EVALUATION OF PAST CURRICULUM TO ALIGN WITH CURRENT EDUCATIONAL GUIDELINES WITHIN INFORMATION TECHNOLOGY

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ABSTRACT

Evaluation of Past Curriculum to Align with Current Educational Guidelines within Information Technology. Craft, Michaela Eatmon Caroline, 2022. Capstone Paper, University of North Carolina Wilmington.

Evaluation of Past Curriculum to Align with Current Educational Guidelines within Information Technology evaluates IT curricular guidelines and the Special Interest Group on the IT Education program compliance score to improve the quality of the general IT program at the University of North Carolina Wilmington. A survey was conducted that outlined the re-structured *essential* IT domains and subdomains. Participants were instructed to estimate the number of learning or contact hours devoted to each IT domain. Some domains such as ITE-IST Integrated Systems Technology and ITE-SIA System Integration and Administration were found to have few reported contact hours which do not meet learning hour requirements. In this case, it was recommended to add a course that introduces the topics covered in both domains. In addition, IT field trends also indicate that cybersecurity and networking are skills that have seen industry growth. Increasing the essential workload for these domains is recommended.

Keywords: curricular changes, essential curriculum, guidelines

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CHAPTER 1: INTRODUCTION

1.1 Guidelines

When the Institute of Electrical and Electronic Engineers/Association for Computing Machinery (IEEE/ACM) first published the first IT curriculum guidelines in 2008, it created a standard for universities to follow when designing IT programs. The IT educators of the University of North Carolina at Wilmington (UNCW) followed IT2008 when adopting their current curriculum. For almost ten years, the IT2008 served as a standard in curriculum creation. However, IEEE/ACM revised the guidelines in 2017 (IT2017) to keep up with the technological developments in the IT industry. Despite changes to the guidelines, UNCW's IT program has not been restructured to adhere to the latest version of the document. Not only does this mean that the curriculum is outdated resulting in grossly underprepared graduates, but the repercussions of outdated curricula can affect the reputation of UNCW.

1.2 SIGITE Scores

In association with the ACM, the Special Interest Group on IT Education (SIGITE) uses the IEEE/ACM guidelines to evaluate the potential effectiveness of undergraduate IT-like programs in universities across the country. Companies relying on graduates to work for them need to be able to trust that new hires are prepared for life outside of the confines of a university setting. By using the guidelines as a benchmark, employers can evaluate applicants' educational histories to decide if they feel the individual applicant has had adequate training. The result of non-compliance with the current guidelines results in the specific university's IT program obtaining lower SIGITE scores. Low SIGITE scores can have a direct impact on student enrollment as students might not be confident in their decision to attend a university for the IT program. A Low

SIGITE score might also affect receiving grants if the individual does not feel the program is an asset to the community.

UNCW's 2021 SIGITE score for the IT program has been rated at 2.74 out of 5 (SIGITE Scores 2021). For all colleges in North Carolina with IT-like programs evaluated, this puts UNCW's IT program at the lowest for state universities and fourth out of the six North Carolina colleges evaluated. This means that if a student who wishes to earn a degree in the state of North Carolina searches for a *general* IT program based on scoring alone, schools such as A&T (3.62), Pembroke (3.54), and East Carolina University (3.33) will be higher on his/her list of potential universities.

1.3 Document Overview

The purpose of this project is to identify areas of study within UNCW's IT program that are not best aligned with IT2017. Chapter 2 of this document discusses the changes made in the IT201 and briefly mentions trends that support the IT2017. To create suggestions on how to revise the program and thus improve the overall SIGITE score, a survey was conducted to give insight into where UNCW IT classes focused their learning hours. Chapter 3 covers the method of collecting the learning hour data. The information used has been collected from IT educators from UNCW's Information Technology department whose courses have been identified as "core" or classes are required regardless of concentration in the IT program. The result of the survey is covered in Chapter 4. Options for moving forward in updating the curriculum will be provided in the conclusion section of Chapter 5. The last section of the chapter evaluates how the project might be expanded in the future.

CHAPTER 2: REVIEW OF THE IT2017 ACM CURRICULUM AND ANALYSIS

2.1 Definition of Terms

Throughout this literature review and analysis, there are a few terms that may be unfamiliar to readers. *Core* and *Essential* domains refer to the items within the curricular framework that all students are required to learn at the time of graduation. The terms *Core* and *Essential* can be used interchangeably. However, *Core* is the term given to the coursework in IT2008, whereas *Essential* is in reference to the domains in IT2017. *Supplemental* domains are the learning hours that provide extra training that may be acquired based on the individual student or a particular concentration. It is important to note that some supplemental and essential coursework might crossover. For the sake of simplicity, the focus of the project and the proceeding two chapters are solely on the Core/Essential domains and their subdomains.

Lastly, there will be frequent use of the term *learning hours.* Learning hours are sometimes used interchangeably with *contact hours*. The IT2017 defines one learning hour as a 50-minute class where an instructor facilitates learning with their students and does not include instructor preparation or a student's study time outside of class (p.30). Learning hours should not be confused with *credit hours* as credit hours are calculated for a student's degree requirements.

2.2 Introduction to The Pillars of Knowledge

The IT2008 focused on a system of core instruction based on "five pillars of knowledge." Figure 2.1 shows the envisioned model that was outlined in the IT2008. The five fundamentals were programming, networking, human-computer interaction, databases, and web servers. These core concepts were not intended to only represent knowledge in first-year or introductory courses; Instead, the intention was to cover a

body of knowledge that is common in all IT programs (ACM/IEEE 2008).

Information assurance and security, along with professionalism had been interwoven or supported by the pillars. However, at the time of publication, technology has progressed leaps and bounds. For example, the first models of the iPhone had just been released only a few months before the release of the IT2008. Now, smartphones have taken over the market in ways that could not have been predicted 14 years ago. So, while the pillars model might have worked for several years, it needed to be reevaluated for relevancy in the modern IT environment.

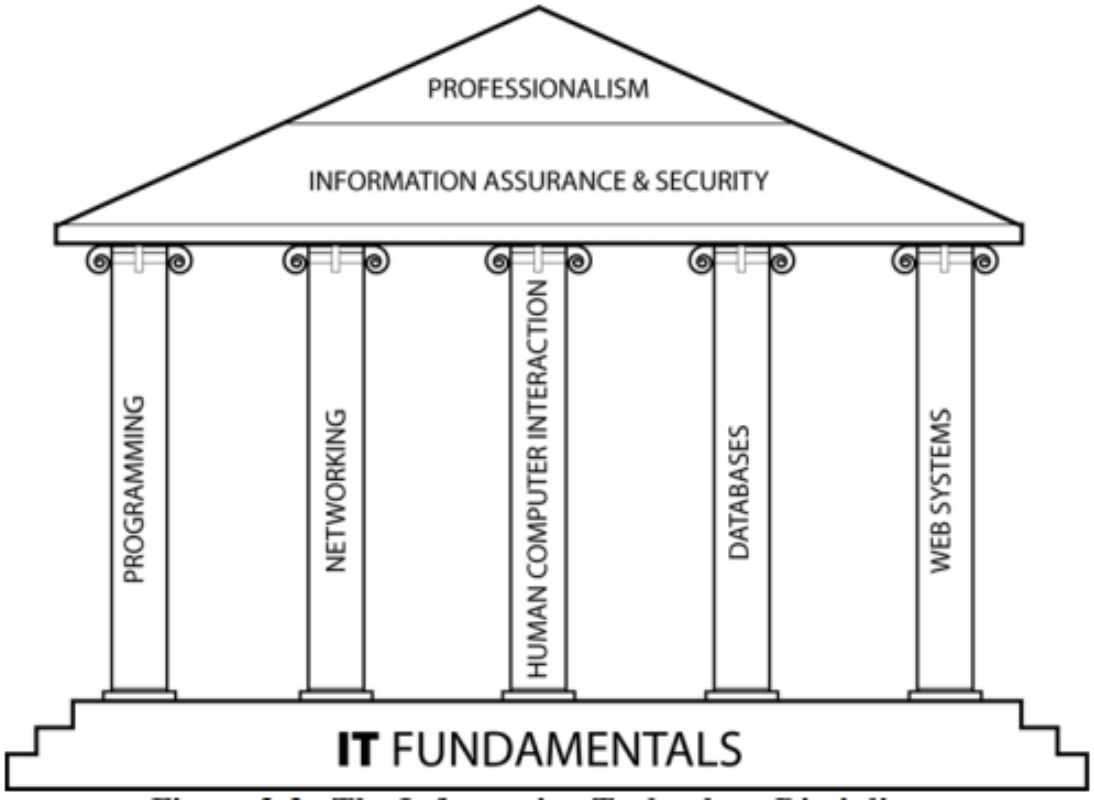


Figure 2.1 The Information Technology Discipline.
Note. ACM/IEEE. (2008) [Information Technology Discipline]. Retrieved February 24, 2022.

2.3 *Knowledge Island*

The IT2017 describes the new model as more of a map, rather than a building with pillars as shown in Figure 2.2. Many of the original "pillars" are now shown as

mountain peaks whereas related topics are shown in the valley below the mountains. Since the IT field is interdisciplinary, there is no reason to have individual pillars of concentration.

Figure 2.2. "The IT Island."
Note. Gamboa, J.M. (2017)[A modern illustration depicting the field of IT] Retrieved April 21, 2022.

2.3.1 Networking. Wireless technology has evolved significantly in the last decade. As a result, IT professionals must support applications on mobile computing devices. One major change in the last few years has been the transition from 4G networks to 5G. When the IT2008 was released, 3G cellular technology was state-of-the-art and data rates were 3 Mbps (Kang et al., 2018). Now, that is no longer the case.

2.3.2 Information Assurance and Security. The industry has also made a shift to expecting jobs in cybersecurity to grow. In a survey, IT professionals had to select hard

skills that they identified would be useful in the mid-2020s. The highest were cybersecurity, project management, cloud computing, and web systems. While project management/soft skills were rated the highest, Cybersecurity came in a close second with a 73% appeal (ACM/IEEE, 2017).

While security breaches are not new, they are becoming more common as more companies are managing credit cards, and bank accounts, and transitioning to cloud computing. In 2005, 157 data breaches were reported; In 2017, the number increased by nearly 500 percent to 1,579 (Johnson, 2021). In one instance the retail company, Target, experienced a data breach in 2013. This resulted in an estimated 70-110 million credit and debit card records being stolen (Popken, 2014).

2.3.3 Professionalism and Soft Skills. A large portion of employment does not depend on concepts learned in an academic setting. One of the biggest changes in the industry in the last couple of years has been the emphasis on intrapersonal skills. In a 2019 report, the Society for Human Resource Management found that some of the most missed skills were intrapersonal communication, critical thinking, and the ability to handle complexity (Wilkie, 2020). These skills fall under the umbrella term *soft skills*. Soft skills are considered "uniquely human," or behaviors and functions machines cannot perform. Whereas *hard skills* are technical skills that can be developed through training. Other examples of soft skills include the ability to communicate effectively, being able to reason to make decisions, empathize with teammates, and act with accountability. During a survey facilitated by The Economist Intelligence Unit, of the 343 executives,72% cited that critical thinking skills were a top priority and 63% cited that collaboration was a highly sought-after skill as well (ACM/IEEE, 2017).

Figure 2.3 shows a graphic on how employers would describe the preparedness of

new college graduates. While not a graphic solely identifying the skills of IT graduates, it does identify the failure of the academic system in career preparedness. In addition, according to another study done in 2019 by The National Associate of Colleges and Employers (NACE), technical skills were only placed 10th in the most endorsed skill of the 172 respondents (Newell & Ulrich, 2022).

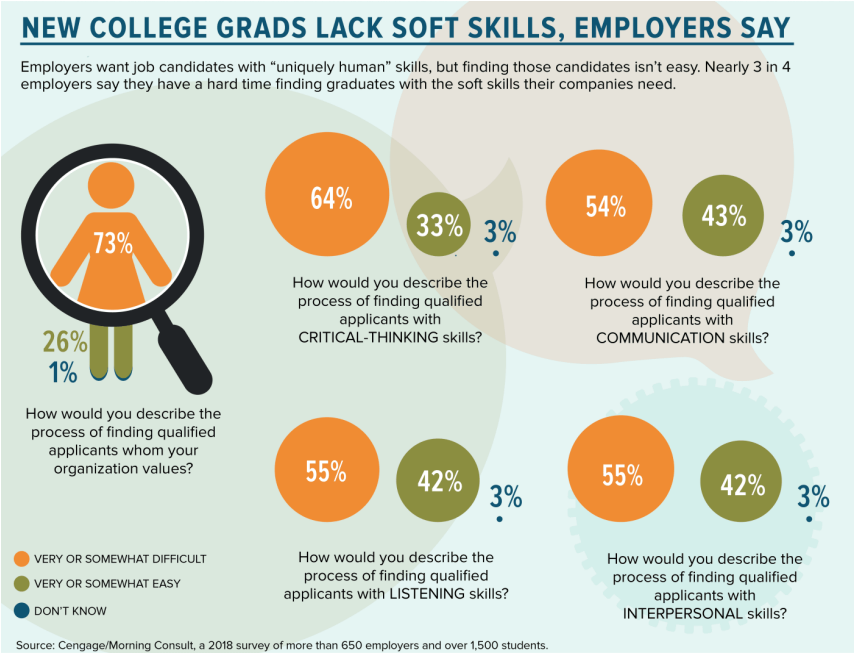


Figure 2.3. Lacking Soft Skills.
Note. Cengage Morning Consult. (2018). [New College Grads Lack Soft Skills] Retrieved July 12, 2022.

Of course, soft skills are acquired through life experiences. The IT2017 makes note of this. However, a solution will be to require students to take a communication course. Multiple ones focusing on reading, writing, and speaking if necessary. As more and more companies integrate with technology the ability to convey information and ideas effectively should be of utmost importance as a mistake could be costly. An emphasis on teamwork within the classroom setting has also been suggested as the IT field has become a group effort in the last decade. Team members need to exercise different leadership roles and volunteer when no roles have been pre-assigned. Teamwork

not only improves their communication skills but also students can learn how to work with those of different backgrounds making a small-scale example of how a workplace will potentially function.

2.4 Domain Changes

With industry changes in mind, the IT2017 outlines the following design principles for curriculum design regardless of local adaption (p. 45-46):

- The curriculum must reflect the integrity and character of information technology as an independent discipline.
- The curriculum must respond to the rapid technological change and encourage students to do the same.
- Curriculum design must be guided by the outcomes the program is intended to achieve.
- The curriculum should maintain a consistent ethos that promotes innovation, creativity, and professionalism.
- The curriculum should be accessible to a wide range of students.
- The curriculum must provide students with a capstone experience that gives them a chance to apply their skills and knowledge to solve a challenging problem.
- The faculty should constantly be looking for better ways to deliver the curriculum.

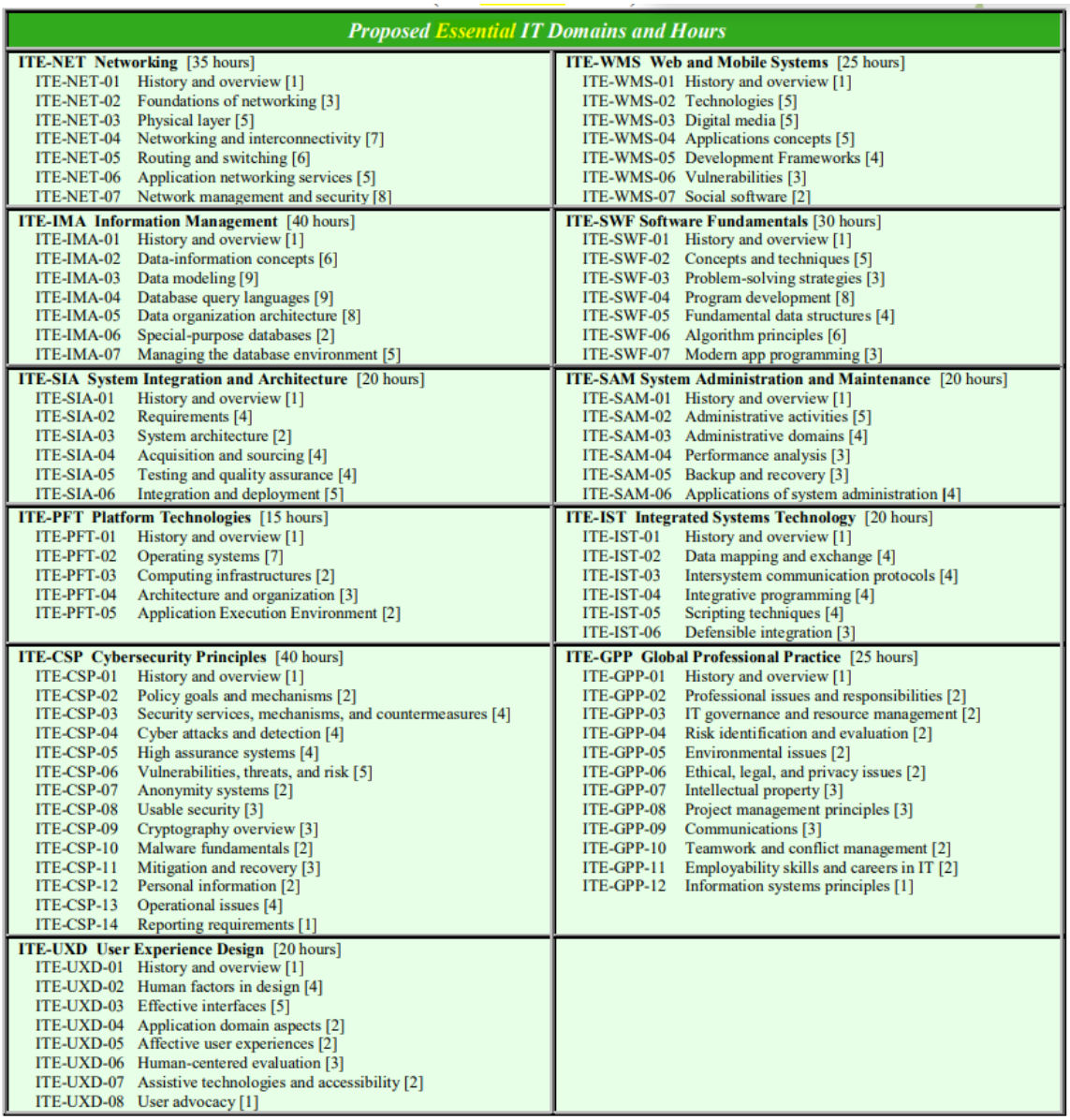
A couple of changes can be noted for IT2008 and IT2017. The overall core/essential learning hours have been reduced from 314 to 290. However, this does not mean that the IT2017 has fewer required hours overall. Instead, mathematics and statistics (Figure 2.4), which are frequently handled by other departments, have been

separated outside of the IT core. A proposed suggestion would be that students should be required to take around 30 learning hours of mathematical instruction.

Proposed IT Essential Mathematics Domain	
ITM-DSC Discrete Structures [30 hours]	
ITM-DSC-01	History and overview [1]
ITM-DSC-02	Sets [2]
ITM-DSC-03	Functions and relations [3]
ITM-DSC-04	Proof techniques [3]
ITM-DSC-05	Logic [2]
ITM-DSC-06	Boolean algebra principles [2]
ITM-DSC-07	Minimization [3]
ITM-DSC-08	Graphs and trees [4]
ITM-DSC-09	Combinatorics [3]
ITM-DSC-10	Iteration and recursion [2]
ITM-DSC-11	Complexity Analysis [2]
ITM-DSC-12	Discrete information technology applications [3]

Figure 2.4. Proposed IT Essentials Mathematics Domain.
Note. IEEE/ACM. (2017). [Proposed IT Essentials Mathematics Domain]. Retrieved April 24, 2022.

The Networking (NET) domains are still required. As stated earlier in the chapter the need for NET has increased in the last decade. Thus, IT2017 recommends the learning hours be increased from 22 to 35. Outside of the additional "History/Overview" and "Networking and Interconnectivity" subdomains, the other topics of study remain largely intact. The learning hours, however, have been rebalanced. Security and Network management have increased learning hours from two and two to eight in total. Application areas have also increased from one hour to five. Other mostly intact domains outside of a few learning hour changes include Information Management (IM/ITE-IMA), Integrative Programming & Technologies (IPT/ITE- IST), and System Administration and Maintenance (SA/ITE-SAM). Figure 2.5 shows the "Proposed Essential IT Domains and Hours."



Proposed Essential IT Domains and Hours

ITE-NET Networking [35 hours]
- ITE-NET-01 History and overview [1]
- ITE-NET-02 Foundations of networking [3]
- ITE-NET-03 Physical layer [5]
- ITE-NET-04 Networking and interconnectivity [7]
- ITE-NET-05 Routing and switching [6]
- ITE-NET-06 Application networking services [5]
- ITE-NET-07 Network management and security [8]

ITE-WMS Web and Mobile Systems [25 hours]
- ITE-WMS-01 History and overview [1]
- ITE-WMS-02 Technologies [5]
- ITE-WMS-03 Digital media [5]
- ITE-WMS-04 Applications concepts [5]
- ITE-WMS-05 Development Frameworks [4]
- ITE-WMS-06 Vulnerabilities [3]
- ITE-WMS-07 Social software [2]

ITE-IMA Information Management [40 hours]
- ITE-IMA-01 History and overview [1]
- ITE-IMA-02 Data-information concepts [6]
- ITE-IMA-03 Data modeling [9]
- ITE-IMA-04 Database query languages [9]
- ITE-IMA-05 Data organization architecture [8]
- ITE-IMA-06 Special-purpose databases [2]
- ITE-IMA-07 Managing the database environment [5]

ITE-SWF Software Fundamentals [30 hours]
- ITE-SWF-01 History and overview [1]
- ITE-SWF-02 Concepts and techniques [5]
- ITE-SWF-03 Problem-solving strategies [3]
- ITE-SWF-04 Program development [8]
- ITE-SWF-05 Fundamental data structures [4]
- ITE-SWF-06 Algorithm principles [6]
- ITE-SWF-07 Modern app programming [3]

ITE-SIA System Integration and Architecture [20 hours]
- ITE-SIA-01 History and overview [1]
- ITE-SIA-02 Requirements [4]
- ITE-SIA-03 System architecture [2]
- ITE-SIA-04 Acquisition and sourcing [4]
- ITE-SIA-05 Testing and quality assurance [4]
- ITE-SIA-06 Integration and deployment [5]

ITE-SAM System Administration and Maintenance [20 hours]
- ITE-SAM-01 History and overview [1]
- ITE-SAM-02 Administrative activities [5]
- ITE-SAM-03 Administrative domains [4]
- ITE-SAM-04 Performance analysis [3]
- ITE-SAM-05 Backup and recovery [3]
- ITE-SAM-06 Applications of system administration [4]

ITE-PFT Platform Technologies [15 hours]
- ITE-PFT-01 History and overview [1]
- ITE-PFT-02 Operating systems [7]
- ITE-PFT-03 Computing infrastructures [2]
- ITE-PFT-04 Architecture and organization [3]
- ITE-PFT-05 Application Execution Environment [2]

ITE-IST Integrated Systems Technology [20 hours]
- ITE-IST-01 History and overview [1]
- ITE-IST-02 Data mapping and exchange [4]
- ITE-IST-03 Intersystem communication protocols [4]
- ITE-IST-04 Integrative programming [4]
- ITE-IST-05 Scripting techniques [4]
- ITE-IST-06 Defensible integration [3]

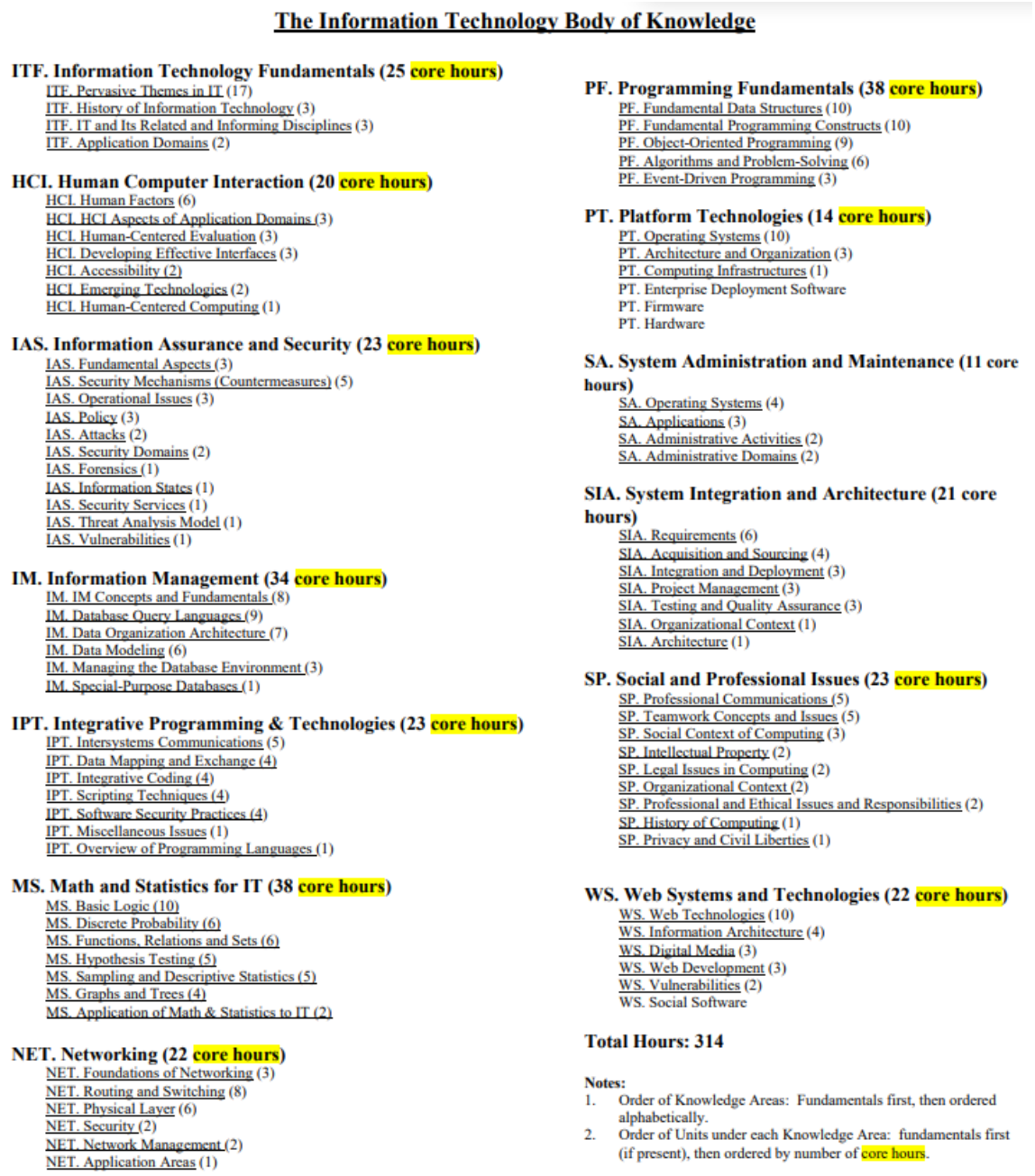
ITE-CSP Cybersecurity Principles [40 hours]
- ITE-CSP-01 History and overview [1]
- ITE-CSP-02 Policy goals and mechanisms [2]
- ITE-CSP-03 Security services, mechanisms, and countermeasures [4]
- ITE-CSP-04 Cyber attacks and detection [4]
- ITE-CSP-05 High assurance systems [4]
- ITE-CSP-06 Vulnerabilities, threats, and risk [5]
- ITE-CSP-07 Anonymity systems [2]
- ITE-CSP-08 Usable security [3]
- ITE-CSP-09 Cryptography overview [3]
- ITE-CSP-10 Malware fundamentals [2]
- ITE-CSP-11 Mitigation and recovery [3]
- ITE-CSP-12 Personal information [2]
- ITE-CSP-13 Operational issues [4]
- ITE-CSP-14 Reporting requirements [1]

ITE-GPP Global Professional Practice [25 hours]
- ITE-GPP-01 History and overview [1]
- ITE-GPP-02 Professional issues and responsibilities [2]
- ITE-GPP-03 IT governance and resource management [2]
- ITE-GPP-04 Risk identification and evaluation [2]
- ITE-GPP-05 Environmental issues [2]
- ITE-GPP-06 Ethical, legal, and privacy issues [2]
- ITE-GPP-07 Intellectual property [3]
- ITE-GPP-08 Project management principles [3]
- ITE-GPP-09 Communications [3]
- ITE-GPP-10 Teamwork and conflict management [2]
- ITE-GPP-11 Employability skills and careers in IT [2]
- ITE-GPP-12 Information systems principles [1]

ITE-UXD User Experience Design [20 hours]
- ITE-UXD-01 History and overview [1]
- ITE-UXD-02 Human factors in design [4]
- ITE-UXD-03 Effective interfaces [5]
- ITE-UXD-04 Application domain aspects [2]
- ITE-UXD-05 Affective user experiences [2]
- ITE-UXD-06 Human-centered evaluation [3]
- ITE-UXD-07 Assistive technologies and accessibility [2]
- ITE-UXD-08 User advocacy [1]

Figure 2.5. Proposed Essential Domains.
Note. IEEE/ACM. (2017). [Proposed Essential IT Domains and Hours]. Retrieved April 24, 2022.

Domains that have been renamed to be more flexible but still have equivalency with the IT2008 include Information Assurance and Security (IAS) which has been restructured and renamed to Cybersecurity Principles (ITE-CSP), and Programming Fundamentals (PF) has been renamed to Software Fundamentals (ITE-SWF). Figure 2.6 shows the "Information Technology Body of Knowledge."



The Information Technology Body of Knowledge

ITF. Information Technology Fundamentals (25 core hours)
- ITF. Pervasive Themes in IT (17)
- ITF. History of Information Technology (3)
- ITF. IT and Its Related and Informing Disciplines (3)
- ITF. Application Domains (2)

HCI. Human Computer Interaction (20 core hours)
- HCI. Human Factors (6)
- HCI. HCI Aspects of Application Domains (3)
- HCI. Human-Centered Evaluation (3)
- HCI. Developing Effective Interfaces (3)
- HCI. Accessibility (2)
- HCI. Emerging Technologies (2)
- HCI. Human-Centered Computing (1)

IAS. Information Assurance and Security (23 core hours)
- IAS. Fundamental Aspects (3)
- IAS. Security Mechanisms (Countermeasures) (5)
- IAS. Operational Issues (3)
- IAS. Policy (3)
- IAS. Attacks (2)
- IAS. Security Domains (2)
- IAS. Forensics (1)
- IAS. Information States (1)
- IAS. Security Services (1)
- IAS. Threat Analysis Model (1)
- IAS. Vulnerabilities (1)

IM. Information Management (34 core hours)
- IM. IM Concepts and Fundamentals (8)
- IM. Database Query Languages (9)
- IM. Data Organization Architecture (7)
- IM. Data Modeling (6)
- IM. Managing the Database Environment (3)
- IM. Special-Purpose Databases (1)

IPT. Integrative Programming & Technologies (23 core hours)
- IPT. Intersystems Communications (5)
- IPT. Data Mapping and Exchange (4)
- IPT. Integrative Coding (4)
- IPT. Scripting Techniques (4)
- IPT. Software Security Practices (4)
- IPT. Miscellaneous Issues (1)
- IPT. Overview of Programming Languages (1)

MS. Math and Statistics for IT (38 core hours)
- MS. Basic Logic (10)
- MS. Discrete Probability (6)
- MS. Functions, Relations and Sets (6)
- MS. Hypothesis Testing (5)
- MS. Sampling and Descriptive Statistics (5)
- MS. Graphs and Trees (4)
- MS. Application of Math & Statistics to IT (2)

NET. Networking (22 core hours)
- NET. Foundations of Networking (3)
- NET. Routing and Switching (8)
- NET. Physical Layer (6)
- NET. Security (2)
- NET. Network Management (2)
- NET. Application Areas (1)

PF. Programming Fundamentals (38 core hours)
- PF. Fundamental Data Structures (10)
- PF. Fundamental Programming Constructs (10)
- PF. Object-Oriented Programming (9)
- PF. Algorithms and Problem-Solving (6)
- PF. Event-Driven Programming (3)

PT. Platform Technologies (14 core hours)
- PT. Operating Systems (10)
- PT. Architecture and Organization (3)
- PT. Computing Infrastructures (1)
- PT. Enterprise Deployment Software
- PT. Firmware
- PT. Hardware

SA. System Administration and Maintenance (11 core hours)
- SA. Operating Systems (4)
- SA. Applications (3)
- SA. Administrative Activities (2)
- SA. Administrative Domains (2)

SIA. System Integration and Architecture (21 core hours)
- SIA. Requirements (6)
- SIA. Acquisition and Sourcing (4)
- SIA. Integration and Deployment (3)
- SIA. Project Management (3)
- SIA. Testing and Quality Assurance (3)
- SIA. Organizational Context (1)
- SIA. Architecture (1)

SP. Social and Professional Issues (23 core hours)
- SP. Professional Communications (5)
- SP. Teamwork Concepts and Issues (5)
- SP. Social Context of Computing (3)
- SP. Intellectual Property (2)
- SP. Legal Issues in Computing (2)
- SP. Organizational Context (2)
- SP. Professional and Ethical Issues and Responsibilities (2)
- SP. History of Computing (1)
- SP. Privacy and Civil Liberties (1)

WS. Web Systems and Technologies (22 core hours)
- WS. Web Technologies (10)
- WS. Information Architecture (4)
- WS. Digital Media (3)
- WS. Web Development (3)
- WS. Vulnerabilities (2)
- WS. Social Software

Total Hours: 314

Notes:
1. Order of Knowledge Areas: Fundamentals first, then ordered alphabetically.
2. Order of Units under each Knowledge Area: fundamentals first (if present), then ordered by number of core hours.

Figure 2.6. Information Technology Body of Knowledge.
Note. This image shows the original core domains found in the IT2008. IEEE/ACM. (2008). [The Information Technology Body of Knowledge]. Retrieved April 24, 2022.

The IT2008 includes Information Assurance and Security (IAS) as part of the core curriculum recommending the student receive 23 learning hours. This domain has been removed. The IT2017 equivalent of this domain can be identified as Cybersecurity. However, the learning hours are required to be 40 hours. This, in part, is due to the

increase of required principles. All domains in IT2017 have had history and overview as a subdomain added, however, cybersecurity has become the largest domain within the suggested curriculum guidelines. New subdomains include *cyber-attacks and detection*, *cryptography overview*, *malware fundamentals*, *mitigation and recovery*, and *high assurance systems.*

Another notable change in the body of knowledge has been the removal of the Human-Computer Interaction domain or HCI. HCI had been previously considered one of the pillars of the "five pillars of knowledge." Given how humans interact with computers differently with the emergence of mobile devices, HCI had to be restructured and redefined. The domain that replaces the original HCI is now User Experience Design (ITE-UXD). The IT2017 outlines the expectations that UXD learning hours should provide:

1. Understanding of advocacy for the user in the development of IT applications and system/
2. Development of a mindset that recognizes the importance of users, the context of use, and organizational contexts.
3. Employment of user-centered methodologies in the design, development, evaluation, and deployment of IT applications and systems
4. User and task analysis, human factors, ergonomics, accessibility standards, experience design, and cognitive psychology.

Some concepts do cross over from HCI to UXD. Both HCI and UXD have a subdomain of Human Factors. Below are the learning outcomes from HCI and UXD, respectively:

Core learning outcomes in HCI:

1. Describe the relationship between the cognitive principles and their application to interfaces and products.
2. Explain the conceptual terms for analyzing human interaction with products such as affordance, conceptual model, and feedback.
3. Analyze different user populations regarding their abilities and characteristics for using both software and hardware products.
4. Explain the importance of user abilities and characteristics in the usability of products.

Competencies in UXD's Human Factors in Design subdomain:

1. Explain the conceptual terms for analyzing human interaction with products (e.g., affordance and feedback).
2. Analyze two different user populations or user cultures regarding their abilities to use software and hardware products.
3. Explain the importance of user abilities and characteristics in the usability of products.
4. Illustrate two ways cognitive and social principles apply to product design.
5. Illustrate three ways that physical aspects of product design affect usability.
6. Identify two goals, activities and tasks related to an UX project.
7. Describe how creative innovation techniques such as brainstorming can lead to the optimal user interface.

UXD's first four competencies match the learning outcomes for the equivalent subdomain in HCI. However, the list has been expanded to include user experience concepts in addition to just how an individual interacts with a computer.

In addition, due to the increase of smartphones and social media, another domain that existed but has seen a restructuring has been Web Systems and Technologies (WS). Now called Web and Mobile Systems (ITE-WMS), this domain has adopted *application concepts*, *development frameworks,* and *social software* as subdomains. The learning outcomes of these include understanding the characteristics of various web and mobile-based communication, being able to develop a mobile application, and being able to discuss constraints that are put on mobile developers.

2.5 SIGITE Data

Another document in addition to the IT2017 that should be reviewed is the SIGITE spreadsheet. As stated in Chapter 1, SIGITE uses a five-point system to rate a school's IT program on effectiveness. The scoring system is based on the credit hours/course list the school advertises on its website and does not necessarily mean the IT program fails in quality.

Table 2.1 shows the first part of the rationale behind the 1.52 rating of the essential topics. The maximum score a university program can receive on this section is a score of two. For topics based on growing industries that were mentioned earlier in Chapter 2, there are more than three credit hours required in each domain. Because these are growing careers within IT, the expectation is that students need to receive more instruction. MIS/CIT 324 is the only instance of a class that fully embraces the CSP domain, resulting in a compliance factor of 0.5 instead of one as the students are only required to take three credit hours instead of six. The same can be said for the NET domain. The only core/essential course in the ITE-NET domain is MIS/CIT 320. As a result, the ITE-NET domain has only a 0.5 compliance factor. ITE-SWF is also missing two credit hours to get the full compliance factor point. ITE-SWF currently sits at 0.6.

A course that falls specifically in the IT-IST domain has not been identified. This would be consistent with the reported learning hours in the domain being 8 in the program. The courses with the ITE-ISP learning hours are MIS/CIT 324 and MIS/CIT 310. The courses fall under ITE-CSP and ITE-WMS, respectively. Without any required credits, the compliance factor for this domain will be factored in as 0.

Table 2.1. Essential Curriculum Compliance Factors

Essential IT Domains					
ITE-CSP (Cybersecurity)	CIT 324	Information Security Manag	3	0.5	.5 if ≈3; 1 if ≈6
ITE-IMA (Information Management)	CIT 213 / MIS 315	Intro to Databases / Manag	6	1	.5 if ≈3; 1 if ≈6
ITE-NET (Networking)	CIT 320	Network Fundamentals	3	0.5	.5 if ≈3; 1 if ≈6
ITE-SPA (System Paradigms)	CIT 352 / CIT 411	System Administration / Inf	6	1	.5 if ≈3; 1 if ≈6
ITE-UXD (User Experience)	CIT 425	Human-Computer Interface	3	1	1 if ≈3
ITE-GPP (Global Professional Practice)	CIT 480 / CSC 385	IT Resource Planning and M	6	1	1 if ≈3
ITE-IST (Integrated Systems Technology)				0	1 if ≈3
ITE-PFT (Platform Technologies)	CIT 225	Platform Technologies	3	1	1 if ≈2
ITE-SWF (Software Fundamentals)	CSC 131	Intro to Computer Science	3	0.6	1 if ≈5
ITE-WMS (Web and Mobile Systems)	CIT 310 / 410	Web Page Development / V	6	1	1 if ≈3
		(Essential) Scaled Score:	1.52		(2 maximum)
Supplemental IT Domains					
		Total Hours:	19		Required Hrs/24
Additional Notes:	Overflow(7) + Supplemental(3) + Electives(9) + Concentration/Emphasis()				
		Business Application Development			
		(Supplemental) Scaled Score:	0.791667		
Related IT Essential Mathematics					
ITM-DSC (Discrete Structures)					
Related IT Supplemental Mathematics					
ITM-SUP (Stats, Lin Alg, Calculus, etc)	MAT 151	Basic Calculus	3		
	STT 215	Intro to Stats	3		
		(Math) Scaled Score:	0.428571		1 if >7 Sem Cr Hrs
Capstone					
Capstone Project (Senior Year)					
		CIT 480 is considered the c			
		(Capstone) Scaled Score:	0		1 if ≥3
		Final Compliance Factor:	2.740238		

Note. SIGITE.(2021) [Compliance Factor UNC Wilmington]. Retrieved July 12, 2022.

The next section of the SIGITE results is the supplemental courses scaled score. While this project's main goal is to improve on the core/essential course load, it is important to note some of SIGITE's scoring has compliance factors that relate to the supplemental instruction. The required hours for a full point are 24. It is also possible that much of the supplemental score has to do with specific concentrations.

The last two sections of the SIGITE score can be evaluated together as both

sections had the most significant impact on the overall score. At the time of the SIGITE report, there was no requirement for a Discrete Structures course (ITM-DSC). Missing the core/essential mathematics makes the compliance factor of the program does not reach the required seven credit hours to receive the full compliance point. Capstones are not a part of core/essential domains but have also been included in the results as they will need to be addressed in the future. At the time of the score, SIGITE did not recognize the current capstone requirements described as sufficient and was factored in at zero.

CHAPTER 3: METHODOLOGY

3.1 Introduction

To make the proper recommendations to align the Information Technology program with the IT2017 guidelines and the SIGITE rating system, a survey must first be conducted so that the current core/essential curriculum learning hours can be evaluated. Once evaluated based on the data, a new curriculum path can be developed. The survey based on the current IT2017 learning hours in the essential curriculum includes responses from instructors who were teaching courses originally identified as a part of the core curriculum in IT2008.

3.2 Research Method and Approach

The research conducted was based on qualitative information. The survey was designed to measure the estimated learning hours each instructor believed their course covered. However, the data received can be considered subjective, as conclusions were reached based on the assumption that the information reported from the participants was both accurate and current.

3.3 Data Collections Methods and Tools

To get the required information to complete the project and make curriculum recommendations, participants were added to a Teams survey that contained an Excel spreadsheet where they were able to report learning hours beneath their name and course name. Table 3.1 provides an example of how the spreadsheet was setup.

The participants were to measure each of their reported learning hours on the left side column and on the right-side column to specify if the hours were (I)ntroductory, (M)easurable, or (P)ractice. Introductory represents the hours that students are lectured on or introduced to new concepts. Measurable means the time students are testing their

knowledge of the concepts, and practice can refer to in-class assignments and labs. These identifiers will not have a large presence in this document but will be helpful when calculating credit hours mentioned as mentioned in the Chapter 5 Future Work section.

Table 3.1. Survey Column Example

					Dorgan		M Ferner	
	I= Introduce	# = number			CIT 204		CIT 213	
	M=Measure	Contact hours are representaitve						
	P = Practice Using	of in-class hours.						
	Knowledge Areas		Required Course: Contact Hours	Actual Course Contact Hours	I= Introduce M=Measure # of Contact Hrs	P = Practice Using	I= Introduce M=Measure # of Contact Hrs	P = Practice Using
ITE-IMA Information Management [40 hours]			40	107.3				
	IMA-01 History and overview [1]			6.5			1	I= Introduce
	IMA-02 Data-information concepts [6]			49.8			37	P = Practice Using
	IMA-03 Data modeling [9]			14			0	
	IMA-04 Database query languages [9]			19			3	P = Practice Using
	IMA-05 Data organization architecture [8]			6			1	I= Introduce
	IMA-06 Special-Purpose databases [2]			4			0	
	IMA-07 Managing the database environment [5]			8			3	P = Practice Using

Note. Some of the data has already been filled in. An explanation of what each item means will be further in the document.

Columns A-B are identified as “Knowledge Areas” as seen in Table 3.2. These are the essential domains of knowledge outlined in the IT2017 guidelines. Each concept was outlined by name and in the brackets ([]) the hours recommended in each subject.

Each of the essential IT sub-domains outlined concepts students should be sufficient in by the end of their degree program. This survey did not include concepts learned in supplemental courses, as the knowledge learned in supplemental courses should complement the knowledge gained through essential courses.

3.4 Sample Selection

The method of using instructor-reported data was used due to identify what courses needed to be modified or removed based on the contact hours when compared with the hours outlined in IT2017. The participants chosen were done so based on whether their courses were identified as a part of the IT2008 core curriculum. Some instructors have multiple classes in the core curriculum scope and thus their names will show up on the survey more than once.

Table 3.2. Knowledge Area Example.

Knowledge Areas
ITE-SWF Software Fundametals [30 essential hours]
SWF-01 History and overview [1]
SWF-02 Concepts and techniques [5]
SWF-03 Problem-solving strategies [3]
SWF-04 Program development [8]
SWF-05 Fundamentals data structures [4]
SWF-06 Algorithm principles [6]
SWF-07 Modern app programming [3]
ITE-IMA Information Management [40 hours]
IMA-01 History and overview [1]
IMA-02 Data-information concepts [6]
IMA-03 Data modeling [9]
IMA-04 Database query languages [9]
IMA-05 Data organization architecture [8]
IMA-06 Special-Purpose databases [2]
IMA-07 Managing the database environment [5]
ITE-UXD User Experience Design [20 Essential Hours]

3.5 Research Process

A spreadsheet had been uploaded to UNCW's Microsoft Teams server on April 17th, 2022. During that time, an example of expected learning hours had been created to guide the participants. The participants were sent a link to the survey on April 19th, 2022. The link also contained a PDF giving instructions on how to fill out their estimated learning hours beneath their courses' section of the spreadsheet. See Appendix A for the instructions on how to complete the survey. Table 3.3 provides an example of required course contact hours compared to reported actual course contact hours. On April 20th, all participants became owners of the Teams Excel file, so everyone had easier access to notifications.

The original deadline had been set for Sunday, April 24, 2022. However, due to the short period between the survey's release time and the deadline, it was decided that the time to complete the survey should be extended to May 1st, 2022.

Table 3.3. Contact Hour Requirements and Estimates

Required Course: Contact Hours	Actual Course Contact Hours
320	444.6

Note. Column D, Row 116 calculates all the learning hours identified on Row 116

3.6 Data Analysis

An analysis of the estimated learning hours provided by the data gathered from the spreadsheet was performed. The current estimated hours were compared with the recommended hours provided by the IT2017. The data was used in restructuring the curriculum and providing recommendations in compliance with the IT2017 and SIGITE guidelines.

3.7 Other Considerations

Having needed to collect data on a small timeframe and during the final few weeks of the Spring semester, it was understood that many instructors might not have the time to input their data as the estimated learning hours required some calculation by using course notes and syllabi. It should also be noted that while the aim would be all participants filling out the spreadsheet with their courses' estimated learning hours, the data was collected voluntarily. The participates could enter and edit their data freely or

choose not to participate at all.

3.8 Research Limitations

For the data that was collected, a few limitations could occur:

- Because the data collecting was conducted fully online, email reminders sent to the participants inviting them to have access to the spreadsheet and server, might be ignored.
- Some instructors might not understand how to use the Excel sheet uploaded on to Microsoft Teams.
- Many of the learning hours are "assumed." Actual hours might not meet the full expectations.
- Some instructors might choose to not enter data at all OR not know what data to use
- There were some instructors who did not distinguish between hours in instruction, practice, and measure and a miscalculation of hours occurred.
- If instructors were re-evaluated, they might change their reporting entirely.

In the future, if the survey is to be taken once more in a similar format, it should be recommended that the instructors meet in person and discuss how to properly fill out the forms. Clarifying further what each subdomain means, and how to identify what learning hour category their reported hours fall under.

CHAPTER 4: RESULTS OF COMPLETED SURVEY

The results of the survey have been broken down into Tables 4.1-4.11. It is important to note that each three-credit-hour course should be roughly 42 lecture hours per semester using IT2017 recommended 1 hour a week for 14 weeks plus a week for exams. A three-credit-hour class with one lecture a week and two hours of lab will end up totaling 14 hours in lecture and 84 lab hours. A class consisting of mostly lab hours does not affect the analysis of balancing the learning hours to satisfy the guidelines, but it does affect if the course reaches the recommended criteria for credit hour calculation.

Table 4.1. Software Fundamentals Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-SWF Software Fundametals [30 essential hours]	30	74.5
SWF-01 History and overview [1]		7.5
SWF-02 Concepts and techniques [5]		17
SWF-03 Problem-solving strategies [3]		14
SWF-04 Program development [8]		14
SWF-05 Fundamentals data structures [4]		5
SWF-06 Algorithm principles [6]		9
SWF-07 Modern app programming [3]		8

Overall, the ITE-SWF Software Fundamentals domain has been satisfied to meet the IT2017 guidelines at 74.5 contact hours estimated. There do seem to be higher learning hours associated with SWF-02 Concepts and SWF-03 Techniques and Problem-solving Strategies. The least amount of learning hours in respect to the recommendation would be Fundamentals and Data Structures which has a total of five learning hours reported with four learning hours recommended.

The course having the most learning hours associated with ITE-SWF has been identified as Business Application Development or MIS/CIT 316. Not only does this course involve practice using concepts from ITE-SWF, but it also has five learning hours.

In total, it has been estimated that roughly three learning hours are used as an introduction (I) and 46 practice (P) hours out of the 49 total estimated hours.

CIS 131 Introduction to Computer Science has the second most hours in the ITE-SWF domain. This course was used in the ITE-SWF section of the SIGITE compliance factor. There is a total of 27 hours within the ITE-SWF domain with most of the instruction and practice involving SWF-02, SWF-03, and SWF-04 Program Development. The total number of hours reported for the class is 46. While there does seem to be a heavy focus on the students' practicing concepts, it is hard to identify if this class would be considered a lecture or a lab-only class at the time it was taught, however, if it is a one-hour lecture and two-hour lab class the total lecture and lab hours might need to be looked at for further evaluation and adjustment.

Table 4.2. Information Management Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-IMA Information Management [40 hours]	40	107.3
IMA-01 History and overview [1]		6.5
IMA-02 Data-information concepts [6]		49.8
IMA-03 Data modeling [9]		14
IMA-04 Database query languages [9]		19
IMA-05 Data organization architecture [8]		6
IMA-06 Special-Purpose databases [2]		4
IMA-07 Managing the database environment [5]		8

ITE-IMA requires 40 contact hours. The IT program currently reports 107.3 contact hours, thus satisfying the contact hour requirements. With that said, 45.8 contact hours are under the Data-information concept (IMA-02) subdomain. A significant 37 practice hours come from Introduction to CIT 213 Databases: Techniques and Technologies. IMA-05 Data Organization architecture, however, does not meet the requirements for contact hours by a difference of two.

ITE-UXD reaches the goal of 20 contact hours by a difference of16.5. eight and a half of these hours are under the UXD-05 Affective User Experiences. All subdomains appear to be balanced well and follow the guidelines according. However, there is one contact hour missing from UXD-03 Effective interfaces.

Table 4.3. User-Experience Design Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-UXD User Experience Design [20 Essential Hours]	20	36.5
UXD-01 History and overview [1]		3
UXD-02 Human factors in design [4]		6
UXD-03 Effective interfaces [5]		4
UXD-04 Application domain aspects [2]		2
UXD-05 Affective user experieces [2]		8.5
UXD-06 Human-centered evaluation [3]		5
UXD-07 Assistive technologies and accessibility [2]		5
UXD-08 User advocacy [1]		3

It has been established that there is not a class that satisfies the SIGITE requirements for an essential domain course in ITE-IST. The course contact hours reported reflect SIGITE's findings. There are only eight course contact hours out of the required 20. Five of the eight hours do come from the subdomain IST-05 Scripting techniques and meet the requirement of four contact hours. IST-02 Data mapping and exchange and IST-04 Integrative programming have zero hours devoted to the practice or study.IST-03 Intersystem communication protocols and IST-06 Defensible integration only receive one hour of instruction.

ITE-CSP has also been noted in SIGITE's scoring system as a domain needing an additional course to get the full compliance factor. Currently, there are only 46.8 contact hours that do meet the IT2017 guidelines of having at least 40 contact hours. Based on the requirements alone, the subdomains are met with the correct number of contact hours.

Two exceptions to this however are CSP-05 high assurance systems and CSP-07 Anonymity systems.

Table 4.4. Integrated Systems Technology Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-IST Integrated Systems Technology [20 Essential Hours]	20	8
IST-01 History and overview [1]		1
IST-02 Data mapping and exchange [4]		0
IST-03 Intersystem communucation protocols [4]		1
IST-04 Integrative programming [4]		0
IST-05 Scripting Techiques [4]		5
IST-06 Defensible integration [3]		1

ITE-NET reaches the 35-contact hour requirement. Many of the hours come from NET-04 Networking and Interconnectivity and NET-05 Routing and Switching. All requirements for the individual domains have been met. However, a course might need to be added to increase SIGITE scores.

ITE-PFT and ITE-SAM results were unexpected. On one hand, all the required hours have been met with both domains. However, SIGITE identified CIT 225 Linux Administration as falling under ITE-PFT when the total course contact hours are congruent with a course under the ITE-SAM domain. CIT 225 did not have any reported learning hours in the ITE-PFT domain. The description of CIT 225 directly from UNCW's course search is as follows:

> "Install, configure, securely administer Linux operating system platforms. Topics include Linux operating systems concepts, system installation and configuration, introduction to networking (protocols, IP addressing, ports, subnetting), security, firewalls, packet filtering, networked file systems, lightweight directory access protocol, virtualization, Linux-Windows integration, and Linux shell

programming" (UNCW Course Descriptions).

Table 4.5. Cybersecurity Principles Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-CSP Cybersecurity Principles [40 essential hours]	40	46.8
CSP-01 History and overview[1]		1.5
CSP-02 Policy goals and mechanisms [2]		2
CSP-03 Security services, mechanisms, and countermeasures [4]		6
CSP-04 Cyber attacks and detection [4]		5
CSP-05 High assurance systems [4]		1
CSP-06 Vulnerabilities, threats, and risk [5]		7.3
CSP-07 Anonymity systems [2]		0
CSP-08 Usable security [3]		6
CSP-09 Cryptography overview [3]		3.2
CSP-10 Malware fundamentals [2]		2
CSP-11 Mitigation and recovery [3]		5
CSP-12 Personal information [2]		2.5
CSP-13 Operational issues [4]		4
CSP-14 Reporting requirements [1]		1.3

CIT 225 should have reported hours in PFT-02 as it involves introducing the Linux operating system. It also reported using subdomain SAM-02. Comparing both competencies, the descriptions are comparable.

Table 4.6. Networking Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-NET Networking [35 Essential Hours]	35	52.3
NET-01 History and Overview[1]		2
NET-02 Foundations of Networking[3]		7.5
NET -03 Physical layer [5]		6
NET-04 Networking and interconnectivity [7]		11.5
NET-05 Routing and Switching [6]		12.5
NET-06 Application networking services [5]		5
NET-07 Network management and security [8]		7.8

ITE-PFT-05's competencies are outlined in IT2017 (p.64)

- Design a simple finite state machine with at least 6 states and 4 conditional

branches, then build and troubleshoot it.

- Complete a comparison in the performance of two different computers with two different operating systems.
- List three advantages and disadvantages of the five main hardware implementation options

Table 4.7. ITE-PFT and ITE-SAM Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-PFT Platform Technologies [15 Essential Hours]	15	45
PFT-01 History and overview [1]		0
PFT-02 Operating systems [7]		41
PFT-03 Computing infrastructures [2]		2
PFT-04 Architecture and organization [3]		2
PFT-05 Application and Execution Enviroment [2]		0
ITE-SAM System Administration and Maintenance [20 essential hours]	20	107.55
SAM-01 History and Overview [1]		1.5
SAM-02 Administrative activities [5]		40.25
SAM-03 Administrative domains [4]		6
SAM-04 Performance analysis [3]		7
SAM-05 Backup and recovery [3]		6.8
SAM-06 Applications of system administration [4]		46

ITE-SAM-02 competencies (p.62):

- Identify situations in which administrative activities are required.
- Identify situations that interfere with administrative activities.
- Design and implement a user and group administrative structure that allows the users to effectively use system resources.
- Design training material on administrative policies for different types of users.
- Develop project plans for major system administration activities.
- Install and configure appropriate software and other resources.
- Install update patches in devices and other resources in the system

- Compare alternative vendors of systems resources.

While not completely interchangeable, the concepts learned by instructing students to create a project can look similar and cover the same topics. The recommendation here would be to have this course re-evaluated to make sure all subdomains have been accurately reported. Regardless of the error, ITE-PFT has missing hours in all subdomains except for PFT-02 Operating systems. In a subdomain within a domain only requiring 15 contact hours, 41 contact hours should be considered excessive.

Table 4.8. System Integration and Architecture Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-SIA System Integration and Architecture [20 Essential Hours]	20	4.3
SIA-01 History and overview [1]		0
SIA-02 Requirements [4]		2
SIA-03 System architecture [2]		0
SIA-04 Acquisition and sourcing [4]		0
SIA-05 Testing and quality assurance [4]		2.3
SIA-06 Integration and deployment [5]		0

The IT program currently does not have a designated essential course that would be under the ITE-SIA domain. ITE-SIA is not a requirement for the SIGITE score, but it is a requirement for the IT2017 guidelines. Not only are the total hours a 4.3 out of 20, but none of the subdomain requirements are met. This will need to be addressed further in Chapter 5.

ITE-GPP exceeds the 25-contact hour requirement but does not reach the requirements for GPP-07 Intellectual Property and GPP-10 Teamwork and Conflict management. There is also an excess of hours in GPP-02 Professional issues and responsibilities. As the surveys in Chapter 2 show, some of the 21 hours might be best served in GPP-10.

Table 4.9. Global Professional Practice Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
TE-GPP Global Professonal Practice [25 essential hours]	25	85.7
GPP-01 History and overview [1]		3
GPP-02 Professional issues and responsibilites [2]		21
GPP-03 IT Governance and resource management [2]		10.3
GPP-04 Risk identification and evaluation [2]		1.6
GPP-05 Enviromental issue [2]		1.5
GPP-06 Ethical, legal, and privacy issues [2]		11
GPP-07 Intellectual property [3]		2
GPP-08 Project management principals [3]		6.3
GPP-09 Communications [3]		10
GPP-10 Teamwork and conflict management [2]		1
GPP-11 Employability skills and careers in IT [2]		16
GPP-12 Information Systems principles [1]		2

ITE-WMS has the most significant contact hours in the entire IT program's curriculum despite only currently requiring 25. Fortunately, all subdomain requirements have been satisfied. Much of the 131 contact hours fall under WMS-02 Technologies and WMS-04 Development Framework. However, while five of the seven subdomains are reported to have >15 contact hours, WMS-06 Vulnerabilities and WMS-07 Social software have very few hours devoted to the subdomains.

Table 4.10. Web and Moblie Systems Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITE-WMS Web and Mobile Systems [25 Essential hours]	25	131
WMS-01 History and overview [1]		16
WMS-02 Techologies [5]		32
WMS-03 Digital media [5]		20
WMS-04 Applications concepts [5]		29
WMS-05 Development Framework [4]		24
WMS-06 Vulnerabilities [3]		6
WMS-07 Social software [2]		4

While SIGITE has not identified a course in ITM-DSC, CSC 133 Discrete mathematical structures do meet the 30 contact hours. Based on the data, the instructor

filled out the survey without indicating if the number of contact hours reported was in total or should be looked at as though 4 hours in (I)ntroduce and (P)ractice would be a total of 8 hours. This was a concern brought up in Chapter 3. In addition, there are a few missing and under-taught subdomain topics. DSC-07 Minimization, DSC-11 Complexity Analysis, and DSC-12 Discrete Information technology applications have missing, or no hours attributed to them. As previously stated, many of the courses do reach the suggested learning hours. In some cases, as in the domains ITM-DSC and ITE-CSP, some subdomains are not met but the domain hours are. There are some courses that the guidelines are not met whatsoever like ITE-ISA and ITE-SIA. These need to be evaluated to a solution.

Table 4.11. Discrete Structures Results.

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours
ITM-DSC Discrete Structures [30 essential hours]	30	76
DSC-01 History and overview [1]		3
DSC-02 Sets[2]		6
DSC-03 Functions and relations[3]		18.5
DSC-04 Proof techniques [3]		2.5
DSC-05 Logic [2]		17
DSC-06 Boolean algebra principles [2]		5
DSC-07 Minimization [3]		0
DSC-08 Graphs and trees [4]		4
DSC-09 Combinatorics [3]		4.5
DSC-10 Iteration and recursion [2]		15
DSC-11 Complexity Analysis [2]		0.5
DSC-12 Discrete information technology applications [3]		0

CHAPTER 5: CONCLUSIONS AND FUTURE WORK

5.1 Domain Contact Hours

When analyzing learning hours to give recommendations for the program, it can be easy to take subdomains with a high accumulation of hours and automatically assume the hours would be best served in another subdomain. However, to assume this would be a fallacy. It must be recognized that many of the courses are introductory, therefore a heavy leaning on subdomains involving concepts should be expected. Information Technology is also cross-disciplinary, so courses will likely have hours in another domain. Lastly, if it is a course that has been identified as an IT field career trend, hours should also be expected to have been increased. In short, the required hours are there to serve as a benchmark for a *minimum* number of contact hours required.

Another issue that can be run into is that the SIGITE score system evaluates only essential courses and does not reflect that required courses may count twice in fulfilling major requirements or "double-dip." As there was not an in-depth look into the curriculum with supplementary and concentration considerations, the learning hour results might look different than if the whole curriculum had been evaluated.

Fortunately, most of the domains did reach the required course contact hours. For the domains that did not reach the required subdomain hours, hours were often deficient by only one to two hours. Many domains and courses without significant concerns will be omitted from the recommendations as a small difference will not likely affect the quality of the curriculum. Instead, the domains, subdomains, and courses that have been flagged as having concerns will be described below.

5.1.1 Information Management and Administration. The first domain of interest is ITE-IMA. SIGITE identified six credit hours students are required to take under this

domain. As the results in Table 5.1 show, there are 49.8 hours in the subdomain IMA-02 whereas the other domains averaged out to approximately 9.8 hours per subdomain. Thirty-seven of these hours come from CIT 213. The instructor of CIT 213 reported there are a total of 46 contact hours, meaning that approximately 80% of the course involves some practice in IMA-02.

The reason the CIT 213 course was chosen to be further evaluated is to show how the survey results can be used when approaching curriculum design. Seeing that significant hours are being spent on one subdomain, it might be beneficial to discuss the course further to find ways it might benefit students differently.

Table 5.1 IMA Results with CIT 213

Knowledge Areas	Required Course: Contact Hours	Actual Course Contact Hours	# of Contact Hrs	I= Introduce M=Measure P = Practice Using
ITE-IMA Information Management [40 hours]	40	107.3		
IMA-01 History and overview [1]		6.5	1	I= Introduce
IMA-02 Data-information concepts [6]		49.8	37	P = Practice Using
IMA-03 Data modeling [9]		14	0	
IMA-04 Database query languages [9]		19	3	P = Practice Using
IMA-05 Data organization architecture [8]		6	1	I= Introduce
IMA-06 Special-Purpose databases [2]		4	0	
IMA-07 Managing the database environment [5]		8	3	P = Practice Using

The student learning outcomes (SLOs) for CIT 213 are as follows:

1. Students can explain why databases are used and how databases differ from and improve upon lists and spreadsheets.
2. Students can describe the components of a database system using correct terminology.
3. Students can apply basic principles of relational database design to collect and analyze end-user requirements, employ a design process, and successfully implement a working database.
4. Students can create and execute database queries.

5. Students can discuss basic security, privacy, and ethical issues as they relate to technology.

For students to gain the learning outcomes, students not only need to know the basic concepts but also need to have practice in other subdomains. Thirty-seven contact hours in one subdomain is excessive. There is a possibility that confusion on the definition of each subdomain occurred. Before asserting an increase in learning hours, it would be recommended to discuss the subdomains and definitions with the instructor. Most, if not all subdomains should be introduced to the students as a base understanding may lead to more success in MIS/CIT 315 and MIS/CIT 411 to which CIT 213 is a pre-requisite. However, if there are no hours that are found to be in the other subdomains or the hours cannot be rebalanced, the topics will need to be covered more extensively in the next level class which would be MIS/CIT 315 Management of Database systems.

5.1.2 Other Minor Contact Hour Recommendations. In Chapter 2, it was noted that employers favored future hires with 'soft skills' more so than hard skills. A recommendation is to put more focus on soft skills found in ITE-GPP. GPP-11 Teamwork and Conflict Management only has one contact hour reported, so it is recommended to increase the hours in the subdomain.

Competencies of GPP-11 outlined in the IT2017 (p.73):

- Describe the meaning of multidisciplinary teams.
- Define two skill sets necessary to function effectively in a team environment.
- Explore two ways in which industry approaches teamwork toward a common goal.
- Identify the basics of conflict management.
- Describe three ways that conflict management aids in building stronger teams.

To successfully teach all competencies, more than the two hours required should be devoted to GPP-11. Personalities and ideas will at some point cause conflict in a graduate's career. Working to improve interpersonal skills will have a positive outcome.

Lastly, ITE-WMS has 131 reported contact hours. However, there are only 6 and 4 contact hours in WMS-06 Vulnerabilities and WMS-07 Social Software. The recommendation will be to increase these hours wherever they can be increased. Many of the learning competencies for WMS-06 and WMS-07 can be applied to the new courses that will be recommended in the subsequent sections in Chapter 5. WMS-06 focuses on competencies that identify vulnerabilities in web communication making the new CSP course able to support the subdomain while also meeting the CSP domain requirements.

WMS-07 should be covered briefly by any course that involves ethics, web design, and cybersecurity as the competencies include learning how to contrast the characteristics of various web and mobile-based communication media. And to understand how social media sites like Facebook and Twitter, discussion boards, wikis, blogs, and chat rooms have emerged in the last decade.

5.1.3 Integration Systems Technology. Domains in ITE-IST and ITE-SIA do not meet the required learning hours. Because both domains have many topics that overlap, it is recommended that an entirely new course that falls under the ITE-IST domain umbrella can be developed. By following IT2017's definition of both domains a course on the 200-300 level might have the course description "Students will gain skills and tools to analyze scripting languages, work towards source code development, and evaluate the integrations of components that make up system technology." The potential learning outcomes for the newly created course may include, but are not limited to:

- Define integration in terms of components and interfaces.

- Describe the importance of integrating various modules into a working system.
- Describe the characteristics of each of the following data encoding schemes and recommend under what conditions each should be used: ASCII, EBCDIC, and Unicode.
- Tell how XML and the document object model are being used to integrate and exchange data between systems.
- Describe the different types of architectures for integrating systems.
- Define the importance of using design patterns.

This course should equate to a three-credit hour course.

5.1.4 Contact Hours in Trending Domains. ITE-NET and ITE-CSP are domains that have seen growth in the last decade. As a response, more time is needed to study the domain concepts to ensure students are successful in their future careers. One option for a recommendation would be to add a three credit hour essential course to both domains and the second option would be to only add one extra three-credit-hour course to the framework.

Information Technology Course Path Option 1. Using MIS/CIT 324 Information Security Management as a baseline when creating a new ITE-CSP course, a new ITE-CSP course would need to cover topics that have not been previously covered and expand upon previous knowledge. Table 5.2 identifies the course path options if nothing else was removed but only had courses added. The recommended subdomains are CSP-05 High Assurance Systems and CSP-07 Anonymity Systems in addition to CSP-04 Cyber Attacks and Detection and CSP-06 Vulnerabilities, Threats, and Risks. As stated earlier in Chapter 5, the new course might also incorporate topics from ITE-WMS-06 and 07 as

threats to social media sites such as Facebook, Twitter, and Instagram are documented problems.

A new ITE-NET course should also follow the recommendation to cover less taught subdomains and to expand on previous knowledge. MIS/CIT 320 Network Fundamentals has covered all the required contact hours. However, more practice within NET-06 Application Networking Services and NET-07 Network Management and Security should be considered.

Table 5.2 Information Technology Course Path Option 1 Essential Scores

University of North Carolina Wilmington					
Abbreviation/Category	**Design**	**Title**	**Cred Hrs**	**Compl Fact**	**How Derived**
Essential IT Domains					
ITE-CSP (Cybersecurity)	CIT 324/CIS4xx	Information Security Manager	6	1	.5 if ≈3; 1 if ≈6
ITE-IMA (Information Management)	CIT 213 / MIS 315	Intro to Databases / Managem	6	1	.5 if ≈3; 1 if ≈6
ITE-NET (Networking)	CIT 320/CIT4xx	Network Fundamentals	6	1	.5 if ≈3; 1 if ≈6
ITE-SPA (System Paradigms)	CIT 225 /CIT 352	System Administration / Inforr	6	1	.5 if ≈3; 1 if ≈6
ITE-UXD (User Experience)	CIT 425	Human-Computer Interfaces	3	1	1 if ≈3
ITE-GPP (Global Professional Practice)	CIT 480/CSC 385	IT Resource Planning and Man	6	1	1 if ≈3
ITE-IST (Integrated Systems Technology)	CIT411	Information Systems Analysis	3	1	1 if ≈3
ITE-PFT (Platform Technologies)	CIT 2xx	Platform Technologies	3	1	1 if ≈2
ITE-SWF (Software Fundamentals)	CSC 131	Intro to Computer Science	3	0.6	1 if ≈5
ITE-WMS (Web and Mobile Systems)	CIT 310 / 410	Web Page Development / Web	6	1	1 if ≈3
		(Essential) Scaled Score:	1.92		(2 maximum)

Note. The table above shows the potential essential scaled score if Option 1 was chosen.

Information Technology Course Path Option 2. However, adding nine credit courses to the curricular framework including the new ITE-IST course might be too much of a workload on a student's schedule if they wish to graduate in four years and if students do not follow research in knowing what university/concentration cross over, then it will be impossible due to potentially reaching the maximum university credits. In addition, adding those extra credits to the existing credit load of the major might not be possible within UNCW's curriculum approval system. The Option 2 recommendation can omit a secondary ITE-CSP course and opt for only an extra ITE-NET course that covers *some* of the topics in CSP. The course would need both CIT 324 and MIS/CIT 320 as

prerequisites. Table 5.3 provides an example of the courses with the addition of a networking course and keeping the number of cybersecurity courses the same.

Table 5.3 Course Path Option 2 Essential Scores

University of North Carolina Wilmington

Abbreviation/Category	Design	Title	Cred Hrs	Compl Fact	How Derived
Essential IT Domains					
ITE-CSP (Cybersecurity)	CIT 324	Information Security Manager	3	0.5	.5 if ≈3; 1 if ≈6
ITE-IMA (Information Management)	CIT 213 / MIS 315	Intro to Databases / Manager	6	1	.5 if ≈3; 1 if ≈6
ITE-NET (Networking)	CIT 320/CIT4xx	Network Fundamentals	6	1	.5 if ≈3; 1 if ≈6
ITE-SPA (System Paradigms)	CIT 225 /CIT 352	System Administration / Inforr	6	1	.5 if ≈3; 1 if ≈6
ITE-UXD (User Experience)	CIT 425	Human-Computer Interfaces	3	1	1 if ≈3
ITE-GPP (Global Professional Practice)	CIT 480/CSC 385	IT Resource Planning and Man	6	1	1 if ≈3
ITE-IST (Integrated Systems Technology)	CIT411	Information Systems Analysis	3	1	1 if ≈3
ITE-PFT (Platform Technologies)	CIT 2xx	Platform Technologies	3	1	1 if ≈2
ITE-SWF (Software Fundamentals)	CSC 131	Intro to Computer Science	3	0.6	1 if ≈5
ITE-WMS (Web and Mobile Systems)	CIT 310 / 410	Web Page Development / Web	6	1	1 if ≈3
		(Essential) Scaled Score:	1.82		(2 maximum)

5.2 Removing Courses

One way to further work towards improving the curriculum is by also removing mandatory classes that are not required. Removal of certain classes won't just lighten the load of coursework, but also prevent a student from potentially losing funding over excessive credit hours. The first class to be removed could be MAT 151 which is non-analytical calculus. Currently, discrete math is an option but, according to SIGITE, it should become a mandatory essential course. A potential removal would be to drop MAT 151 as an option since the course content has not been as heavily recommended in IT2017. The course is also not required to meet the requirements from Accreditation Board for Engineering and Technology (ABET) which has similar requirements and verbiage as SIGITE and the ACM. Moving forward, MAT 151 can be considered an optional elective for those students who do wish to take it or have concentrations that require it (*Criteria for Accrediting Computing Programs, 2022 – 2023*). Figure 5.1 provides a visual of how the major would look with the removal of MAT 151.

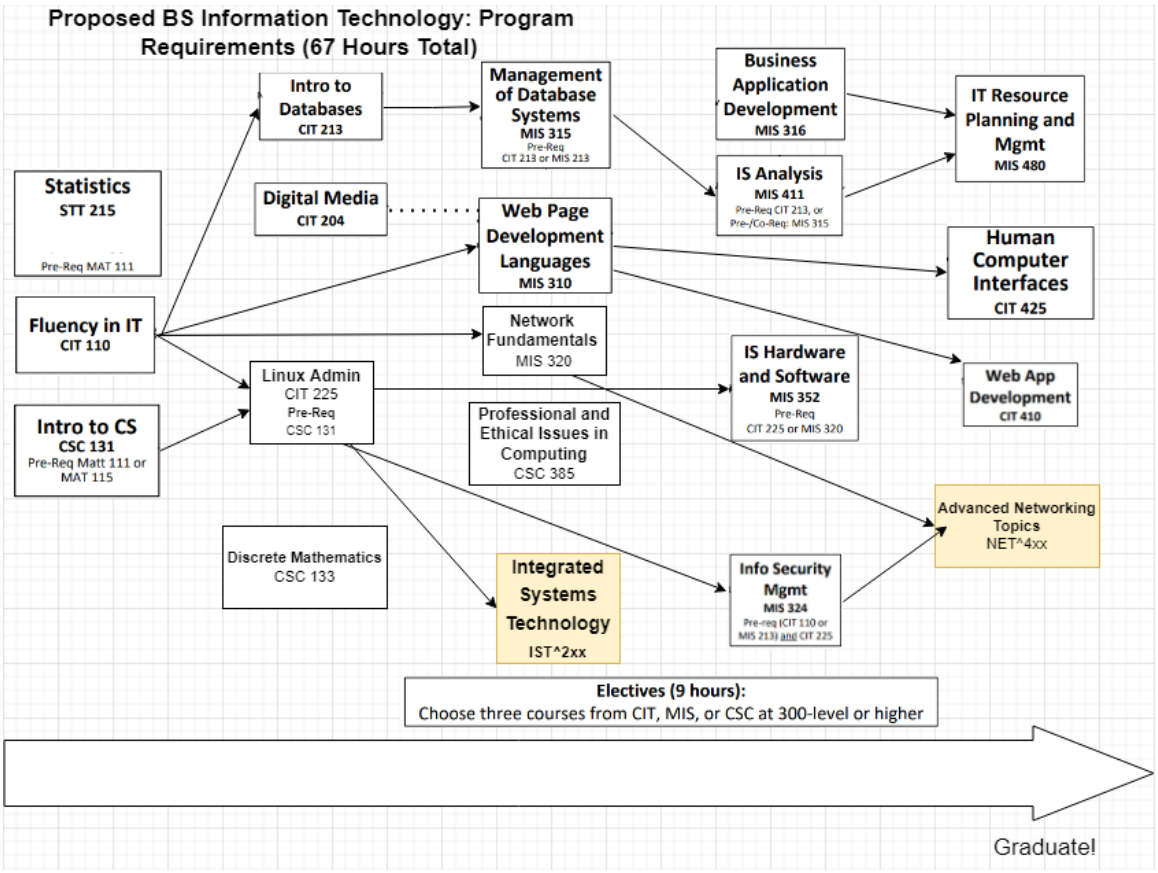


Figure 5.1 Program Requirements Map .

Another class that could be potentially removed entirely is BAN 280. BAN 280 and STT 215 are considered equivalent courses and are prerequisites for the Business Data Management concentration; thereby putting the statistics course's possible elimination into question.

Another way to lighten the course workload would be to evaluate the excessive learning hour courses. However, discretion will be needed if a course is removed for that reason. For now, the course that would seem like a candidate for removal would be either CSC 385 or MIS 480. Removing one ITE-GPP course would have no effect on SIGITE scoring, but CSC 385 is a required course and MIS 480 serves as the IT program's capstone. Removing any ITE-GPP course is not recommended. However, based on the results in Chapter 3, there are some GPP subdomains that need to be more of a priority.

Since learning hours are subjective, another recommendation would be to have instructors be required to speak with their colleagues to communicate how their learning hours are being spent to avoid excessive focus on a particular subdomain.

5.3 Improving Scores

When it comes to improving SIGITE scores, UNCW's IT program does not achieve a perfect score of five points. If ITE-SWF requires five credit hours to receive a full point on SIGITE's rating system, the three credit hours in CSC 131 Introduction to Computer Science should be considered sufficient for UNCW'S program. With that said, the IT program needs be competitive with schools within the state and schools in the country. If Option 1 is followed, as identified in subsection *5.1.4*, the addition of three additional credit hours in ITE-CSP, ITE-NET, combined with the creation of a course specifically for ITE-IST, would bring the essential domain rating to 1.92 out of 2. And, requiring a Discrete Mathematics course, CSC 133 in UNCW's case, would further improve the overall score. In total, the program could expect their score to increase from 2.74 to 3.71. If the IT program's essentials course load were increased by nine credit might require the removal of electives.

Option 2, as described in subsection *5.1.4*, would only increase the essentials course load by six credit hours. The courses added would fall under ITE-IST and ITE-NET (or CSP if found to be necessary). Appendix B has an example of format of requirements when courses are designed. By adding these courses, the essential domain rating would increase to 1.82. If no other changes were made from Option 1, the program's SIGITE score could be expected to rise to approximately 3.61. While the score is slightly lower than Option 1, future work suggests that supplemental domains and the capstone may also need to be updated. That update could, in the long run be better for the

program's overall score. For example, making the capstone meet requirements would give an entire point to the program making the final score 4.61.

If Option 2 is chosen it will still be possible to complete the program and graduate within eight semesters. However, the program would, in total, take approximately five semesters to complete without a concentration. Students would need to start taking courses in the second semester of their sophomore year or take summer courses to graduate on time.

Option 3 is a slight variation of Option 2, showing the removal of BAN 280 as an option and MAT 151. There would be no change to the current required course hours. Meaning that the essential score would be 1.82 regardless of if Option 2 or Option 3 were chosen. The main difference comes from the math section. See Table 5.4 for an example of ITE courses.

Table 5.4 Information Technology Course Path Option 3 Essential Scores with Math Included

University of North Carolina Wilmington

Abbreviation/Category	Design	Title	Cred Hrs	Compl Fact	How Derived
Essential IT Domains					
ITE-CSP (Cybersecurity)	CIT 324	Information Security Manager	3	0.5	.5 if ≈3; 1 if ≈6
ITE-IMA (Information Management)	CIT 213 / MIS 315	Intro to Databases / Manager	6	1	.5 if ≈3; 1 if ≈6
ITE-NET (Networking)	CIT 320/CIT4xx	Network Fundamentals	6	1	.5 if ≈3; 1 if ≈6
ITE-SPA (System Paradigms)	CIT 225 /CIT 352	System Administration / Inforr	6	1	.5 if ≈3; 1 if ≈6
ITE-UXD (User Experience)	CIT 425	Human-Computer Interfaces	3	1	1 if ≈3
ITE-GPP (Global Professional Practice)	CIT 480/CSC 385	IT Resource Planning and Man	6	1	1 if ≈3
ITE-IST (Integrated Systems Technology)	CIT411	Information Systems Analysis	3	1	1 if ≈3
ITE-PFT (Platform Technologies)	CIT 2xx	Platform Technologies	3	1	1 if ≈2
ITE-SWF (Software Fundamentals)	CSC 131	Intro to Computer Science	3	0.6	1 if ≈5
ITE-WMS (Web and Mobile Systems)	CIT 310 / 410	Web Page Development / Web	6	1	1 if ≈3
		(Essential) Scaled Score:	1.82		(2 maximum)
Related IT Essential Mathematics					
ITM-DSC (Discrete Structures)			3		
Related IT Supplemental Mathematics					
ITM-SUP (Stats, Lin Alg, Calculus, etc)	MAT 151	Basic Calculus	0		
	STT 215	Intro to Stats	3		
		(Math) Scaled Score:	0.92857		1 if >7 Sem Cr Hrs

Without MAT 151 as a requirement, the points will not reach a full point for the scaled score in math. However, if the capstone matched SIGITE guidelines, then the score could result in a score of 4.54. Considering that the top SIGITE score belongs to George Mason University at 4.76 (SIGITE Scores 2021), Option 3 could be considered overall more advantageous since the required credit hours are not exceeding 67.

5.4 Degree Completion

With the recommendations above, students would be able to complete their degree in four years. Depending upon when they started their program studies, it could require them to complete some of the University's required courses during a summer session. Appendix C shows the current major listing of core and required courses along with the possible major concentrations. Appendix D provides a possible outline of courses incoming first-year students could take to complete the IT degree. Appendix E shows a plan for students to take their first two years of entry courses within the community college system and then transfer to UNCW to complete their degree in Information Technology. For community college students, additional courses may also need to be taken to ensure they meet the 120 minimum credit hour requirement of the University.

5.5 Future Work

5.4.1 Supplementary Instruction. While this project focuses on how to better align the Essential curriculum with the guidelines outlined in IT2017, essential domains do not make a complete curriculum. One could think of essential domains as the minimal amount of training that is required for the four-year curriculum. However, to complete the curriculum, students will need to have additional training that encompasses competencies that reflect industry expectations. Therefore, future work should involve

evaluating the current supplemental IT domains and adjusting to industry changes as they appear.

A survey to conduct the current contact hours should be designed in the same manner as the essential curriculum survey. A minor change to the survey format can be to instruct participants to clarify contact hours for each of the 3 learning hour types. Another change should be to add subdomain descriptions in a separate sheet in the workbook to avoid confusion in defining learning hours. Once essential and supplemental coursework (see Figure 5.2 for IT2017's Proposed Supplemental Domains) has been re-defined, the IT program can then focus on making the student capstone in line with the expectations of ACM and SIGITE.

5.4.2 Credit Hours. One way the IT2017 remains flexible to each university's specific needs is to not recommend a certain *type* of learning hour. There is no indication of how many hours are supposed to be hours of instruction, practice, or measure. However, when determining how much a course "weighs" or how many credit hours a student received when successfully completing a course, the type of instruction does matter. The following is taken from the IT2017 to show how a university may calculate credit hours (p.94):

Lecture hours: presentation of material in a classroom setting:

One credit hour = one, one-hour lecture per week for 15 weeks

Laboratory hours: formal experimentation in a laboratory setting:

One credit hour = One, three-hour laboratory session per week for 15 weeks

This means that a 3-credit hour class can be calculated as follows:

- 3 lecture hours per week or 14 weeks (plus a week for exams)

  =42 lecture hours

- Three credit hours with a one-hour laboratory session and a two-hour lecture per week for 14 weeks

  =28 lecture hours

  =42 lab hours
- Three-credit project design course with one-classroom meetings and six hours of laboratory per week

  =14 lecture hours

  =84 lab hours

Some classes may need to be re-evaluated. By using (I)nstruction, (P)ractice, (M)easure on the survey, the curriculum board can calculate if a course should be re-classified or updated.

5.4.3 Community College to UNCW Specific Path. Attending a university can be costly. Specifically, the cost to attend UNCW for the 2022-2023 academic year is $4,443 in-state and $19,063 for out-of-state students. Tuition cost does not include the other services the university provides to students. For New Hanover County residents wanting to eventually attend UNCW, a community college's lower fees might be an attractive option for the first two years of college. According to the American Association of Community Colleges, 46% of undergraduate college students in the U.S. attend a community college (American Association of Community Colleges). With New Hanover and surrounding counties adopting dual high school and college enrollment programs such as Wilmington Early College High School, the popularity of two-year degrees can be expected to increase.

While many community college students who transfer to a university have only taken university-required courses, some degree-specific UNCW classes at a 100-200

level can be taught to freshmen and sophomores. It is important for the board of UNCW's IT program to work directly with the IT program directors at the local community colleges to come up with a plan for a degree path that will transfer easily without the student having to re-take lower-level courses. The ACM Committee for Computing Education in Community Colleges (CCECC) has resources for community colleges like the guidelines outlined in the IT2017, which may provide a good resource when deciding on a degree path.

(130 Hours selected from 245 possible hours)

Proposed Supplemental IT Domains and Hours	
ITS-DSA Data Scalability and Analytics [30 hours] ITS-DSA-01 History and overview [1] ITS-DSA-02 Foundations [8] ITS-DSA-03 Data Management [4] ITS-DSA-04 Methods, techniques, and tools [6] ITS-DSA-05 Data governance [5] ITS-DSA-06 Applications [6]	**ITS-ANE Applied Networks** [30 hours] ITS-ANE-01 Proprietary networks [6] ITS-ANE-02 Network programming [5] ITS-ANE-03 Routing protocols [4] ITS-ANE-04 Mobile networks [4] ITS-ANE-05 Wireless networks [4] ITS-ANE-06 Storage area networks [2] ITS-ANE-07 Applications for networks [5]
ITS-IOT Internet of Things [30 hours] ITS-IOT-01 History and overview [1] ITS-IOT-02 IoT architectures [4] ITS-IOT-03 Sensor and actuator interfacing [2] ITS-IOT-04 Data acquisition [3] ITS-IOT-05 Wireless sensor networks [4] ITS-IOT-06 Ad-hoc networks [2] ITS-IOT-07 Automatic control [4] ITS-IOT-08 Intelligent information processing [4] ITS-IOT-09 IoT application and design [6]	**ITS-MAP Mobile Applications** [25 hours] ITS-MAP-01 History and overview [1] ITS-MAP-02 Architectures [2] ITS-MAP-03 Multiplatform mobile application development [5] ITS-MAP-04 Servers and notifications [2] ITS-MAP-05 Performance issues [3] ITS-MAP-06 Views and gestures [3] ITS-MAP-07 Interface implementations [4] ITS-MAP-08 Camera, state, and documents interaction [3] ITS-MAP-09 2D graphic and animation [2]
ITS-SDM Software Development and Management [20 hours] ITS-SDM-01 Process models and activities [5] ITS-SDM-02 Platform-based development [2] ITS-SDM-03 Tools and services [4] ITS-SDM-04 Management [5] ITS-SDM-05 Deployment, operations, maintenance [4]	**ITS-SRE Social Responsibility** [20 hours] ITS-SRE-01 Social context of computing [4] ITS-SRE-02 Goals, plans, tasks, deadlines, and risks [4] ITS-SRE-03 Government role and regulations [3] ITS-SRE-04 Global challenges and approaches [3] ITS-SRE-05 Risk management [3] ITS-SRE-06 Energy standards and utilities [3]
ITS-VSS Virtual Systems and Services [30 hours] ITS-VSS-01 History and overview [1] ITS-VSS-02 Application of virtualization [5] ITS-VSS-03 User platform virtualization [3] ITS-VSS-04 Server virtualization [3] ITS-VSS-05 Network virtualization [5] ITS-VSS-06 Cluster design and administration [5] ITS-VSS-07 Software cluster applications [5] ITS-VSS-08 Storage [3]	**ITS-CCO Cloud Computing** [30 hours] ITS-CCO-01 History and overview [1] ITS-CCO-02 Concepts and fundamentals [6] ITS-CCO-03 Security and data considerations [6] ITS-CCO-04 Using cloud computing applications [5] ITS-CCO-05 Architecture [4] ITS-CCO-06 Development in the cloud [4] ITS-CCO-07 Serves and platforms [4]
ITS-CEC Cybersecurity Emerging Challenges [30 hours] ITS-CEC-01 Case studies and lessons learned [2] ITS-CEC-02 Network forensics [4] ITS-CEC-03 Stored data forensics [4] ITS-CEC-04 Mobile forensics [2] ITS-CEC-05 Cloud security [2] ITS-CEC-06 Security metrics [2] ITS-CEC-07 Malware analysis [3] ITS-CEC-08 Supply chain and software assurance [2] ITS-CEC-09 Personnel and human security [2] ITS-CEC-10 Social dimensions [2] ITS-CEC-11 Security implementations [2] ITS-CEC-12 Cyber-physical systems and the IoT [3]	

Figure 5.2 IT2017 Proposed Supplemental Domains

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APPENDIX A

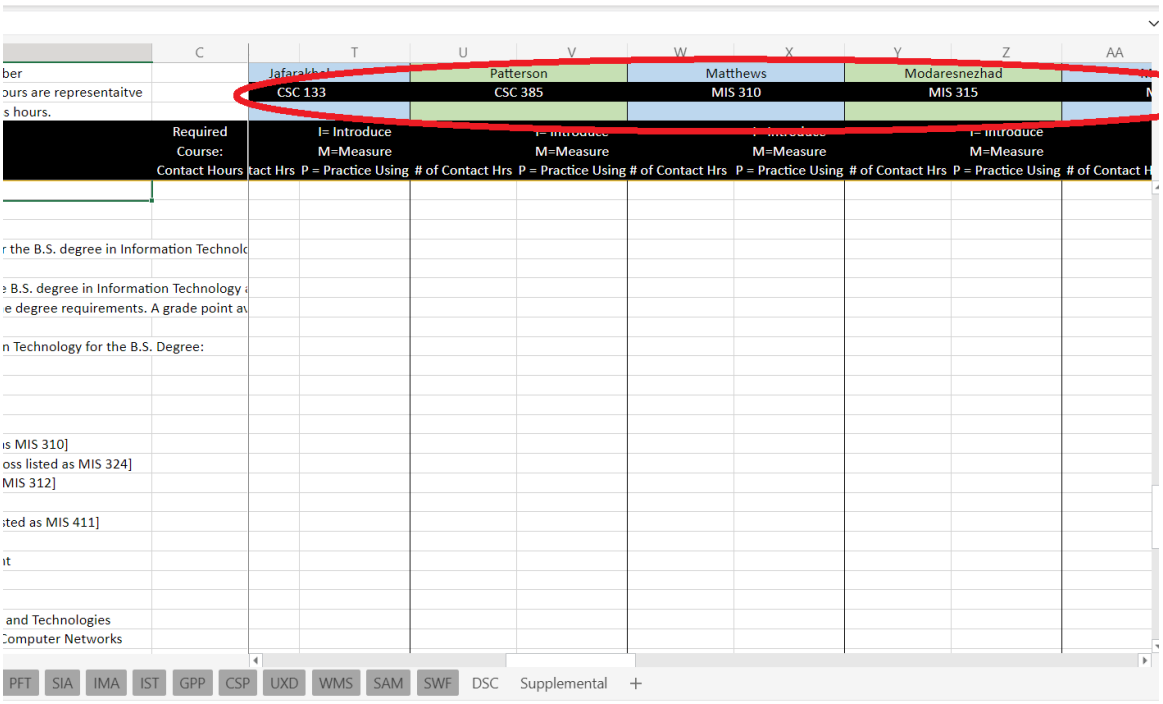
Instructor instructions for Survey

Instructions on How to Fill out the Survey

Thank you for taking the time to enter your data in the shared Excel Sheet!
There are a few instructions I wish to go over.
The left most side of the sheet contains the required knowledge areas for the recommended updated 2017 ACM course curriculum. The brackets contain the hours required for each concept. Not every class will fully satisfy the requirements, but all classes combined must in total.

	A	B	C
		I= Introduce # = number	
		M=Measure Contact hours are representaitve	
		P = Practice Using of in-class hours.	
		Knowledge Areas	Required Course: Contact Hours
7		ITE-SWF Software Fundametals [30 essential hours]	30
8		SWF-01 History and overview [1]	
9		SWF-02 Concepts and techniques [5]	
10		SWF-03 Problem-solving strategies [3]	
11		SWF-04 Program developmennt [8]	
12		SWF-05 Fundamentals data structures [4]	
13		SWF-06 Algorithm principles [6]	
14		SWF-07 Modern app programming [3]	
15		ITE-IMA Information Management [40 hours]	40
16		IMA-01 History and overview [1]	
17		IMA-02 Data-information concepts [6]	
18		IMA-03 Data modeling [9]	
19		IMA-04 Database query languages [9]	
20		IMA-05 Data organization architecture [8]	
21		IMA-06 Special-Purpose databases [2]	
22		IMA-07 Managing the database environment [5]	
23		ITE-UXD User Experience Design [20 Essential Hours]	20
24		UXD-01 History and overview [1]	
25		UXD-02 Human factors in design [4]	
26		UXD-03 Effective interfaces [5]	
27		UXD-04 Application domain aspects [2]	
28		UXD-05 Affective user experieces [2]	
29		UXD-06 Human-centered evaluation [3]	
30		UXD-07 Assistive technologies and accessibility [2]	

You will note that the right side of the Excel file, starting at Column E you will have names associated with the course you are teaching. These are what the ACM consider "Essential" concepts for the program. Note: you might have more than one class represented on the sheet.



You will note the two columns under the class name. Column one is where you want to enter what you estimate your in-class learning hours for the content your course goes over. You will NOT have to fill out every section. Generally, the course for 3 credit hours should be around 45 contact hours.

The left column under your course will contain an i, p, or m, depending on if you consider these hours are used in practicing, introductions, or measuring the students' competency.

Once completed, save the file. The yellow row will calculate the total number of contact hours your course provides. Please do not change anything below or at the line!

Thank you so much for participating.
Michaela Craft

APPENDIX B

Example Student Learning Objectives (SLOs)

COURSE DESCRIPTION

Dept. Number	CIT 2XX	Course Title	Integrated Systems Technologies
Semester hours	3	Course Coordinator	Depends on home department

Current Catalog Description

CIT 2XX. Integrated Systems Technologies (3)
Prerequisites: CIT 225
Students will gain skills and tools to analyze scripting languages, work towards source code development, and evaluate the integrations of components that make up system technology.

Textbook

None.

References

None

Course Outcomes

1.1 Define integration in terms of components and interfaces.
1.2 Describe the importance of integrating various modules into a working system.
1.3 Describe the characteristics of each of the following data encoding schemes and recommend under what conditions each should be used: ASCII, EBCDIC, and Unicode.
1.4 Tell how XML and the document object model are being used to integrate and exchange data between systems.
1.5 Describe the different types of architectures for integrating systems.
1.6 Define the importance of using design patterns.

Program Student Learning Outcomes

1. Students will be able to conceptualize a technological issue into a coherent written statement and oral presentation.
2. Students will demonstrate effective use of technology.

Relationship between Course Outcomes and Program Outcomes

Course Outcomes Mapped to Program Outcomes			
Course Outcomes	Program Outcomes		
	1	2	3
1			
2			
3			

Prerequisites by Topic

Major Topics Covered in the Course

Assessment Plan for the Course

How Data in the Course is Used to Assess Program Outcomes (unless adequately covered already in the assessment discussion under Criterion 4)

APPENDIX C

2021-2022 BS in Information Technology Checklist

UNCW UNIVERSITY COLLEGE 2021-2022 CATALOGUE

B. S. Information Technology (IT)

College of Arts & Sciences & Cameron School of Business

Course requirements for all UNCW degrees include: (1) University Studies, (2) specific major requirements, and (3) sufficient elective hours for a combined total of a minimum of 120 hours.

MAJOR REQUIREMENTS – CIT (Minimum 67 hours)

Core Courses: (30 hours)

_____CIT 110	Fluency in Information Technology (3)
_____CIT 204	Digital Media (3) Prerequisite: CIT 110 CSC 105, or CSC 112, or permission of instructor
_____CIT 225	Linux Administration (3) Prerequisite: CSC 121 or 131 with a C- or better
or CSC 242	Computer Organization (3) Prerequisite: CSC 131 with a "C" or better and CSC 133
_____MIS 310	Web Page Development (3) Prerequisite: CIT 110 or CSC 131 or MIS 213
_____MIS 324	Information Security Management (3) Prereq: CIT 110 or MIS 213 and CIT 225 with a C- or better
_____MIS 352	Network System Administration (3) Prerequisite: CIT 225 or MIS 320 with a C- or better
_____CIT 410	Web Application Development (3) Prerequisite: MIS 310
_____MIS 411	Information Systems Analysis (3) Prereq: CIT 213 with a grade C- or better or Pre/Coreq MIS 315 **(Meets Applied Learning Requirement)**
_____CIT 425	Human-Computer Interfaces (3) Prerequisite: MIS 310
_____MIS 480	IT Resource Planning and Management (3) Prerequisite: MIS 411 with a grade of C- or better

Required Courses: (25 hours)

_____CIT 213	Introduction to Databases: Techniques and Technologies (3) Prerequisite: CIT 110
_____+CSC 131	Introduction to Computer Science (4) Prerequisite: MAT 111 or 115
_____MIS 320	Network Fundamentals (3) Prereq: CIT 110 or MIS 213 with a grade of C- or better
or CSC 344	Computer Networks (3) Pre/Corequisite: CSC 231 with a grade of C or better or CYBR 251 with a "C" or higher
_____CSC 385	Professional and Ethical Issues in Computing (3) Prereq: ENG 101 or equivalent and Junior/Senior standing in CSC or CIT (Meets Oral Communication Requirement)
_____+MAT 151	Basic Calculus with Applications I (3) Prereq: MAT 111 or equivalent preparation in Algebra
or +CSC 133	Discrete Mathematical Structures (3) Prereq: MAT 111 or MAT 115
_____MIS 315	Management of Database Systems (3) Prerequisite: MIS 213 or CIT 213
_____MIS 316	Business Application Development (3) Prerequisite: MIS 216 or CSC 112 or CSC 131 or another programming language course approved by department chair
_____+STT 215	Introduction to Statistics (3) Prerequisite: MAT 105 or satisfactory performance on math test
or +BAN 280	Statistical Analysis for Business and Economics (3) Prerequisite: MAT 111

Concentration Courses: (12 hours) Must Choose One

Students who wish to complete two concentrations may simultaneously apply up to 3 credit hours of course work towards both concentrations if the course is approved in both concentrations.

a. Business Applications Development

_____MIS 419[1]	Information Technology Project Management (3) Prerequisite: MIS 213 and admission to CSB
_____	**Choose 3 courses from the following list: CSC 315, 331, MIS 328, 331, 364, 413, 491, 495,
_____	498[1] (with a Business Application Development Focus)
_____	

b. Business Data Management

_____MIS 327	Data Center Management (3) Prerequisite: MIS 213
_____MIS___	**Choose 3 courses from the following list, with at least 1 MIS course: BAN 300, 301, 302, 303, 400, MIS 322, 329, 330, 491. 495, 1498 with a Business Data Management focus.

c. Computer Science

_____+CSC 131	Introduction to Computer Science (4) Prereq: MAT 111, 115, or equivalent, or sufficient math placement
_____ CSC 231	Introduction to Data Structures (4) Prereq: CSC 131 with grade of "C" or better; Coreq CSC 133
_____CSC ___	**Choose 2 courses from the following CSC 315, 365, 385, 455, 465

_____CSC ___

d. Cybersecurity

_____MIS 322	Information Assurance and Security (3) Prerequisite: MIS 213 or CIT 110
_____MIS 365	Ethical Hacking (3) Prerequisite: MIS 324 and Prereq/Coreq MIS 352
_____MIS ___	**Select 2 courses from the following list of courses: MIS 362, 363, 364, 367, 491, 495, 498
_____MIS ___	

e. General Information Technology (12 hours)
Students who are unable to satisfy one of the concentrations may, with prior approval of the Dean, select four three-credit hour MIS, CIT. or CSC courses at 300-400 level with a grade or C- or better. Students who pursue this concentration may not complete a second concentration.

A minimum GPA of "C" (2.00) is required in all major courses. No grade below "C-" will be accepted towards graduation in a core or required course.

**These courses require a lab*
[1]*These courses require admission to the Cameron School of Business prior to enrollment*
+May also be used to satisfy University Studies Foundations & Approaches and Perspectives requirements

Requirements to declare CIT: Completion of 24 UNCW hours. For further information, see the CIT web site: https://uncw.edu/bsit/future.html

This document is considered an unofficial guide. Please refer to your degree audit for the latest updates. 6/23/2021

APPENDIX D

Incoming First-Year Student Academic Degree Four-Year Plan

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 1			
ENG 101	College Writing and Reading I	1.a. Composition	3
WPA 101	Wellness and Physical Activity	1.b. Lifetime Wellness	1
WPAL 101	Wellness and Physical Activity Lab	1.b. Lifetime Wellness Lab	1
MAT 111	College Algebra	Prereq for Major Requirement 1.c. Math & Statistics	3
UHI&B	Course 1	1.d. Understanding Human Institutions & Behaviors	3
UNI	First Year Seminar	First Year Seminar	3
		Total Semester Credit Hours	14

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 2			
ENG 201	College Writing and Reading I	1.a. Composition	3
CSC 131	Introduction to Computer Science (programming)	Major requirement Critical Reasong Requirement	4
WL&C	World Language #1	World Languages & Culture	3
SANW	Science Class w/Lab	11.c. Scientific Approaches to the Natural World	4
CSC 133	Discrete Math	Major requirement	3
		Total Semester Credit Hours	17

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 3			
WL&C	World Language #2	World Languages & Culture	3
CIT 110	Fluency in Information Technology	Major requirement Information Fluency requirement	3
CIT 225	Linux Administration	Major Requirement	3
BAN 280	Statistical Analysis for Business & Economics	Major Requirement	3

H&PA	Historical & Philosophical Approaches #1	Historical & Philosophical Approaches	3
		Total Semester Credit Hours	15

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 4			
WL&C	World Language #3	World Languages & Culture	3
CIT 204	Digital Media	Major Requirement	3
MIS 316	Business Application Development	Major Requirement	3
MIS 320	Network Fundamentals	Major Requirement	3
AIL	Aesthetic, Interpretive, Literary #1	Aesthetic, Interpretive, Literary	3
		Total Semester Credit Hours	15

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 5			
CIT 213	Intro Databases: Techniques & Technology	Major Requirement	3
CSC 385	Professional & Ethical Issues in Computing	Major Requirement Oral Communication Competency Writing Intensive Information Literacy	3
MIS/CIT 324	Information Security Management	Major Requirement	3
MIS/CIT 310	Web Page Development	Major Requirement	3
H&PA	Historical & Philosophical Approaches #2	Historical & Philosophical Approaches	3
		Total Semester Credit Hours	15

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 6			
MIS/CIT 315	Management of Database Systems	Major Requirement	3
MIS/CIT 352	Network System Administration	Major Requirement	3
CONC	Concentration Course #1	Concentration Requirement	3

AIL	Aesthetic, Interpretive, Literary #2	Aesthetic, Interpretive, Literary	3
SANW	Science w/o Lab	Scientic Approaches to the Natural World	3
		Total Semester Credit Hours	15

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 7			
MIS/CIT 411	Information Systems Analysis	Major Requirement Exploration Beyond the Classroom Applied Learning	3
CIT 410	Web Application Development	Major Requirement	3
CONC	Concentration Course #2	Concentration Requirement	3
CONC	Concentration Course #3	Concentration Requirement	3
UHI&B	Course #2	Understanding Human Institutions & Behaviors	3
		Total Semester Credit Hours	15

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 8			
MIS/CIT 480	IT Resource Planning & Management	Major Requirement	3
CIT 425	Human-Computer Interfaces	Major Requirement	3
CONC	Concentration Course #4	Concentration Requirement	3
DN	Diverse Nation	Diverse Nation	3
GS	Global Society	Global Society	3
		Total Semester Credit Hours	15

APPENDIX E

Academic Plan for NC Community College Students
Completing Their Degree at UNCW

Course Code	Course Name	Fulfills What Requirements?	Credits
Semesters 1-4			
CET 172 or CTS 120	Internet Technologies or Hardware/Software Support	CIT 110 Fluency in Information Technology	
DBA 110	Database Concepts	CIT 213 Introduction to Databases	
CET 245	Internet Servers	CIT 225 Linux Administration	
MAT 161	College Algebra	MAT 111 College Algebra	
CTI 240 and CTI 241	Virtualization Admin I and Virtualization Admin II	CIT 301 Cloud Computing & Virtualization	
	World Language 1		
	World Language 2		
Completion of Associates Degree will waive University Studies			

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 5			
CSC 131	Introduction to Computer Science (programming)	Major Requirement Critical Reasoning	4
WLC	World Language #3	World Language Requirement	3
CIT 204	Digital Media	Major Requirement	3
LDN of LGS	Living in a Diverse Nation or Living in a Global Society	Living in a Diverse Nation or Living in a Global Society	3
		Total Semester Credit Hours	13

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 6			
MIS/CIT 316	Business Application Development	Major Requirement	3
MIS/CIT 320	Network Fundamentals	Major Requirement	3
MIS/CIT 310	Web Page Development	Major Requirement	3
MIS/CIT 324	Network Security Management	Major Requirement	3

MIS/CIT 315	Management of Database Systems	Major Requirement	3
		Total Semester Credit Hours	15

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 7			
MIS/CIT 352	Systems Administration	Major Requirement	3
CIT 410	Web Application Development	Major Requirement	3
MIS/CIT 411	Information Systems Analysis	Major Requirement Information Literacy Explorations Beyond the Classroom Applied Learning	3
CSC 385	Professional & Ethical Issues in Computing	Major Requirement Writing Intensive Information Literacy Oral Communication	3
CONC	Course #2	Concentration Requirement	3
		Total Semester Credit Hours	15

Course Code	Course Name	Fulfills What Requirements?	Credits
Semester 8			
MIS/CIT 480	IT Resource Planning & Management	Major Requirement	3
CIT 425	Human-Computer Interfaces	Major Requirement	3
CONC	Concentration Course #3	Concentration Requirement	3
CONC	Concentration Course #4	Concentration Requirement	3
		Total Semester Credit Hours	15