____ **Date:** _____

STEP 2 ADVISORY COUNCIL:

This meeting has been scheduled by the Vice Provost for Academics on:_____

at: _____ **in room:** _____

If you have any questions, please contact the Office of the Provost at 610-519-4525.

STEP 3 FINAL APPROVALS FOR NEW OR SUBSTANTIALLY REVISED PROGRAMS:

#1 Department Chair: _____ **Date:** _____

#2 Cooperating Department Chair*: _____ **Date:**_____

#3 College Dean: _____ **Date:** _____

#4 Cooperating College Dean*: _____ **Date:** _____

#5 Additional Signatures (as noted):

_____	_____	_____
Bursar	**Registrar**	**Financial Aid**
_____	_____	_____
UNIT	**Library**	**Other:**_____
_____	_____	_____
Other:_____	**Other:**_____	**Other:**_____

#6 Associate Vice Provost, Fin & Admin:_____ **Date:**_____

#7 Vice Provost for Academics: _____ **Date:** _____

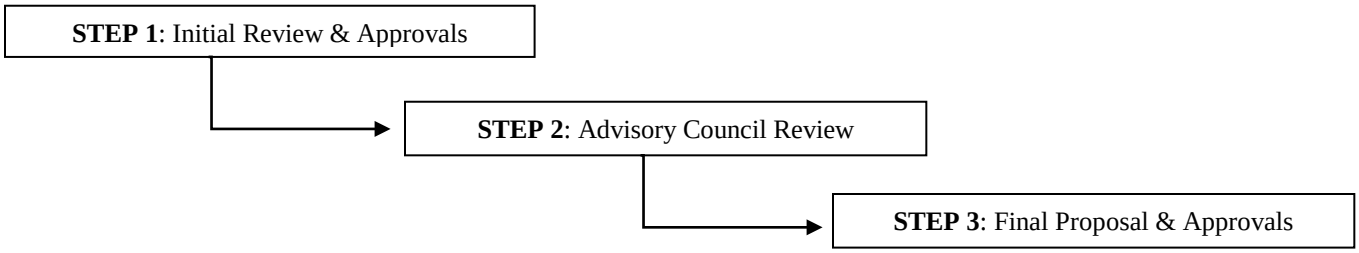
**If there is more than one cooperating department chair or college dean, please attach additional signatures in an appendix.*

NEW OR SUBSTANTIALLY REVISED ACADEMIC INITIATIVES: GUIDELINES

Academic initiatives (new degrees, programs, majors, minors, concentrations) and changes to existing programs which are consonant with Villanova University's strategic plan are encouraged.

To start, please complete the checkboxes on the upper portion of the first page of this form to classify the type of program and the magnitude of the change. Subsequent instructions provide further clarity as to the required steps to obtain approval.

Proposals for new or substantially revised credit and non-credit programs follow the below process:



Please note that this is an iterative process and comments and feedback received may require the sponsoring party to revise previously submitted materials prior to receiving final approval.

STEP 1: Initial Review & Approvals: Attach a proposal (maximum 10 pages) in which you preliminarily explain items 1-8a in the "Proposal Criteria" table on the following page. Circulate and discuss the proposal with the noted individuals in the order in which they appear under Step 1 on the previous page, incorporating any necessary edits prior to securing their signature. Please note that if you anticipate that your program will have any impact on existing curricula in other departments or colleges (as described in response to item # 6 in the "Proposal Criteria" table on the following page), you will need to secure the signatures of the associated department chairs and college deans. Final review and approval will be conducted by the Vice Provost for Academics. Signatures and the proposal should be sent for this final review via PDF to academics@villanova.edu. If final approval is granted, the Vice Provost for Academics will schedule a meeting with the Advisory Council and note the date, time and location on the signature page under Step 2. The Vice Provost for Academics will also indicate (on the previous page under Step 3 item #5) who needs to review and formally approve the final proposal.

STEP 2: Advisory Council Review: Present a 20-30 minute presentation of the new or substantially revised credit or non-credit program focusing on the most pertinent items from the "Proposal Criteria" table on the following page. Formal remarks will be followed by a Q&A session. After submission and approval of the preliminary proposal in Step 1, the Vice Provost for Academics will schedule the meeting and note the date, time and location on the previous page under Step 2. The advisory council is comprised of members of the student support service areas and provides a forum for operational guidance and advice prior to submitting a formal proposal. This step does not include an approval process, rather it is designed to be advisory in nature and assist the program sponsors in considering important administrative details when structuring their programs. While this committee has been assembled to help streamline the communication process, please note that there are other offices on campus that could be impacted by your program and/or from whom you may benefit from separate consultation. These offices may include but are not limited to:

- Enrollment Management (for student recruitment, enrollment issues)
- Facilities Management (if facilities must be constructed or modified)
- Office of Education Abroad (if the program has international or study abroad aspects)
- Student Life or Residence Life (if the program involves their programs and operations)
- Alumni Relations or Development Office (if the program involves alumni or fund-raising)
- Career Center (for employment and career development considerations)
- Office of the Vice President and General Counsel (for any legal implications)
- Campus Ministry (for service learning or liturgical considerations)
- Office of Planning and Institutional Research (for surveys, etc.)

STEP 3: Final Proposal & Approvals: Attach a final proposal in which you comprehensively explain all items in the "Proposal Criteria" table on the following page for the respective program type (i.e. credit or non-credit). This may require that you revise and elaborate on descriptions submitted as part of Step 1 based on any additional guidance received. Circulate and discuss the proposal with the noted individuals in the order in which they appear under Step 3 on the previous page (including the individuals noted in #5 by the Vice Provost for Academics), incorporating any necessary edits prior to securing their signature. Please note that this step does require securing a second signature from individuals who approved the initial proposal in Step 1, including signatures from cooperating department chairs and deans as applicable. Complete proposals and signatures should be sent via PDF to academics@villanova.edu. Final review and approval will be conducted by the Vice Provost for Academics. If a new degree is approved, it will then be submitted to the Academic Affairs Committee of the Board of Trustees for review and approval. Normally, this process would not exceed four months following the final approval of the Vice Provost for Academics.

PROPOSAL CRITERIA		CREDIT	NON-CREDIT
1	Describe the program's objectives	X	X
2	Justify the program in terms of the University's mission and strategic plan. Any new academic program and changes to existing programs must be grounded in, and must be an implementation of, the University's strategic plan.	X	X
3	Market Analysis – Identify competitors, explain the program's unique position, likely student profile and demand.	X	X
4	Program Structure – Explain the adequacy of existing courses, need for new courses, frequency of course offerings and provide a sample curriculum sequence and academic calendar.	X	X
5	Program Delivery – Describe the modality and technology to be used. For online and hybrid programs, also describe asynchronous and synchronous elements, the relationship to the campus program (if applicable) and any residency requirements.	X	X
6	Explain any impact on existing curricula in other departments and Villanova colleges.	X	X
7	Provide a timetable for implementation including a course development plan.	X	X
8	Budget Analysis: Any academic program must have a budget and human resource base that substantially guarantees its sustainability without adverse impact on other programs. a) Provide anticipated revenue (credits/enrollments) and expenses (faculty, staff and technology). Please specifically list any new faculty or staff who will need to be hired. Also describe the cumulative effect of the additions/changes on the existing credits/revenue and expenses/resources of the college.	X	X
	b) Provide a detailed <u>three year budget</u> and any supporting documentation <u>using the template provided below.</u> Projections should be reviewed and discussed with the college finance director.	X	
9	Explain the admission and completion requirements including the frequency of new student starts.	X	
10	Third-Party, Vendor and/or Corporate Relationships – Analyze the pros/cons of partnering and describe the scope of proposed services, breakdown of responsibility by major functional area, financial arrangements, proposed length of partnership and vendor/partner support team.	X	X
11	Assess the adequacy and availability of student academic support areas (e.g. library, learning commons, career center), facilities (classroom, lab, office space), special equipment, etc.	X	X
12	Accreditation (Regional and Professional) – Provide a fully developed assessment plan including an explicit statement of student learning objectives and outcomes, measurement techniques, assessment schedule and the process by which the information will be used to inform future improvements.	X	

Budget Template (see #8b in "Proposal Criteria" table above):

<u>Entrepreneurial Program</u>

Tuition Rate
Special Fee(s)
Projected New Students
Projected Total Enrollment

Gross Revenue
- University Overhead[1]
- Fin Aid/Scholarships

Net Revenue

Expenses
Full-Time Faculty Salary (In Load)[2]
Faculty Salary (Adjunct/Overload)
Course Development Expenses
Staff Salary
Benefits[3]
Program Expenses
Marketing Expenses
Other General & Admin Expenses
Total Expenses

Net Profit (Deficit)

<u>Traditional University Program (Undergrad/Summer/Grad)</u>

Tuition Rate
Special Fee(s)
Projected New Students
Projected Total Enrollment

Gross Revenue
- Fin Aid/Scholarships

Net Revenue

Expenses
Faculty Salary (Adjunct/Overload)
Course Development Expenses
Staff Salary
Program Expenses
Marketing Expenses
Other General & Admin Expenses
Total Expenses

Net Profit (Deficit)

Notes: [1]15% on first $1 million in revenue; 8% thereafter; [2]1/8 of base salary per three credit course taught (in load); [3] 30% of full-time faculty and full-time staff salary; 10% of adjunct/overload.